Insects and Mites Associated with Shade Trees and Woody Ornamentals

This publication is for nursery employees, arborists, extension agents and others who are frequently asked about insect control. In some cases, there may be additional or alternative measures that are not discussed in this publication.

Kansas State Agricultural Experiment Station and Cooperative Extension Service

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Introduction

Insects are the most successful group of animals on earth. They have existed for 350 million years, taken on many diverse forms and successfully adapted to a variety of environmental niches. There are an estimated 500,000 to 1.5 million insect species. Given this array of insects, relatively few species are classified as pests. What one person considers a pest might not be considered a pest by another person depending on the ability to tolerate the presence of the insect and accept some feeding damage.

The frequency of pest problems may vary by year and location. A combination of environmental conditions and naturally occurring predators and parasites help suppress pest populations. Abnormal climatic factors or disruptions of predator and parasite populations may allow pest populations to go unchecked and inflict damage on shade trees and woody ornamentals.

Generally, insects and mites are not responsible for the death of shade trees or woody ornamentals. But they do cause other abnormalities. For example, temporary or permanent disfigurement caused by insect or mite feeding or gall-forming activities might make plants unattractive. Or the inhibition of normal plant growth and development might delay the provision of effective and desirable shading or visual screening. The transmission of plant pathogens could cause or intensify those situations. Weakened plants might be less able to ward off attacks by other pest species.

The nuisance of unwanted insects could be more of a problem than plant damage. These include shed skins or excess honeydew collecting on vehicles, lawn furniture, equipment or toys beneath aphid- or scale-laden trees; caterpillar webbing and droppings; ground litter from early leaf or twig drop; and insects wandering away from trees and shrubs into homes.

Diagnosis of Problems

Specific predictions guaranteeing the occurrence of various insect pests are not possible because the presence of a specific pest is often sporadic or a pest species may be geographically restricted in Kansas. For example, elm leaf beetles are more common than elm calligrapha beetles, and the Zimmerman moth is usually only seen in several northwestern counties of Kansas.

Reactive Measures

Insect pests are commonly found after growers notice plant abnormalities such as ragged, cupped, curled, stippled or discolored foliage; swellings and growths; and dieback. By this time, pests may have completed their cycles and disappeared, or, if they are still present, are unlikely to inflict additional damage. In these instances, corrective actions are not necessary. Reactive measures, which are usually the use of insecticides to lower pest populations to tolerable levels, are advisable only if the offending pests are expected to cause unacceptable amounts of additional damage. Remember, plant damage will remain, although new growth may eventually camouflage the old growth.

Proactive Measures

People who regularly and rigorously monitor plantings are less likely to be surprised by pests. By being familiar with various pests associated with specific shade trees and woody ornamentals, growers can accurately identify and separate innocuous insects from pests. The best timing for corrective actions can be pinpointed with continued pest monitoring and recording. However, if natural or biological control factors suppress pest populations to acceptable damage levels, insecticidal treatments is unnecessary.

Some pests are difficult to monitor. For example, various borer-type insects deposit eggs that are almost undetectable. Once newly emerged larvae tunnel into plants, they are safe from traditional spray treatments. Thus, preventative treatments are advisable.

Artificial pheromones developed for specific pest species should be used with pheromone traps to identify the onset and duration of adult borer activities. Insecticide treatments can then timed to provide maximum protection against various borers.

Types of Insect Damage

Foliar Feeding

Chewing Pests

Insect pests with chewing mouthparts derive nourishment when one or more of their developmental life stages feed on foliage. Damage differs by the type of feeding. For example, elm leaf beetle larvae skeletonize leaves by feeding on the interveinal tissues of lower leaves. Leaves stripped of protective epidermal layers become desiccated, resulting in a tree with a browned or burnt appearance. The feeding damage of lepidopteran larvae,

on the other hand, causes little visible feeding damage when larvae are small. However, these larvae consume increasingly greater amounts of foliage as they grow, resulting in a tree with a stripped appearance.

Other undesirable visual abnormalities include webbing that is associated with some defoliating caterpillar species, leafrolling, tying and mining, all of which are of minor importance to the health of established and vigorously growing trees.

Sucking Pests

The mouthparts of some pests are long, slender stylets that they use to suck juices from the vascular tissues. Aphids, leafhoppers and plant bugs may cause leafspotting at the stylet-probing sites. Phytotoxic salivary secretions of some species may cause leaf distortions, deformations, leaf yellowing or leaf death. Honeydew may accumulate on leaves, branches and items beneath infested plantings. Honeydew also serves as a substrate for the buildup of sooty molds that give plantings a blackened appearance.

Scale insects vary in shape, color, developmental cycles and preferred hosts. Unlike most sucking insects, scale insects are sessile. Generally, they do not move after they have inserted their stylets. Armored scales have a hard cover, while soft scales do not. As scale populations increase (usually over several generations or years), the continued withdrawal of plant juices may reduce tree vigor and kill branches. Honeydew problems can also occur with soft scales.

Mites use their short, knife-like mouthparts to stab epidermal plant cells and drink the cellular contents. Lace bugs feed predominantly on lower leaf surfaces. But visible feeding damage such as stippling and discoloration due to chlorophyll removal and cell death appears on upper leaf surfaces.

Gall-Forming Pests

Galls are abnormal growths of plant tissue possibly caused by hormonal secretions of insects and mites. Most gall-forming insects or mites attack only certain plant species. They may only affect a leaf, and then only a certain portion of that leaf, such as the mid-vein, petiole, leaf margin or fleshy leaf tissue. Gall shapes, sizes and colors are consistent and predictable for specific gall-forming species.

Treatment Against Foliar Feeders

Foliar feeders often go unnoticed until sufficient feeding damage draws attention. But then corrective treatments may not be useful. For example, by the time an elm tree appears burned, most of the elm leaf beetle larvae are already pupating. In situations where complete defoliation by lepidopterean larvae becomes evident, most of the late-developmental-stage larvae responsible for the defoliation have satisfied their feeding requirements and will be preparing to pupate. High aphid populations generally crash, and rain washes away sticky honeydew and sooty mold buildups. Deformed leaves will stay deformed and galls will not go away. In most situations, insecticide treatments after observed damage are of little benefit.

Wood Feeding

The damage caused by insect larvae beneath bark that develop in the wood of shade trees and woody ornamentals is more serious. Weakened trees or shrubs are especially vulnerable to attacks by borer-type insects. Vascular tissue disruption interferes with the transport of water and essential nutrients for photosynthesis as well as the distribution of photosynthates to use sites. Insects with growth stages tunneling deeper into the wood may weaken an entire tree. Try to prevent wood-feeding pests from establishing because corrective control is difficult and less effective after establishment.

Borers

Various pests bore into the wood of shade trees and woody ornamentals. Although bark beetles and their larvae are relatively small, the number of potential larvae per female, coupled with large numbers of females, may result in substantial damage of cambium tissue, including girdling. Borer larvae can cause serious damage because of their larger size.

Twig Girdlers

While borer damage is a threat to tree health, twig girdling is more of a nuisance. Some beetle species deposit eggs in twigs, then girdle the twig below the site of egg-laying. Twigs then break off and fall to the ground. Larvae complete their development and pupate inside the twigs. Fallen twigs on areas such as lawns, parks and playgrounds are a common annoyance.

Treatment Considerations

Integrated Pest Management

Insecticides are the most common method for controlling plant pests. Because of concerns about introducing excessive amounts of insecticides into the environment, consider alternative control options. An integrated approach using individual or combined techniques

could replace the need to apply insecticides to control pest populations.

Biological Control

Insects and mites have natural enemies that help keep pest populations under control in most instances. While monitoring pest levels, note the presence of predators and parasites. While populations of naturally occurring beneficials might be augmented with releases of commercially obtained predators and parasites, these attempts often are unsuccessful.

It would be more useful to preserve populations of naturally occurring beneficials by avoiding the frequent use of broad-spectrum insecticides that kill both targeted pests and non-targeted beneficials. If insecticide use is necessary, select a material that has minimal effect on non-target organisms.

Cultural Control

Generally, vigorously growing plants are able to withstand certain pests. For example, if tree roots have adequate soil moisture, the water moving through vascular elements can drown small borer larvae that survive better in drought-stressed trees.

Pruning and trimming should be done at a time that does not coincide with the appearance of certain pests. Proper timing will allow pruning cuts to heal and be unattractive to adult borers seeking a place to deposit eggs.

Some plant species serve as hosts for a variety of insects while others have fewer associated pests. Depending on the grower's desires, consider planting a relatively insect-free Osage orange instead of a more insect-prone green or white ash. Avoid elm trees if there is an aversion to elm leaf beetles, or select a cultivar such as the lace bark elm that is resistant to the elm leaf beetle.

Insect pests can be brought home on purchased plants. Buy plants from a reputable local nursery. The likelihood of buying infested materials diminishes when patronizing local producers that are monitored more often by Kansas Department of Agriculture nursery inspectors. There is a higher potential for purchasing infested stock from non-nursery local retail outlets, many of which obtain plant materials from out-of-state wholesalers. Although plant materials are inspected by state inspection agencies, there is still a greater chance of infested plants.

The chances of moving infested plants are greatest when materials are exchanged between neighbors and friends. Inspect plants before bringing them home and reject them if they are infested.

Sanitation is another way to minimize pest problems. Periodically inspect established plantings for insects or mites. Depending on the value of infested plants, removing and disposing of them could prevent further spread of pests to uninfested plants.

Mechanical and Physical Control

Some pests can be physically removed. Where trees and shrubs are smaller in size and number, eastern tent caterpillar egg masses can be pruned out once they are visible after leaves have dropped in the fall, but before eggs hatch around budbreak the following spring. Bagworm bags can be removed by hand through late summer, fall, winter and early spring.

Foraging eastern tent caterpillars retreat to the protection of their webbing. Fall webworms forage in their expanding webs. Both of these pests can be removed by breaking up and removing webbing. Non-webbing but gregarious yellownecked caterpillars can be eliminated by pruning out branches where they have congregated.

The life cycles of some lepidopteran pests can be disrupted by the timely placement of a sticky band around the trunks of trees. Where there is concern for spring cankerworm, a band will snare the wingless female moths as they climb trees in search of egg-laying sites in tree canopies. Similarly, walnut and yellow-necked caterpillar life cycles can be disrupted by intercepting mature larvae as they descend from trees in search of pupation sites in the ground. In this case, remember that severe defoliation has already occurred. Additionally, some larvae avoid being caught by simply dropping to the ground. In both instances, monitor bands during the active period to remove ensnared moths or larvae that provide a bridge over the sticky material.

Another mechanical control is using a garden hose to wash aphids or mites off plant foliage. Eliminate aphids by pruning and disposing of the infested foliage. Pests can be blocked from smaller trees and shrubs by shrouding them with small meshed netting during peak times of pest activity.

Insecticidal Control

Despite efforts to use alternative controls, or where no alternative controls are available or practical, insecticides may be required to reduce pest populations. Timely treatments can be made before extreme damage occurs by periodically monitoring pest levels. Spraying after extensive damage has occurred is not as effective and should be avoided.

Aspects of Insecticidal Control

Methods of Application

Sprays

Spraying is the most common method of applying insecticides that kill on contact or act as stomach poisons after ingestion. Types of spray delivery systems vary depending on the number and size of trees or shrubs to be treated. Handheld or knapsack sprayers may be suitable for treating a few small or short plantings. Hydraulic sprayers or mist blowers can be used on large plantings or sites that cannot be reached by hand-operated sprayers.

There are drawbacks to spray treatments. Windy conditions may prevent applications. Insecticides can be blown off target even when there is not much wind. Broad-spectrum insecticides can kill non-targeted organisms, including beneficial predators and parasites. Residual effectiveness may be shortened by exposure to environmental factors such as ultraviolet radiation, temperature extremes and rain.

Systemics

Some insecticides can be systemically circulated within the vascular systems of trees and shrubs. There are advantages and disadvantages to systemic insecticides. Two advantages of systemic insecticides are that applications can be made when windy conditions prohibit the use of foliar insecticide spray treatments, and beneficial insect and mite populations are spared because they are not exposed to the broad-spectrum effects that insecticides have on non-target species.

Drawbacks to systemic insecticide treatments include the range of pests that can be controlled and the speed of treatment effect. Systemic insecticides are circulated via plant vascular systems and are most effective against insects that probe vascular elements with their piercing-sucking mouthparts. Some insects with chewing mouthparts can be controlled with systemic insecticides if they ingest plant tissues that contain the systemic toxicant.

Direct contact with foliar sprays reduces pests rapidly, while systemic treatments usually require more time for circulation within plants. Also, the integrity of vascular elements and systems are key for systemic insecticide circulation. Not all trees and shrubs have perfect systems, so systemic insecticides may not be evenly distributed throughout the entire plant.

The speed at which systemic insecticides are circulated depends on whether they are applied directly or indirectly. Direct applications are applied through trunk injections. Various micro-injector systems are available to professional arborists. Companies may limit product sales to personnel who have successfully completed training on injection techniques required for the use of specific injector systems. In addition, some micro-injectors contain restricted-use insecticides sold only to personnel certified through the Kansas Department of Agriculture to purchase and use restricted-use pesticides.

There are drawbacks to injection treatments. Wood may become discolored at injection sites and above. Cambial tissue may be sensitive to some insecticides. In already weakened trees, dead cambial tissue can increase stress and decrease tree vigor even more. Continual yearly injection treatments may have a deleterious additive effect. Trunk injections should be considered a special treatment procedure instead of a routine practice.

Indirect applications are made through soil drench or soil injection. Either method requires time for treatments to take effect. Insecticide uptake depends on adequate soil moisture to move insecticides to root zones where they can be absorbed. Pests will be controlled when adequate amounts of insecticide have been absorbed through the roots and circulated.

Insecticide Categories

Organics

Organic insecticides contain carbon atoms. They make up the majority of synthetic insecticides used to combat insect pests on shade trees and woody ornamentals.

Endosulfan and methoxychlor were the only organochlorine active ingredients registered in 2004 in Kansas for use on shade trees and woody ornamentals (12 and three products, respectively). While the number of organophosphate active ingredients may seem large (acephate, dimethoate, disulfoton, malathion and trichlorfon), the former wide array of products containing those active ingredients has dwindled. The active ingredient carbaryl is the mainstay of the carbamate insecticides. In 2004, the number of registered products (in Kansas) containing the active ingredients bifenthrin, cyfluthrin, cypermethrin, deltamethrin, esfenvalerate, lambda-cyhalothrin and permethrin were 72, 77, 52, 65, 48, 29 and 669, respectively. Pyrethroid active ingredients are increasingly commonplace.

The neonicotinoid active ingredients are the latest to come to the forefront of insecticides. They are highly systemic in plants, making them especially effective against sucking insects. The active ingredient imidacloprid was

in 140 products registered in Kansas in 2004. The more recently introduced active ingredients acetamiprid and thiamethoxam were in 10 and seven products, respectively.

Botanicals

Botanicals are organic insecticides derived from plant extracts. "Old time" botanicals include nicotine, rotenone, sabadilla, ryania and pyrethrin. There are few botanical products registered for use on shade trees and woody ornamentals.

Much of the current interest in botanical insecticides centers around neem insecticides. Of the many (reportedly hundreds) chemicals identified in extracts derived from the bark, leaves and seeds of the neem tree, azadirachtin is the most important to insecticides. Azadirachtin is an insect growth regulator that interferes with the molting process of immature insects. Azadirachtin also has repellent and antifeedant properties that are useful, but short-lived (less than a day). Eight products containing azadirachtin were registered in Kansas in 2004.

Some oils extracted from neem seeds do not contain azadirachtin. The mode of action of neem oils is similar to that of oils from petroleum distillates – death by suffocation and the disruption of cellular membranes and physiological processes. Soft-bodied insects or developmental stages are most susceptible to neem oil. Eighteen products containing neem oil were registered in Kansas in 2004.

Oils

Oils have long been known to possess insecticidal and acaricidal properties. In 1300 A.D., Marco Polo used oils to treat mange in camels. In 1800, whale oil was used against scale insects. In 1820, fish oil was advocated as an insecticide.

Modern oils are derived from petroleum distillates. Before the mid-1960s, oils were categorized as dormant or summer. Dormant oils (known to burn foliage) were only applied to dormant plants. Summer oils were used as solvents and served as carriers for toxicants.

With the development of more sophisticated distillation procedures in the mid-1960s, narrow-range oils became available and are those now used as insecticides. During the oil-refining process, most of the impurities responsible for causing foliar burning (the unsulfonated residues) are removed. Modern horticultural oils range from 92 percent to 99 percent purity. Now, dormant and summer refer to the time of the treatment application.

Oils are effective against the soft-bodied stages of insects and mites. While oils work primarily as suffocants, they also impair other physiological processes by corroding air passageways, muscles and nerves. Oils that cross egg membranes cause the coagulation of developing embryos.

Understanding pest life cycles is necessary to ensure that oil treatments are applied at the proper time. Thorough spray coverage is essential. Oil treatments do not provide residual control, and once the treatments have dried, insects are no longer at risk. However, newly arriving beneficial predators and parasites are not threatened either. Oil spray treatments are safe for humans, birds and mammals.

In 2004, 43 oil products were registered in Kansas. Be careful when using oil treatments. Proper temperature and moisture regimes must be followed. In addition, some plants may be sensitive to oil treatments.

Check product labels in order to maximize pest control and minimize spray damage to plants.

Soaps

Insecticidal soaps are potassium salts of fatty acids derived from a reaction between plant fats and oils with lye.

Soaps have a physical, as opposed to chemical, mode of action that disrupts cuticular and cellular membranes. Soaps also disrupt respiratory systems. Soap sprays must directly contact pests. Insecticidal soaps provide no residual control when dry. Treatment must be reapplied as long as pests are active.

For the most part, soaps are not toxic to nontarget organisms. Phytotoxicity is restricted to only a few sensitive plants, and these are designated on product labels. However, even nonsensitive plants can be damaged. Damage depends on temperature, moisture levels and plant stress.

Be sure to check product labels to maximize pest control and minimize damage to plants.

Insect Growth Regulators

Insect growth regulators (IGRs) disrupt the insect's developmental process. The normal molting process may be accelerated. Insects unable to successfully complete the molt may die while trapped in the unshed skin. Or, if insects (such as aphids) successfully complete the final molt, other complications may occur. For instance, due to the failure of the genital plate and pore to form, matured aphids may succumb to embryo congestion caused by the inability to dispel parthenogenically produced

nymphs. Other abnormalities such as wing distortion will limit the spread of insect populations. Insect fertility may be reduced. Some IGRs inhibit chitin synthesis, which causes abnormalities in the development of cuticular elements.

IGRs will not cause rapid population reductions compared to the use of traditional insecticides. By their designation as insect growth regulators, their effectiveness depends on their application in a timely manner. IGRs must be targeted at immature developmental stages. Users of IGRs must take an active role in their insect control program by dedicating time and effort to inspect and detect insect pests before they complete molting and cuticle formation.

Beauveria bassiana

A naturally occurring fungus, *Beauveria bassiana,* attacks a number of insect pests. Fungal spores attach to susceptible host species. Spores germinate and produce enzymes that dissolve the insect cuticle. Hyphae (fungal filaments) produce peg-like outgrowths (called haustoria) that rapidly enter individual cells. Rapid loss of water and cellular nutrients cause insect death. Five products containing *Beauvaria bassiana* were registered in Kansas in 2004.

Bt (*Bacillus thuringiensis*)

Bacillus thuringiensis is commonly referred to as Bt. Crystalline protein structures (delta endotoxins) are produced in bacterial cells. These crystals disrupt intestinal membranes once they have been ingested by insects. The insects die from blood poisoning.

A great advantage of Bt is its narrow range of activity and nontoxicity to nontarget organisms such as humans, wildlife and beneficial predators and parasites. However, because of that narrow activity range, additional insecticide treatments may be required to suppress other pests not controlled by Bt. Another drawback to Bt is that most types are short lived due to sensitivity and breakdown by ultraviolet radiation, heat and desiccation. Several newer encapsulated products provide longer residual control.

Bt is not a contact insecticide. The delta endotoxin must be ingested for Bt to work. Bt is marketed against foliar feeding larvae. Because Bt products are most effective on young larvae, they are especially appropriate when used with a scouting program that finds larvae before they are large and destructive.

Unlike nerve poisons, Bt products do not cause rapid mortality. Larvae may be active for several days after application. However, those larvae are not damaging. They are not actively feeding because almost immediately after ingesting Bt, their digestive systems (including the mouthparts) become paralyzed.

Various companies market Bt products. Some companies may have several formulations of the same Bt and may target certain formulations toward special user groups. In 2004, 36 products containing Bt were registered in Kansas.

Read package labels to ensure that the product is registered for use on the specific pest and target site.

Abamectin

The soil actinomycete *Streptomyces avermitilis* secretes abamectin. Abamectin has a broad spectrum of activity. Abamectin is a neurotoxin with a different mode of action than that of most insecticides that affect cholinergic systems. Abamectins work best when ingested. However, good contact activity has been observed. In 2004, there were 29 products with the active ingredient abamectin registered in Kansas.

Spinosad

The soil actinomycete *Saccarhopolyspora spinosa* produces a number of chemicals known as spinosyns. Spinosad, a mixture of spinosyn A and spinosyn D, targets the nervous system of a variety of chewing insect pests including caterpillars, leaf beetles and their larvae, leafminers and thrips. In 2004, 15 products containing spinosad were registered in Kansas.

Possible Reasons for Failure of Insecticides to Control Pests

People sometimes report that a recommended insecticide failed to control an insect pest. After a second application with a different material, they again report failure. Unless insecticide resistance is the actual reason for a control failure, which is rare, other factors may be responsible.

If an insect is listed on a product label, there usually is data to substantiate that chemical's efficacy against the pest. Failure to control may be caused by using less than the labeled rate of insecticide or there may not have been adequate coverage if the water carrier was insufficient. The carrier pH may not have been correct. The insects may not have been in a susceptible life stage. They may have been protected in a tree or shrub when treatments were applied. Or insects may have been killed but overlooked because of new arrivals.

There are no magic chemicals. Properly used and timed insecticides should provide reasonable control of insect and mite pests.

Because of the number of active ingredients and formulations in pesticides registered for

use against insect and mite pests of shade trees and woody ornamentals, it is impossible to list the specific uses for all marketed products.

The end user is responsible for reading the product label to ensure safe and legal use.

General Pests

Aphid

Aphids are soft-bodied insects that suck juices from plants. Plant responses to aphid feeding vary from no effect to minor leaf spotting or discoloration to severe leaf or branch deformation. Heavy aphid populations may be responsible for nuisances such as honeydew buildups.

Most aphids have prominent cornicles or tailpipes, but some may appear to have none or have small rims or pores. Most aphids are "naked" while others are "clothed" with white waxy flakes. Some are winged (alate). Others are apterate (unwinged).

Most aphid species reproduce sexually and asexually. Asexual reproduction is by parthenogenic means where females produce or deposit living young. Newly deposited nymphs mature rapidly in six to seven days and repeat the cycle. Rapid reproductive rates enable rapid population buildups that can reach staggering proportions if left unchecked. Sexual aphid forms appear in the fall and produce overwintering eggs.

Control

Chemical control against aphids that do not cause plant deformations is questionable. Aphid populations often crash soon after they peak. Various reasons for sudden population declines include adverse environmental conditions, natural control by predators, parasites, fungal diseases, and normal population dispersal mechanisms.

Control of aphids that cause unsightly deformations may be necessary to preserve the appearance of susceptible plants. Elimination of aphids after deformities have occurred will not restore the appearance of affected tissues. Pruning out the affected plants and any aphids still present might be better than insecticide treatments.

Numerous insecticidal materials are registered for aphid control. Most insecticides are broadly labeled against aphids. However, some products are only registered for use on specific species.

Products for Aphid Control

Active Ingredient	Commercial Trade Names
abamectin	Avid, Vivid II
acephate	AceCap 97, Dendrex, OrtheneTTO
acetamiprid	TriStar
azadirchitin	Azatin XL, Ornazin
Beauvaria bassiana	BotaniGard
bifenthrin	BifenthrinPro, Onyx, Talstar
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
dicrotophos	Inject-A-Cide B
disulfoton	Di-Syston 15G
endosulfan	Endosulfan, Phaser, Thiodan
fenpropathrin	Tame
horticultural oil	Horticultural Oil Insecticide, Saf-T-Side
imidacloprid	IMI-jet, Imicide, Imicide Hp, Imisol, Marathon, Merit, Pointer, Pointer II, Systemic Insecticide
insecticidal soap	Insecticidal Soap, M-Pede
lambda-cyhalothrin	Battle, Scimitar
malathion	Malathion
neem oil	Triact
oxydemeton methyl	Harpoon, Inject-A-Cide
permethrin	Astro
pyriproxyfen	Distance
thiomethoxam	Flagship

Bagworm

Although commonly associated with evergreens, bagworms feed on a variety of trees and shrubs.

Bagworms overwinter as eggs in the pupal cases (contained in bags) of female bagworm moths. Eggs begin hatching in mid- to late-May and may continue into late summer. Larvae leave the bags, begin feeding and immediately begin constructing their bags. Due to their small size, newly constructed bags go unnoticed. As worms continue to feed, they enlarge their bags, which become more noticeable. After 11 to 12 weeks of feeding, matured larvae close their bags and pupate.

Clearwinged and black male moths emerge from mid- to late-September and through October. They are attracted to female bags by pheromones emitted by the female moths. The female lacks wings, eyes, legs and antennae. After mating, female moths deposit their eggs in their pupal cases, leave their bags, drop to the ground and die. There is one generation per year.

Control

Bags can be handpicked during the fall, winter and early spring. If handpicking is impractical due to large numbers of bags or trees, control bagworms with spray treatments when larvae emerge or are smaller and actively feeding.

Products for Bagworm Control

Active Ingredient	Commercial Trade Name
acephate	AceCap 97, Dendrex, OrtheneTTO
azadirchitin	Azatin XL, Ornazin
Bacillus thuringiensis	Crymax, Deliver, DiPel, Javelin, Lepinox
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
diflubenzuron	Dimilin
lambda-cyhalothrin	Battle, Scimitar
malathion	Malathion
permethrin	Astro
spinosad	Conserve, Entrust, SpinTor
trichlorfon	Dylox

Cankerworm

Cankerworms are the larvae of cankerworm moths. Cankerworms have the peculiar habit of looping as they move forward. Spring cankerworms are the predominant species in Kansas. They overwinter as pupae within earthen cells in the soil. Moths emerge during warm periods in February and March. Males mate with the wingless females that crawl up the trunks to deposit their eggs.

Larvae emerge from eggs in April and early May. They complete development in four to five weeks and then enter the soil where they spend the summer and early fall before pupating into the overwintering stage. There is one generation per year.

Cankerworms feed on a variety of trees and shrubs. People may be unaware of cankerworms. They may attribute late leafing of trees and shrubs to weather when developing cankerworms may have been consuming leaf buds or the small leaves as they unfurled. Also, trees and shrubs may suddenly become defoliated when larger cankerworms consume enormous amounts of foliage. In both cases, new leaves appear soon after cankerworms have completed their development.

Control

In situations where cankerworms might be suspected, 6-inch bands of a sticky material around trunks can be used to intercept female bagworm moths before they have the opportunity to deposit their eggs in trees and shrubs. Where cankerworms are an occasional occurrence or where trunk bands are not used, cankerworms can be detected by rapping on branches. This disturbs cankerworms and makes them drop down on silken threads. If necessary, insecticidal treatments may be applied.

Products for Cankerworm Control

Active Ingredient	Commercial Trade Name
acephate	AceCap 97, Dendrex, OrtheneTTO
azadirchitin	Azatin XL, Ornazin
Bacillus thuringiensis	Crymax, Deliver, DiPel, Javelin, Lepinox
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
diflubenzuron	Dimilin
lambda-cyhalothrin	Battle, Scimitar
permethrin	Astro
spinosad	Conserve, Entrust, SpinTor

Lace Bug

Lace bugs are named for the lacy appearance of their forewings that are horizontally flattened when not in flight. There are many lace bug species. They are named for the particular host plant or tree upon which they feed.

Lace bugs overwinter as adults in cracks and crevices of the bark on their host tree or in protected sites elsewhere near their hosts. In late spring or early summer, they deposit eggs on the bottoms of leaves. Nymphs emerge and reach adulthood in one month. The first-generation adults deposit eggs for the second generation of lace bugs. Adults of the second generation overwinter.

Nymphs and adults have piercing-sucking mouthparts. While they feed on lower leaf surfaces, their damage is visible on the upper leaf. The damage is separate chlorotic specks that may eventually coalesce, making the entire leaf appear chlorotic. Evidence that lace bugs caused the damage may be in the cast skins of lace bug nymphs or shiny black specks of fecal deposits on the bottoms of leaves.

Control

Lace bug damage is more of an annoyance than threat to tree health. Treatments, if applied, need to be timed to prevent damage. Treatment after damage will not restore

healthy leaves. Lace bugs generally disperse to overwintering sites after damage has occurred.

Products for Lace Bug Control

Active Ingredient	Commercial Trade Name
abamectin	Abacide, Abasol, Greyhound, Vivid II
acephate	AceCap 97, Dendrex, Orthene
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
disulfoton	Di-Syston 15G
horticultural oil	Horticultural Oil Insecticide, Saf-T-Side
insecticidal soap	Insecticidal Soap, M-Pede
imidacloprid	IMA-jet, Imicide, Imicide Hp, Imisol, Marathon, Merit, Pointer, Pointer II, Systemic Insecticide
lambda-cyhalothrin	Battle, Scimitar
malathion	Malathion
permethrin	Astro
thiomethoxam	Flagship

Leafhopper

Leafhoppers are small, wedge-shaped insects with piercing-sucking mouthparts. They move rapidly by running or flying. They propel themselves into flight after hopping from the leaf or twig where they were resting or feeding.

There are hundreds of leafhopper species. Most are innocuous. However, under drought-stress conditions, high leafhopper populations may cause leaves or plants to wilt. Some leafhopper species inject a phytotoxic salivary secretion that causes leaf margins and eventually the entire leaf to look scorched, known as hopperburn.

Some leafhopper species overwinter in Kansas, while some migrate from southern climates where they overwintered. Eggs are deposited in leaf tissues. Nymphs, incapable of flying but able to move quickly, require varying periods of time before maturity, depending on species and environment. Generally, there are at least two generations per year.

Control

Leafhopper treatments are best before damage is inflicted. However, the presence of leafhoppers goes undetected until damage has occurred. Elimination of the pests will not restore damaged foliage. After-damage treatments may not be useful.

Products for Leafhopper Control

Active Ingredient	Commercial Trade Name
acephate	OrtheneTTO
acetamiprid	TriStar
azadirchitin	Azatin XL, Ornazin
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
dicrotophos	Inject-A-Cide B
disulfoton	Di-Syston 15G
fenpropathrin	Tame
imidacloprid	IMA-jet, Imicide, Imicide Hp, Imisol, Marathon, Merit, Pointer, Pointer II, Systemic Insecticide
insecticidal soap	Insecticidal Soap, M-Pede
lambda-cyhalothrin	Battle, Scimitar
malathion	Malathion
neem oil	Triact
permethrin	Astro
thiomethoxam	Flagship

Mite

Mites are close relatives of insects.Because of their small size, mites often go unnoticed. Their presence is usually detected after sick plants have been closely examined. Confirmation of their presence may be done by placing a white sheet of paper beneath a branch, tapping the branch and than checking the paper to see if there are any “specks” (mites) moving about.

There are different mite species, and determine the exact species is difficult. Some have limited host ranges while others feed on many different plant, tree or shrub species. Some thrive in hot, dry environments while others require cooler conditions. However, the damage caused by mites is similar.

Mites primarily feed on lower leaf surfaces. Using their chilicerate mouthparts to stab epidermal cells, they drink the leaked cellular contents. Chlorotic spots occur where damaged adjacent cells coalesce. A stippling appears on upper leaf surfaces. Severely damaged leaves may die.

Some mite species cause foliage to be deformed or create gall-like structures. These types of damage are more aesthetically objectionable than detrimental to overall plant health and vigor.

Control

Mite control can be achieved if miticidal materials are properly applied. Treatments should be initiated before mite populations

have reached damaging levels. Proper miticide dosage rates should be used. Adequate water carrier rates ensure thorough coverage of infested foliage. Materials must be delivered to where the mites are on lower leaf surfaces. Sprays must penetrate any webbing that can protect mites. Two follow-up treatments applied three to four days after the initial treatment may be required to kill mites that escaped initial treatments or emerged from eggs afterwards.

Products for Mite Control

Active Ingredient	Commercial Trade Name
abamectin	Avid, Abacide, Abasol, Greyhound, Vivid II
acephate	AceCap 97
bifenazate	Floramite
bifenthrin	BifenthrinPro, Onyx, Talstar
disulfoton	Di-Syston 15G
etoxazole	TetraSan
fenpropathrin	Tame
horticultural oil	Horticultural Oil Insecticide, Saf-T-Side
insecticidal soap	Insecticidal Soap, M-Pede
lambda-cyhalothrin	Battle, Scimitar
malathion	Malathion
neem oil	Triact
oxydemeton-methyl	Harpoon, Inject-A-cide
propargite	Ornamite
spinosad	Conserve, Entrust, SpinTor

Scale

Scale insects are highly specialized organisms that come in many shapes, sizes and forms. Scale insects feed on plants by inserting their stylets into leafy or woody tissues and withdrawing plant juices. Heavy scale infestations may weaken and kill plants. Soft-scales also produce honeydew that makes plants sticky and serves as a substrate upon which sooty molds may grow or buildup giving plants dirty or sooty appearance.

Scale insects have three life stages: egg, nymph and adult. "Crawlers" emerge from eggs and travel a short distance before inserting their stylets into plant tissues. Once stylets are in place, the immature forms generally become sessile (their legs may atrophy or become greatly reduced). Mature male scale insects lack mouthparts, have but a single pair of wings and mate with the immobile females that produce eggs to repeat the cycle.

Control

Scale insects derive their name from the scale-like coverings that some produce. Other scales have a waxy or hard protective layer. Scale covers and waxy cuticles protect the delicate, softbodied insects from insecticides, so effective control can be a challenge.

The best time to apply insecticidal treatments is when exposed crawlers are prevalent. Dormant oil treatments or injection treatments also provide control of some scale insects that are not in the crawler stage.

Different species of scale have different times when treatment is best because of varying developmental cycles, habits and generations. For maximum control, be sure to know which species of scale is present.

Products for Scale Control

Active Ingredient	Commercial Trade Name
abamectin	Vivid II
acephate	AceCap 97, Dendrex, OrtheneTTO
azadiractin	Ornazin
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
dicrotophos	Inject-A-Cide B
disulfoton	Di-Syston 15G
fenpropathrin	Tame
horticultural oil	Horticultural Oil Insecticide, Saf-T-Side
imidacloprid	IMA-jet, Imicide, Imicide Hp, Imisol, Merit, Pointer, Pointer II, Systemic Insecticide
insecticidal soap	Insecticidal Soap, M-Pede
lambda-cyhalothrin	Battle, Scimitar
oxydemeton methyl	Harpoon, Inject-A-Cide
malathion	Malathion
pyriproxyfen	Distance
thiamethoxam	Flagship

Webworm

Webworms, specifically the fall webworm, overwinter as pupae in silken cocoons in ground litter or just below the soil surface. Blackheaded moths have white wings with black or brown dots and a 1¼-inch wingspread. These moths emerge in May to deposit egg masses on the undersides of leaves. Redheaded moths emerge in June. Both kinds of larvae require about six weeks to complete their development, after which they pupate. Moths deposit eggs for a second generation of larvae that eventually develop into the overwintering pupae.

Webworm larvae feed on a variety of tree species. Most eggs in an egg mass hatch at the

same time. The small larvae are gregarious and immediately form a web mass that is usually at the ends of tree branches. Larvae stay in the webbing and expand the web as they deplete the foliage. Mature larvae leave the webbing and drop to the ground by a silken thread, where they pupate.

Control

Generally, first-generation fall webworm populations are sparse. Second-generation fall webworms are more prevalent and noticeable. Defoliation by fall webworms is not serious to most trees, but the web masses can be unattractive.

Webbing can be physically destroyed, eliminating many larvae. Webbed branches can be pruned out. If insecticidal sprays are applied, they must be delivered inside the protective webbing to contact the larvae.

Products for Webworm Control

Active Ingredient	Commercial Trade Name
abamectin	Abacide, Abasol
acephate	AceCap 97, Dendrix, OrtheneTTO
azadirachtin	Ornazin
Bacillus thuringiensis	Crymax, Deliver, DiPel, Javelin, Lepinox
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
diflubenzuron	Dimilin
lambda-cyhalothrin	Battle, Scimitar
permethrin	Astro
spinosad	Conserve, Entrust, SpinTor
trichlorfon	Dylox

Arborvitae

Aphid

See General Pests: Aphid, page 9.

Bagworm

See General Pests: Bagworm, page 9.

Fletcher Scale

See Taxus (Yew), page 30.

Mite

See General Pests: Mite, page 11.

Ash

Aphid

See General Pests: Aphid, page 9.

Apple Twig Borer

See Golden Rain Tree, page 18.

Ash/Lilac Borer

Ash/lilac borers overwinter as larvae in infested trees and shrubs and pupate in the spring. Moth emergence begins in mid to late April, peaks in May, dwindles by mid to late June and ends by the first week of July. Moths deposit eggs in cracks and crevices of bark. They hatch in 10 to 14 days. Larvae immediately bore into trees. There is one generation per year.

Control

Use pheromone traps to determine the presence of the adults, which are clearwing moths. Initiate spray treatments seven to 10 days after the capture of the first moths in pheromone traps. Thoroughly treat the trunk and larger limbs.

Products for Ash/Lilac Borer Control

Active Ingredient	Commercial Trade Name
bifenthrin	Onyx
endosulfan	Endosulfan, Phaser, Thiodan
permethrin	Astro

Oystershell Scale

See Elm, page 15.

Scurfy Scale

See Elm, page 15.

Bald Cypress

Bagworm

See General Pests: Bagworm, page 9.

Mite

See General Pests: Mite, page 11.

Barberry

Aphid

See General Pests: Aphid, page 9.

Birch

Bronze Birch Borer

White bark birch trees appear to die from the top down. Upon examination, D-shaped holes mark sites where adult beetles emerged. Adults are ½-long, slender, iridescent, olive- or bronze-colored beetles. Adults emerge and deposit eggs through June, July and August.

Larvae bore through the outer bark and tunnel into the cambium between the bark and the wood. Due to the extended egg-laying period, larvae in different developmental stages may be present in the same host tree. Most overwinter as larvae in an advanced growth stage. Mature larvae are 1 inch long and ribbon-like with an enlarged flattened area just behind their heads. Their meandering tunnels, or galleries, are packed with sawdust-like fecal material. Callous tissue may form around the gallery, giving the outer bark the appearance of raised ridges.

Various factors determine if a single year is adequate for the development of bronze birch borer, but two years is more common.

Control

Start spray treatments during the last week of May or the first week of June. Periodic follow-up treatments are essential through July or the first week of August. Thoroughly treat the trunk and especially the larger branches within reach.

Products for Bronze Birch Borer Control

Active Ingredient	Commercial Trade Name
acephate	AceCap 97, Dendrex
bifenthrin	BifenthrinPro, Onyx, Talstar
dichrophos	Inject-A-Cide B
imidacloprid	IMA-jet, Imicide, Imicide Hp, Merit, Pointer, Pointer II, Systemic Insecticide
permethrin	Astro

Black Locust and Globe Locust

Locust Borer

Locust borers are black, longhorned beetles with bold W-shaped yellow bands. They commonly feed on goldenrod in the fall. Adults begin emerging in late summer and are most abundant in September. They deposit their eggs in bark crevices. Newly emerged larvae bore into the inner bark where they overwinter. Most of their feeding, development and damage is done in the spring and early summer. Pupae form by mid-July, followed by new adults in late summer, which repeats the cycle. There is one generation per year.

Control

Initiate treatments in late August. Repeat according to labeled instructions.

Products for Locust Borer Control

Active Ingredient	Commercial Trade Names
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
imidacloprid	IMA-jet
permethrin	Astro

Boxelder

Bagworm

See General Pests: Bagworm, page 9.

Boxelder Bug

Boxelder bugs do not cause serious injury to trees. They are nuisance pests that invade homes or buildings. Control of boxelder bugs is difficult because of their host range and feeding habits.

Control

Control procedures are best when overwintered adults congregate on host trees in late April and early May, or when first-generation adults gather on host trees later in the summer.

Products for Boxelder Bug Control

Active Ingredient	Commercial Trade Names
acephate	Dendrex, OrtheneTTO
azadirachtin	Ornazin
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
lambda-cyhalothrin	Battle, Scimitar

Boxwood

Mite

See General Pests: Mite, page 11.

Oystershell Scale

See Elm, page 15.

Burning Bush

Mite

See General Pests: Mite, page 11.

Cotoneaster

Bagworm

See General Pests: Bagworm, page 9.

Lace Bug

See General Pests: Lace Bug, page 10.

Mite

See General Pests: Mite, page 11.

Oystershell Scale

See Elm, page 15.

San Jose (Armored) Scale

See General Pests: Scale, page 12.

Female scales are flat, circular and grayish with a darker nipple-like formation near the center. Males are smaller and somewhat elongated. Both males and females overwinter as immatures. Scales become sexually mature and mate in the spring. Females give live birth to first-generation crawlers in late June. There are two or more generations per year.

Control

Oils can be used as dormant treatments in the spring. Insecticides can be used against crawlers in late June.

Cottonwood and Poplar

Cottonwood Borer

Large, 1½-inch, black and white, or cream-colored beetles begin emerging in late June. They deposit their eggs in chewed indentations in bark at or below soil line. Larvae begin feeding in the root collar zone but tunnel deeper into the roots where they cause extensive damage. Some larvae complete their development in a single season, while others require two.

Control

Thoroughly spray lower trunk and treat by drenching it where it meets the soil.

Products for Cottonwood Borer Control

Active Ingredient	Commercial Trade Names
bifenthrin	BifenthrinPro, Onyx, Talstar
imidacloprid	IMI-jet, Imicide, Imicide Hp
permethrin	Astro

Leaf Beetle

Several different leaf beetles are associated with cottonwoods and poplars. Adults generally emerge in May, and first-generation larvae skeletonize leaves in June. A second and possibly a partial third generation occur in later summer.

Control

Treat before damage becomes noticeable.

Products for Leaf Beetle Control

Active Ingredient	Commercial Trade Name
azadirchitin	Azatin, Azatin XL+, Ornazin
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
horticultural oil	Horticultural Oil Insecticide, Saf-T-Side, Sunspray
imidacloprid	Merit, Systemic Insecticide
lambda-cyhalothrin	Battle, Scimitar
spinosad	Conserve, Entrust, SpinTor

Poplar Petiolegall Aphid

See General Pests: Aphid, page 9.

Galls may appear on leaf petioles. Little injury is associated with the unsightly galls, although some leaves may drop prematurely.

Control

To prevent the formation of galls, aphids must be killed during leaf expansion.

Eastern Red Cedar

See Juniper, page 20.

Elm

Aphid

See General Pests: Aphid, page 9.

Cankerworm

See General Pests: Cankerworm, page 10.

Elm Calligrapha

Elm calligrapha beetles are oval and slighly elongated with creamy, white wing covers marked with irregularly shaped metallic-green stripes and spots. Overwintered adults deposit eggs from early spring to mid-June. Larvae and adults skeletonize leaves. There is one generation per year.

Control

Apply insecticide treatments during May or early June after most larvae have emerged.

Products for Elm Calligrapha Control

Active Ingredient	Commercial Trade Names
azadirchitin	Azatin XL, Ornazin
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
horticultural oil	Hort Oil Insecticide, Saf-T-Side
imidacloprid	IMA-jet, Merit, Systemic Insecticide
lambda-cyhalothrin	Battle, Scimitar
spinosad	Conserve, Entrust, SpinTor

Elm Leaf Beetle

Most elm leaf beetles overwinter as adults outdoors in protected sites, but some are found in homes. Beetles vary in color and pattern. Some are mostly yellow with darker stripes down the wing covers and spots on the thorax and head, or they may be entirely olive with no distinct markings. The appearance of elm leaf beetles may vary between years or sites within Kansas.

Control

Insecticide applications should be timed to coincide with egg hatches, which generally occur in mid-May for the first generation and early to mid-July for the second generation.

Products for Elm Leaf Beetle Control

Active Ingredient	Commercial Trade Names
abamectin	Abacide, Abasol, Greyhound, Vivid II
acephate	AceCap 97, Dendrex, OrtheneTTO
azadirchitin	Azatin XL, Ornazin
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
dicrotophos	Inject-A-Cide B
disulfoton	Di-Syston 15C
horticultural oil	Horticultural Oil Insecticide, Saf-T-Side, Sunspray
imidacloprid	IMA-jet, Imicide, Imicide Hp, Imisol, Marathon, Merit, Pointer, Pointer II, Systemic Insecticide
lambda-cyhalothrin	Battle, Scimitar
oxydemeton methyl	Harpoon, Inject-A-Cide
spinosad	Conserve, Entrust, SpinTor

European Elm (Mealybug-like) Scale

Immature scales overwinter on twigs and branches. They resume feeding in early spring and become sexually mature by late spring. Tiny yellow crawlers move to leaves in late June through mid-July, and back to overwintering sites in October.

Control

See General Pests: Scale, page 12.

Apply dormant oil treatment or use a material that is listed for control against crawlers between late-June and mid-July.

Lecanium (Soft) Scale

A general designation for several species of large, round, up to ¼ inch-long, dark brown, leathery scales that attack shade trees. Sometimes European fruit lecanium is a serious problem on elms. Nymphs overwinter on bark and become adults by May when they produce eggs. Crawlers move to leaves in June, and back to twigs shortly before leaf drop.

Control

See General Pests: Scale, page 12.

Apply a dormant oil treatment to kill overwintering nymphs or use a product listed for control against crawlers that move onto leaves in June.

Oystershell (Armored) Scale

Oystershell scales are small, ⅛ inch long, and resemble oyster shells. They overwinter as eggs under encrustations of old scale covers on bark of various limbs. Crawlers are active in May or June.

Control

See General Pests: Scale, page 12.

Control is best with a dormant oil treatment and an additional treatment when crawlers appear. Repeated treatments may be required depending on how long crawlers are present.

Scurfy (Armored) Scale

Two species of scurfy scale overwinter on bark as purplish or reddish eggs beneath the shell of the dead female. First-generation crawlers appear in May or June. Second-generation scales produce overwintering eggs in late fall.

Control

See General Pests: Scale, page 12.

Control is best with dormant oil treatment and a listed material applied when crawlers appear. Repeated treatments may be required depending on how long crawlers are present.

Euonymus

Euonymus (Armored) Scale

Euonymus scales overwinter as mature, fertilized females. Eggs are deposited in spring, and orange-colored, first-generation crawlers appear in late May or early June. Second-generation crawlers appear in late August to early September.

Control

See General Pests: Scale, page 12.

Control is best with a dormant oil treatment and the use of a listed material applied when crawlers appear. Controlling scales on heavily infested plants is difficult. Removal of the entire infested planting, including the root, may be necessary.

Flowering Fruit Trees

Ornamental Crabapple, Peach, Pear, Plum and Quince

Aphid

See General Pests: Aphid, page 9.

Cankerworm

See General Pests: Cankerworm, page 10.

Eastern Tent Caterpillar

Eastern tent caterpillars overwinter as shiny, black egg masses on twigs of flowering fruit trees such as wild cherry, sandhill plum, apple, cherry and peach. Generally, eggs hatch about the time leaves begin unfolding in late March and early April. Larvae forage for six to eight weeks on developing or expanded foliage and retreat at night and during inclement weather to tents constructed in the forks and crotches of trees. Mature, 2-inch long larvae are somewhat hairy and black with white and blue markings including a white dorsal stripe. Larvae move to protected areas where they spin silken cocoons. Adults emerge in June, mate and deposit eggs that hatch the following spring. There is one generation per year.

Control

Tents can be removed or destroyed, which interferes with caterpillar development. If sprays are used, control is best when larvae are small. For effective control using spray treatments, apply the insecticide inside tents where larvae are congregated.

Products for Eastern Tent Caterpillar Control

Active Ingredient	Commercial Trade Names
acephate	Acecap 97, Dendrex, OrtheneTTO
azadirchitin	Azatin XL, Ornazin
Bacillus thuringiensis	Crymax, Deliver, DiPel, Javelin, Lepinox
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
dicrotophos	Inject-A-Cide B
diflubenzuron	Dimilin
insecticidal soap	Insecticidal Soap, M-Pede
lambda-cyhalothrin	Battle, Scimitar
malathion	Malathion
permethrin	Astro
spinosad	Conserve, Entrust, SpinTor

Fall Webworm

See General Pests: Webworm, page 12.

Flatheaded Borer

See Maple, page 21.

Peach Tree Borer

Peach tree borers overwinter as larvae in roots and lower trunks. Larvae vary in size and resume feeding in the spring. Mature larvae pupate. The clearwinged moth, which resembles a wasp, begins to emerge in May and June and continues into September. These borers have an extended egg laying, which accounts for larvae size variations. There is one generation per year.

Control

Use pheromone traps to decide when to apply insecticides. Concentrate sprays from the main branches down, and especially on the lower trunk and base of trees. Depending on the insecticide and the length of the egg-laying period, more treatments may be necessary.

Products for Peach Tree Borer Control

Active Ingredient	Commercial Trade Names
azadirchitin	Ornazin
bifenthrin	BifenthrinPro, Onyx, Talstar
endosulfan	Endosulfan, Phaser, Thiodan
permethrin	Astro

Scale

Flowering fruit trees can be attacked by various species of scale insects. To properly time treatments for maximum control, accurately identify the type of scale.

Control

See General Pests: Scale, page 12.

Golden Rain Tree

Apple Twig Borer

This false powderpost beetle makes tunnels in ¼- to ½-inch branches in early summer. Prune and destroy infested branches. No insecticides are registered against this pest on this plant.

Redshouldered Plant Bug

This red and black insect resembles the boxelder bug. It removes plant juices as it feeds on leaves. Little is known about its biology or the extent of damage it causes. See insecticides for boxelder bugs.

Hackberry

Cankerworm

See General Pests: Cankerworm, page 10.

Hackberry Lace Bug

See General Pests: Lace Bug, page 10.

Hackberry Nipplegall Maker (Psyllid)

Adult psyllids overwinter outdoors in protected sites such as cracks, crevices and under debris, or in buildings. Adults become active in spring and deposit eggs over a period of weeks on newly unfolded leaves. The leaf tissue is stimulated and eventually envelops the nymph, which completes its development in the nipple-like structure. Adults emerge before leaf drop in the fall. Although heavily infested leaves may drop prematurely, the galls do not injure trees. Control procedures are not essential for tree vitality.

Control

Successful control depends on insecticide applications that coincide with egg laying and take place before nymphs are enveloped in the gall.

Products for Hackberry Nipplegall Maker Control

Active Ingredient	Commercial Trade Names
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
deltamethrin	DeltaGard
dicrotophos	Inject-A-Cide B
imidacloprid	IMA-jet, Imicide, Imicide Hp, Marathon, Merit, Pointer, Pointer II, Systemic Insecticide
thiomethoxam	Flagship

Holly

Lecanium Scale

See Elm, page 15.

Mite

See General Pests: Mite, page 11.

Oystershell Scale

See Elm, page 15.

Spittlebug

The holly spittlebug, also known as the two-lined spittlebug, is commonly associated with holly. They are brown to black with two distinct orangish bands across the wings, and a third but less obvious narrow band across the thorax.

It is unclear whether two-lined spittlebugs overwinter as eggs in or under the bark of host plants or as adults that deposit eggs on grass hosts in the spring. Nymphal development takes place on grass hosts. Single nymphs are protected in frothy spittle masses. At maturity, adult spittlebugs move to secondary woody hosts. It has not been determined whether the two-lined spittlebug has one or two generations per year in Kansas.

Control

Necrotic spots mark the sites where two-striped spittlebug stylets enter leaf tissue. Feeding can create blotches on the lower surfaces of older leaves. If immature or young leaves are attacked they may become distorted, discolored and stunted.

Products for Spittlebug Control

Active Ingredient	Commercial Trade Names
azadirachtin	Ornazin
bifenthrin	BifenthrinPro, Onyx, Talstar
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
dicrotophos	Inject-A-Cide B
lambda-cyhalothrin	Battle, Scimitar

Honeylocust

Bagworm

See General Pests: Bagworm, page 9.

Borer

Several species of roundheaded borers are associated with honeylocust, and most of those attack cut logs and dead or dying trees. However, the redheaded ash borer is a potential pest of young trees.

Redheaded ash borers overwinter as larvae in the xylem of infested trunks. Pupation occurs in the spring, and adults emerge when red maples are in bloom. Eggs are deposited beneath the bark. Larvae feed on the inner bark and summer wood before boring into the xylem tissues. There is one generation per year in Kansas.

Damage from redheaded ash borers is twofold. Tree sap flow is cutoff by larvae feeding on the bark and wood. Trees are weakened by the larvae boring deeper into the wood in preparation for overwintering.

Control

Providing adequate water throughout the growing season, especially during heat and drought, helps trees maintain a good sap flow, which hinders larvae establishment. Periodic trunk sprays also can be applied to kill adults as they deposit eggs. If most eggs are deposited beneath the bark, treatments may not be effective against larvae. For larvae that emerge from eggs laid on the surface of the bark or in cracks and crevices, thorough trunk spray treatments would kill larvae before they could move beneath the bark.

Products for Borer Control

Active Ingredient	Commercial Trade Names
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
imidacloprid	IMA-jet
permethrin	Astro

Cankerworm

See General Pests: Cankerworm, page 10.

Honeylocust Podgall Midge

These pests overwinter as adults somewhere outside of the pods. Eggs are deposited on young leaflets and hatch a day or two later. Larvae immediately begin feeding and stimulate the abnormal growth of leaf tissue, which causes pods to form. Single or several larvae complete development in the podgalls. Adults emerge after pupation, which also occurs in podgalls. In Connecticut, five to seven generations are produced each season, so it is likely that honeylocust podgall midges are multigenerational in Kansas.

Leaflets may dry and drop prematurely. While repeated attacks may cause dieback of small branches, new shoots eventually develop at points of dieback.

Control

Successful control depends on well-timed insecticide treatments. The first treatment should coincide with newly unfolded leaves in spring, and subsequent treatments applied at 10-day intervals until the infestation is eliminated.

Products for Honeylocust Podgall Midge Control

Active Ingredient	Commercial Trade Names
carbaryl	Sevin
lambda-cyhalothrin	Battle, Scimitar
spinosad	Conserve, Entrust, SpinTor
thiomethoxam	Flagship

Mimosa Webworm

Mimosa webworms overwinter as pupae in cocoons under bark or in debris and soil beneath trees. Moths emerge in June and deposit eggs. Small green larvae produce webbing and skeletonize leaves. First-generation adults appear in late July and early August, and produce a second generation of pupae that overwinter.

Control

Insecticidal control of mimosa webworm is most effective when initial treatments are applied before extensive webbing, which shields larvae from insecticides.

Products for Mimosa Webworm Control

Active Ingredient	Commercial Trade Names
acephate	OrtheneTTO
Bacillus thuringiensis	Crymax, Deliver, DiPel, Javelin, Lepinox
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo,
deltamethrin	DeltaGard
diflubenzuron	Dimilin
disulfoton	Di-Syston 15G
lambda-cyhalothrin	Battle, Scimitar
permethrin	Astro
spinosad	Conserve, Entrust, SpinTor

Plant Bug/Leafhopper Complex

This is a group of five different insects consisting of three plant bug species, one leafhopper species and one treehopper species. All overwinter as eggs on or just beneath the bark of the current year's twigs. Nymphs suck sap from growing leaves. After about 30 days, nymphs mature. Adults deposit eggs in late May and early June. The eggs hatch the following spring when leaf buds open in early April. There is one generation per year.

Small, developing leaves are sensitive to the feeding of the growing nymphs. Leaf cells are killed and leaves become distorted as they

unfurl and expand. While heavily damaged leaves drop off, they are soon replaced by a new flush of normal leaves from axillary buds, so trees will look normal for most of the season. Less damaged, but distorted, leaves do not drop off but remain in tact giving the tree an aesthetically unacceptable appearance.

Control

Successful control depends on insecticide treatments that must coincide with nymphal emergence or before nymphs cause extensive feeding damage.

Products for Plant Bug/Leafhopper Control

Active Ingredient	Commercial Trade Names
abamectin	Vivid II
acephate	OrtheneTTO
acetamiprid	TriStar
azadirchitin	Azatin XL, Ornazin
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
dicrotophos	Inject-A-Cide B
fenpropathrin	Tame
horticultural oil	Horticultural Spray Oil, Saf-T-Cide
imidacloprid	Imicide, Imicide Hp, Imisol, Merit, Systemic Insecticide
lambda-cyhalothrin	Battle, Scimitar
malathion	Malathion
neem oil	Triact
permethrin	Astro
thiomethoxam	Flagship

Honeysuckle

Honeysuckle Aphid

Honeysuckle aphids congregate on new plant growth. Salivary secretions stunt leaves and stem growth and cause leaves to fold up. Shoots do not elongate normally, so there are a lot of small and weak side shoots, which creates a broom effect. Aphid colonies build up in folded leaves.

Honeysuckle aphids overwinter as eggs and are found on plants that were infested the previous year. Eggs hatch in the spring. Many generations may be produced during the summer. All aphids are females that reproduce asexually. Sexual aphids are produced in the fall of the year and these produce the overwintering eggs.

Honeysuckle aphids are small and easily overlooked. They are pale green to cream in color and covered with a fine, powdery dust. The brooming effect on honeysuckles is a sign of honeysuckle aphids.

Control

See General Pests: Aphid, page 9.

Many eggs can be eliminated by removing the previous year's infested plant materials. Because not all of the eggs will be removed, apply an insecticide early in the year (before newly hatched aphids multiply and cause leaves to fold). Winged honeysuckle aphids from outside areas may continually reinfest established plantings, which makes additional treatments necessary. Treatments should be applied every 10 to 14 days throughout the season if unsightly growth is unacceptable.

Juniper

Bagworm

See General Pests: Bagworm, page 9.

Bark Beetle

Stressed trees are more susceptible to bark beetle attacks than healthy, growing trees. Twig dieback and red flagging are the result of adults feeding in twig axils. Small larvae feed between the bark and wood producing galleries that run across the wood grain.

Control

Maintaining vigor will help trees resist bark beetles. Remove and burn heavily infested trees to reduce overall pest populations.

Studies on bark beetle life cycles have not been done in Kansas. Frequent insecticide applications are necessary because of overlapping generations. Trunks and interior parts should be thoroughly treated beginning in May and ending with an August spray.

Products for Bark Beetle Control

Active Ingredient	Commercial Trade Names
azadirachitn	Ornazin
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
oxydemeton methyl	Harpoon, Inject-A-Cide
permethrin	Astro

Fletcher Scale

See Yew (Taxus), page 30.

Juniper (Armored) Scale

Leaves of infested junipers turn yellow or brown. Juniper scales overwinter as females filled with eggs beneath their white, circular scales that have a raised, yellow center. Eggs

are deposited over a 30- to 40-day period and crawlers begin to appear in mid- to late-June. Males are produced sometime during the summer. They fertilize female scales, which then overwinter. There is one generation per year.

Control

See General Pests: Scale, page 12.

Use a dormant oil treatment in early spring or apply insecticide when crawlers appear. Several treatments applied at 10-day intervals may be required because of the extended period of crawler activity.

Mite

See General Pests: Mite, page 11.

Sawfly

Sawfly larvae are common on Juniper, but seldom cause extensive damage. Full-grown larvae are ¾-inch long, have light brown heads and three dull green longitudinal stripes running the length of their bodies.

Control

Control procedures are usually not required. Treatments should be applied before damage becomes noticeable in late May to early June if necessary.

Products for Sawfly Control

Active Ingredient	Commercial Trade Names
acephate	Dendrix, OrtheneTTO
acetamiprid	TriStar
azadirchitin	Azatin XL, Ornazin
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
dicrotophos	Inject-A-Cide B
diflubenzuron	Dimilin
horticultural oil	Horticultural Oil Insecticide, Saf-T-Side, Sunspray
imidacloprid	IMA-jet, Marathon, Merit, Pointer, Pointer II, Systemic Insecticide
insecticidal soap	Insecticidal Soap, M-Pede
lambda-cyhalothrin	Battle, Scimitar
malathion	Malathion
permethrin	Astro
thiomethoxam	Flagship

Juniper Webworm

This webworm attacks Juniper foliage in central and western Kansas.

While exact time for moth emergence and egg laying have not been determined in Kansas, both probably occur in late May through mid-June. Small larvae go unnoticed because of their initial leaf tunneling activities followed by feeding on the surface of thick, inner foliage during summer and fall. Several larvae gather and construct nests for overwintering.

Overwintered larvae resume their feeding and development in early spring and produce thick webbing. Larvae pupate during late spring. Moths emerge to repeat the cycle. There is one generation per year.

Control

Control measures are best when larvae are small during September, October or in early spring (March to early May). Control may be difficult because heavy foliage or webbing may shield larvae from insecticide.

Products for Juniper Webworm Control

Active Ingredient	Commercial Trade Name
abamectin	Abacide, Abasol
acephate	AceCap 97, Dendrix, OrtheneTTO
azadirachtin	Ornazin
Bacillus thurnigiensis	Crymax, Deliver, DiPel, Javelin, Lepinox
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
diflubenzuron	Dimilin
lambda-cyhalothrin	Battle, Scimitar
permethrin	Astro
spinosad	Conserve, Entrust, SpinTor
trichlorfon	Dylox

Lilac

Ash/Lilac Borer

See Ash, page 13.

Oystershell Scale

See Elm, page 15.

Maple

Aphid

See General Pests: Aphid, page 9.

Boxelder Bug

See Boxelder, page 14.

Cankerworm

See General Pests: Cankerworm, page 10.

Cottony Maple (Soft) Scale

Cottony maple scales are small, flat, brown and attach to twigs and branches of trees including maples, white ash, black and honey locusts, euonymus, oak, boxelder, dogwood, hackberry, sycamore, elm, willow and poplar.

Immature but already mated female cottony maple scales overwinter on twigs and branches. After maturing by late May, they deposit eggs in white, cottony egg sacs. Eggs hatch from mid June until early July.

Crawlers move onto leaves where they feed. Winged male scale insects emerge in late summer and mate with immature female scale insects. Mated female scales move back to overwintering sites on twigs and branches before leaves drop in the fall. There is one generation per year.

Control

See General Pests: Scale, page 12.

Reduce overwintering immature female scale with dormant oil treatments, or apply insecticide to upper and lower leaf surfaces to kill unprotected crawlers before they produce waxy covers.

Flatheaded Appletree Borer

Flatheaded appletree borers attack many species of deciduous shrubs, fruit trees and shade trees. They overwinter as larvae in various growth stages. Overwintered mature larvae pupate in the spring, and adults emerge in May. As other larvae complete the maturation process and pupate, additional beetles emerge throughout the summer. Beetles are flat, dark metallic brown to dull gray and about ½ inch long. They deposit individual eggs in cracks and crevices of bark and under bark scales, especially on trunks and larger branches exposed to the sun. Larvae bore through the outer bark to feed on the inner bark. With the approach of colder weather, larvae form overwintering cells in the outer wood. While larvae may be killed in shrubs or trees with a heavy sap flow, they cause extensive feeding damage to phloem tissues in less vigorous plantings.

Control

Newly planted, stressed or wounded plantings are attractive to flatheaded appletree borer beetles and are most susceptible to damage from the larvae. To stop attacks by flatheaded appletree borers, use tree wrappings and keep trees healthy and vigorous.

Insecticidal treatments can be used to kill newly emerged larvae before they penetrate the protective bark layer. Because of the extended period of activity of the adult flatheaded appletree borers, repeated treatments are essential for control.

Products for Flatheaded Appletree Borer Control

Active Ingredient	Commercial Trade Names
abamectin	Vivid II
bifenthrin	BifenthrinPro, Onyx, Talstar
imidacloprid	IMA-jet, Imicide, Imicide Hp, Marathon, Merit, Pointer, Pointer II, Systemic Insecticide,
permethrin	Astro

Greenstriped Mapleworm

Maple trees may be completely defoliated by heavy infestations of this pest. Greenstriped mapleworms overwinter as pupae. Large, white, female moths with a 2-inch wingspan deposit first-generation eggs in mid to late May. By late June or early July, mature and distinctively green-striped, black-horned larvae descend from trees to pupate in protected areas or under ground debris. Moths emerge 10 to 14 days later and deposit eggs for second-generation larvae, which pupate and overwinter.

Control

If control measures are necessary, reduce defoliation with insecticidal sprays directed at small larvae of either generation.

Products for Greenstriped Mapleworm Control

Active Ingredient	Commercial Trade Names
acephate	AceCap 97
Bacillus thuringiensis	Crymax, Deliver, DiPel, Javelin, Lepinox
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
lambda-cyhalothrin	Battle, Scimitar
permethrin	Astro
spinosad	Conserve, Entrust, SpinTor

Maple Bladdergall Mite

Tiny, elongated eriophyid mites create bladder-shaped galls on upper leaf surfaces. Galls initially are green but turn red and eventually black. Overwintered adult mites move to newly developing leaves. Leaf tissues form pouch-like galls around mites as they feed. Mites deposit eggs in the galls, but they eventually leave to find newly formed leaf tissue, which creates new bladdergalls. Mite activity slows during summer heat.

Control

See General Pests: Mite, page 11.

Because they are not detrimental to overall tree health, the need to control maple bladder-gall mites is questionable. If control is necessary, apply an initial treatment when the first leaves are unfurling and apply a follow-up treatment 10 days later.

Oystershell Scale

See Elm, page 15.

Scurfy Scale

See Elm, page 15.

Do not use Orthene on red or sugar maple.

Mimosa

Mimosa Webworm

See Honeylocust, page 18.

Oak

Caterpillars

These pests include the variable oakleaf, unicorn and saddled-prominent caterpillars.

Variable oakleaf caterpillars have a red streak from the head to the end of the body. Unicorn caterpillars have a purple head and a pointed, split projection on the first abdominal segment. Their first two thoracic segments are green and the rest of their bodies are brick-red and slashed with pale lines. Saddled prominent caterpillars have a bright red saddle-like mark on the topside of the third, forth and fifth abdominal segments.

Control

Caterpillar control is not usually necessary because they generally appear in late summer after trees have produced most of their food reserves for the upcoming year. If control measures are necessary, insecticides should be directed at larvae while they are small and less capable of inflicting severe defoliation.

Products for Caterpillar Control

Active Ingredient	Commercial Trade Names
abamectin	Vivid II
acephate	Dendrex
Bacillus thuringiensis	DiPel, Lepinox, Crymax, Deliver, Javelin
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
dicrotothos	Inject-A-Cide B
diflubenzuron	Dimilin
lambda-cyhalothrin	Battle, Scimitar
permethrin	Astro
spinosad	Conserve, Entrust, SpinTor

Flatheaded Wood Borer

See Maple, page 21.

Gall

Certain midge flies, mites and wasps are responsible for causing plant tissue to form abnormal growths or galls. Galls of some insects have a distinctive shape, occupy specific sites such as leaves, twigs and bark, or locations such as on the top or bottom of leaves, on veins, interveinal, at leaf margins and on petioles. They are unique to a specific host genus. Oak trees are host to a majority of galls. Galls are more of an aesthetic annoyance than a threat to overall tree health.

Control

People become aware of galls only after they have developed. Although many insects or mites can be specifically identified by the unique galls, little is known regarding most of their life cycles. The timing for applying spray treatments is imprecise for most gall-formers. Usually, gall-forming insects and mites are active when leaves are unfurling and expanding. Treatments at this time might kill gall-forming insects and mites. Spray treatments after galls have been formed would be almost useless. Pruning out stem and twig galls, where practical, may reduce the number of future galls.

Products for Gall Control

Active Ingredient	Commercial Trade Names
carbaryl	Sevin
horticultural oil	Horticultural Oil Insecticide, Sunspray
insecticidal soap	Insecticidal Soap, M-Pede
spinosad	Conserve, Entrust, SpinTor
thiomethoxam	Flagship

Kermes Oak (Gall-like) Scale

Kermes oak scales cause leaf curling and shortened shoots on pin and bur oaks. Current year's growth may be killed back, causing an unsightly appearance. Female kermes oak scales are brown to black, ⅛ to ¼ inch in diameter and look like galls. They are found on current year's growth.

Kermes oak scales overwinter as male and female crawlers in cracks and crevices of bark on trunks and branches. In the spring, female crawlers move to areas of new growth while male crawlers remain at overwintering sites. Male and female scales mature by late May and early June with males flying to and mating with females. Eggs are produced in late June and early July. Newly emerged crawlers move back to the overwintering sites. There is one generation per year.

Control

See General Pests: Scale, page 12.

Control of Kermes oak scale is best when unprotected male and female crawlers move to overwintering sites in late June through July, or when unprotected females move back to new growth. In theory, treatment could be applied while crawlers are at overwintering sites. However, given their small size and ability to squeeze into extremely tight spaces, even drench treatments may not kill crawlers.

Lace Bug

See General Pests: Lace Bug, page 10.

Lecanium Scale

See Elm, page 15.

Obscure (Armored) Scale

Although reported to occur on various tree species, oaks are the principal host for obscure scales. Heavy concentrations of obscure scales may build up on twigs, branches and trunks, and cause dieback of smaller branches. Overall tree vigor might be threatened depending upon the severity and frequency of attacks, and other environmental stress.

Obscure scales overwinter as immature male and female nymphs. At the beginning of May, nymphs resume their development and reach maturity by late June or early July. After mating, peak egg laying begins in July and is followed by peak crawler activity in late July and early August. Crawlers settle down, begin feeding and become the immature overwintering scales. There is one generation per year.

Female scale covers are grayish to black, circular, ⅛ inch in diameter, slightly convex and have a central nipple-like formation that is the shed skin of the first-instar nymph. Male scale covers are smaller and oval with the shed skin in a subterminal position. Scale covers may overlap and build several layers deep.

Control

See General Pests: Scale, page 12.

Control efforts are best at the crawler stage. Insecticidal sprays should be applied in late July when most crawlers are active. Repeat the treatment a week later to control stragglers. Control of obscure scale might be complicated because eggs may be deposited beneath clusters of old scales. Crawlers may never leave the protective coverings and escape insecticide treatments.

Yellownecked Caterpillar

Yellownecked caterpillars overwinter as pupae. Moths deposit eggs in late June and July. Egg masses may contain up to 100 eggs. Eggs within individual masses hatch simultaneously. Larvae are gregarious and have a prominent orange or yellow neck prothoracic shield immediately behind the black head capsule. After feeding for up to six weeks, adults descend from trees and enter the ground where they pupate and overwinter. There is one generation per year.

Control

Skeletonization of lower leaf surfaces by small larvae generally goes unnoticed. Larger larvae consume all but leaf petioles. Generally, by the time larvae are noticed they have completed their feeding phase, and insecticidal controls are of little value.

Products for Yellownecked Caterpillar Control

Active Ingredient	Commercial Trade Names
Bacillus thuringiensis	Crymax, Deliver, DiPel, Javelin, Lepinox
bifenthrin	BifenthrinPro, Onyx, Talstar
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
lambda-cyhalothrin	Battle, Scimitar
permethrin	Astro
spinosad	Conserve, Entrust, SpinTor

Pecans

Phylloxeran Gall

Galls on pecan are caused by phylloxerans, which are small insects closely related to aphids. Pecans are host to several phylloxeran species.

Phylloxerans overwinter as eggs in old gall structures. Eggs hatch early in the spring as

leaves unfurl. The newly emerged phylloxerans, which are called stem mothers, leave the old gall and begin feeding near leaf petioles. They soon become enveloped in gall tissue.

Inside the new gall, an individual phylloxeran matures and deposits many eggs. By the time the newly emerged nymphs mature and become winged adults, the galls split open. The released phylloxerans move to the undersides of leaves where they deposit eggs. Male and female phylloxerans emerge from these eggs. They mate, and the females deposit single eggs in old gall structures. These are the overwintering eggs.

Control

Timely insecticidal treatments are critical for phylloxeran control. Treatments must be applied as leaves unfurl and before the stem mothers become encased within gall structures. Further treatments are difficult to time because it is hard to determinine when phylloxerans leave galls to produce the sexual generation and when the female progeny, which produce overwintering eggs, appear.

Products for Phylloxeran Control

Active Ingredient	Commercial Trade Names
azadirachtin	Neemix
carbaryl	Sevin
esfenvalerate	Asana
malathion	Malathion

Pines

Adelgid

Adelgids are close relatives of aphids. Because adelgids produce flocculent materials such as powders, waxy filiments and ribbons, they are sometimes confused with wooly aphids. Adelgids insert their piercing-sucking mouthparts into plant tissues and withdraw plant juices.

There are various species of adelgids associated with pines. Species identification is difficult. One of the more commonly encountered adelgids is the pine bark adelgid. They overwinter in the wooly masses found on the bark of trunks, branches and twigs. Some say immature adelgids overwinter, while others say the mature adelgid is the overwintering form. Mature pine bark adelgids, which are black and have short legs, deposit eggs early in the year. After crawlers emerge and move a short distance, they settle down to feed until they molt. They may move before settling down to feed again. At maturity, they produce eggs for the next generation. Pine bark adelgids produce numerous generations each season.

Control

The seriousness of adelgid population buildups is questionable. A heavy attack may leave tree trunks covered in white flocculence, with no apparent damage to trees. Heavy populations on twigs and branches can cause dieback.

Insecticide treatments must be thorough. Use enough water carrier to drench infestations. Insecticidal materials must penetrate the wooly material that protects the adelgids.

Products for Adelgid Control

Active Ingredient	Commercial Trade Name
abamectin	Vivid II
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
deltamethrin	DeltaGard
horticultural oil	Horticultural Oil Insecticide, Saf-T-Side, Sunspray
imidacloprid	IMA-jet, Imicide, Imicide Hp, Imisol, Marathon, Merit, Pointer, Pointer II, Systemic Insecticide
insecticidal soap	Insecticidal Soap, M-Pede
oxydemeton methyl	Harpoon, Inject-A-Cide

Aphid

Not much is known about the aphids associated with pines in Kansas. People usually become unaware of aphids when something else, usually brown or discolored needles, cause them to look closely at trees. Due to their long legs and ability to move quickly, people often erroneously report spiders, rather than aphids, on pine trees.

Control

See General Pests: Aphid, page 9.

While the brown or discolored needles are usually caused by something besides aphids, sprays may be necessary.

European Pine Sawfly

The European pine sawfly is the most common sawfly species to attack pine in Kansas. Sawfly larvae resemble moth larvae because both have a pair of legs on each of the three body segments immediately behind the head. Sawfly larvae have additional pairs of fleshy prolegs, or false legs, on other segments, while moth larvae only have two to four pairs situated on the more distal abdominal ones.

European pine sawfly overwinter as eggs in the previous year's needles. Larvae emerge

early the next spring but are small and do not inflict noticeable damage. Their presence is usually detected when they have grown larger (by mid-April) and caused feeding damage. By early May, most larvae become mature and drop to the ground to form cocoons in the ground litter. Some larvae form cocoons on the host plant. Larvae pupate inside the cocoons. Adult sawflies (somewhat bee-like but not hairy) emerge in mid- to late-September, and mating and egg laying occurs soon after. There is one generation per year.

Control

Sawfly larvae control is not difficult. Inspect pine plantings weekly as new needles form but before larvae have grown enough to cause damage to the previous year's growth. Where populations are low, larvae can be removed or destroyed by handpicking. If this method is impractical because of extensive populations or because many plantings are infested, consider insecticides.

Products for European Pine Sawfly Control

Active Ingredient	Commercial Trade Names
acephate	Dendrix, OrtheneTTO
acetamiprid	TriStar
azadirchitin	Azatin Xl, Ornazin
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
dicrotophos	Inject-A-Cide B
diflubenzuron	Dimilin
horticultural oil	Horticultural Oil Insecticide, Saf-T-Side, Sunspray
insecticidal soap	Insecticidal Soap, M-Pede
imidacloprid	IMA-jet, Marathon, Merit, Pointer, Pointer II, Systemic Insecticide
lambda-cyhalothrin	Battle, Scimitar
malathion	Malathion
permethrin	Astro
thiomethoxam	Flagship

Mite

See General Pests: Mite, page 11.

Nantucket Pine Tip Moth

The larvae of this moth are small and orange. They bore into the terminal and lateral shoots of two-needle pines. They are the most serious pest of Scotch pine. Injury is most severe on trees less than 6 feet tall.

This insect overwinters as pupae in terminal buds. Moths emerge in early spring. They produce first-generation larvae, which feed, pupate and mature. Those moths produce second-generation larvae, which produces moths that produce the third and final generation in Kansas.

Control

Where only several plantings are involved, usually around homes, infested tips can be pruned and discarded or destroyed.

Homeowners may consider insecticidal sprays. Generally, apply chemical controls from late April to early May for the first generation, late June to early July for the second generation, and late July to early August for the third generation.

Emergence and peak flight activity vary from year to year in Kansas, depending on weather or temperature. Moths may appear as early as late March. Mid to late April is more normal.

Because Christmas tree plantations and nurseries are at risk, personnel should use pheromone traps to monitor Nantucket pine tip moth flights for maximum control.

Products for Nantucket Pine Tip Moth Control

Active Ingredient	Commercial Trade Names
acephate	AceCap 97, Dendrex, OrtheneTTO
azadirchitin	Azatin XL, Ornazin,
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
diflubenzuron	Dimilin
disulfoton	Di-Syston 15G
imidacloprid	IMA-jet, Imicide, Imicide Hp, Imisol, Merit, Pointer, Pointer II, Systemic Insecticide
lambda-cyhalothrin	Battle, Scimitar
oxydemeton methyl	Harpoon, Inject-A-Cide A
permethrin	Astro
spinosad	Conserve, Entrust, SpinTor
trichlorfon	Dylox

Pine Needle (Soft) Scale

Pine needle scales attack various conifers including pine, spruce, hemlock, fir and yew. They appear as white specks on the needles. Heavy infestations may weaken and kill branches or entire trees.

Pine needle scales overwinter as eggs beneath the female scale cover. Bright red first-generation crawlers appear shortly after needle growth begins, typically May to early June. Second-generation crawlers appear about a month later in mid to late July.

Control

See General Pests: Scale, page 12.

Apply dormant oil treatments to kill overwintering eggs, or apply insecticides when first- or second-generation crawlers are exposed.

Pine Tortoise (Soft) Scale

Pine tortoise scales attack various species of pine including Scots and Austrian. Female pine tortoise are circular, convex, brown to red-orange-brown and wrinkled. Heavily infested trees may look blackened because of sooty molds on the honeydew substrate. Feeding may cause yellow or short needles, branch mortality or tree death.

Pine tortoise scales overwinter as immature but mated females.

Females begin developing in the spring. Enlarged by mid-June, they deposit eggs from which crawlers emerge. Female crawlers remain on twigs and branches and male crawlers move to needles. Male crawlers mature in one month, and after a brief resting stage, tiny winged males search out and fertilize the immature females. There is one generation per year.

Control

See General Pests: Scale, page 12.

Dormant oil treatments can be used to kill immature overwintering female scale, or insecticidal applications could be applied when crawlers are active in June and early July.

Pine Wilt Nematode

Pine wilt nematodes are transmitted to various species of pine, including Scots, Austrian and white by any four species of longhorned, cerambycid beetles. Commonly called sawyers, these beetles generally attack stressed trees that are dying.

The nematodes enter the beetles' spiracular openings before they leave the tree hosts where they developed. As the beetles feed and deposit eggs, they introduce the nematodes to unaffected trees. The new generation of beetles become infected in the same manner by their egg-laying mother. There likely is a single sawyer generation per year responsible for pine wilt nematode transmission.

Control

Applying insecticides on the adult beetles is impractical. The more prudent route is to remove and burn infected trees (including the stumps) during the fall, winter or early spring. Do this before adult beetles emerge from diseased trees in May.

Yellow-bellied Sapsucker

Yellow-bellied sapsuckers are birds primarily associated with forests or woodlots. They peck a series of small, evenly spaced holes around the trunks of various species of pine. Sometimes the damage is excessive and can weaken or kill trees. Sapsuckers seem to have favorite trees that they return to and feed on. They use their specialized tongue to remove the sap, which oozes from the holes.

Control

There is no practical method of preventing yellow-bellied sapsuckers from damaging trees. It is illegal to shoot sapsuckers without proper authorization. They may be discouraged from making new holes by applying a band of sticky material, such as tree tanglefoot, just below the most recently made holes.

Privet

Borer

See Ash, page 13.

Thrips

Thrips are very small (1/16-inch) slender-bodied insects. Immature and adult thrips have rasping mouthparts they use to erode the epidermal cells of leaves. They then suck the liquids that are bleeding from damaged tissues. Foliage may appear flecked or silvery.

Control

Thrips control is difficult. Eggs are inserted in plant tissues. The pupal resting stage is underground, and nymphs and adults remain hidden behind leaf sheathes and under bud scales for much of the time. Insecticide lables often say to apply to exposed thrips.

Two to three successive treatments that are three to five days apart may be required to eliminate a thrips infestation.

Products for Thrips Control

Active Ingredient	Commercial Trade Names
abamectin	Avid
acephate	AceCap 97, Dendrex, OrtheneTTO
acetamiprid	TriStar
azadirchitin	Azatin XL, Ornazin
Beauveria bassiana	BotaniGard
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
disulfoton	Di-Syston 15G
fenpropathrin	Tame
horticultural oil	Hort Oil Insecticide, Saf-T-Side, Sunspray
imidacloprid	IMA-jet, Imicide, Imicide Hp, Imisol, Marathon, Merit, Pointer, Pointer II, Systemic Insecticide
insecticidal soap	Insecticidal Soap, M-Pede
lambda-cyhalothrin	Battle, Scimitar
malathion	Malathion
neem oil	Triact
spinosad	Conserve, Entrust, SpinTor

Pyracantha (Firethorn)

Bagworm

See General Pests: Bagworm, page 9.

Lace Bug

See General Pests: Lace Bug, page 10.

Mite

See General Pests: Mite, page 11.

Redbud

Leafhopper

See General Pests: Leafhopper, page 11.

Redbud Leafroller

Small, pale green to white larvae with brown heads create protective sites by folding leaves over themselves and webbing them together, or by webbing together adjacent leaves. Mature larvae are black and white striped. There are two generations each year.

Control

In late April, apply insecticide treatments as soon as larvae begin to feed, but before they are protected by webbed leaves.

Products for Redbug Leafroller Control

Active Ingredient	Commercial Trade Names
acephate	Dendrex, OrtheneTTO
azadirchitin	Azatin XL, Ornazin
Bacillus thuringiensis	Crymax, Deliver, DiPel, Javelin, Lepinox
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo,
deltamethrin	DeltaGard
lambda-cyhalothrin	Battle, Scimitar
permethrin	Astro
spinosad	Conserve, Entrust, SpinTor

Two-striped Spittlebug

See Holly, page 18.

Rose

Aphid

Several species of aphids infest garden and greenhouse roses. Most aphids are green, but may vary in color. Aphids may appear on buds, stems and foliage.

Control

See General Pests: Aphid, page 9.

False Unicorn Caterpillar

See Oak: Caterpillar, page 23.

Leafcutting Bee

Leafcutter bees cut circular holes in leaflets, but seldom cause serious injury.

Midge

Midge larvae (maggots) distort flowers and leaves. Maggots are white to orange and reach ½ inch in length. A generation can be completed in 20 to 30 days with many generations possible each year.

Control

Pick and destroy infested buds.

Roseslug

The larvae of several species of sawflies (which are not flies, but more closely related to bees and wasps) prefer to feed on rose foliage. The roseslug is the most common species.

Roseslugs overwinter as larvae underground beneath rose plantings. They pupate early in the year and adult sawflies emerge soon after. Females use their saw-like ovipositer to insert eggs into pockets between leaf surfaces. Larvae skeletonize upper leaf surfaces. Mature larvae have a yellow, translu-

cent appearance with a darker green interior, which is the digestive tract as viewed through their back. Larvae mature by late June and early July, then drop to the ground to prepare their overwintering cells. There is one generation per year.

Control

If needed, apply insecticides to kill larvae before plant skeletonization.

Products for Roseslug Control

Active Ingredient	Commercial Trade Names
acephate	OrtheneTTO
azadirchitin	Azatin XL, Ornazin
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
diflubenzuron	Dimilin
horticultural oil	Horticultural Oil Insecticide, Saf-T-Side, Sunspray
imidacloprid	IMA-jet, Marathon, Merit, Pointer, Pointer II, Systemic Insecticide
insecticidal soap	Insecticidal Soap, M-Pede
lambda-cyhalothrin	Battle, Scimitar
malathion	Malathion
thiomethoxam	Flagship

Mite

See General Pests: Mite, page 11.

Spirea

Aphid

See General Pests: Aphid, page 9.

Obliquebanded Leafroller

Obliquebanded leafrollers overwinter as second- and third-instar larvae in hibernaculums beneath old bud scales or rough areas between twig crotches. In late spring, larvae complete development and pupate.

Moths emerge and quickly deposit eggs in late spring or early summer. Newly emerged first-generation larvae suspend themselves on silk threads and are dispersed by the wind. Larvae skeletonize the undersides of leaves and roll or fold leaves together with silken threads. Larvae complete their development and pupate. Newly emerged first-generation moths deposit eggs that begin a second-generation of larvae that overwinter.

Control

If needed, focus control on first-generation larvae. Insecticides must be applied while larvae are exposed and before they are protected in leaves.

Products for Obliquebanded Leafroller Control

Active Ingredient	Commercial Trade Name
acephate	OrtheneTTO
azadirchitin	Azatin XL, Ornazin
Bacillus thuringiensis	Crymax, Deliver, DiPel, Javelin, Lepinox
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
fenpropathrin	Tame
lambda-cyhalothrin	Battle, Scimitar
permethrin	Astro

Spruce

Spruce Needle Miner

Spruce needle miners overwinter as partially matured larvae in nests constructed the previous year of needles and frass held together with silk. In early spring, larvae resume feeding and re-enter the nest at maturity to form silken cocoons and pupate. Moths emerge from mid May to mid June and deposit eggs on needles. Small larvae enter needles at their base and mine upwards. New nests are created when hollowed needles are cut off and held together by silken threads. Nests are enlarged until the first frost when larvae become inactive and prepare for overwintering.

Control

If needed, time control efforts to kill larvae immediately after egg hatch in late May through June, but before they are protected in needles or nests.

Products for Spruce Needle Miner Control

Active Ingredient	Commercial Trade Names
acephate	AceCap 97, Dendrex, OrtheneTTO
azadirchitin	Azatin XL, Ornazin
Bacillus thuringiensis	Crymax, Deliver, DiPel, Javelin, Lepinox
bifenthrin	BifenthrinPro, Onyx, Talstar
carbaryl	Sevin
cyfluthrin	Decathlon, Tempo
deltamethrin	DeltaGard
diflubenzuron	Dimilin
fenpropathrin	Tame
lambda-cyhalothrin	Battle, Scimitar
permethrin	Astro
spinosad	Conserve, Entrust, SpinTor

Mite

See General Pests: Mite, page 11.

Sweetgum

Bagworm

See General Pests: Bagworm, page 9.

Eastern Tent Caterpillar

See Flowering Fruit Trees, page 17.

Fall Webworm

See General Pests: Webworm, page 12.

Mite

See General Pests: Mite, page 11.

Sycamore and Londonplane

Bagworm

See General Pests: Bagworm, page 9.

Lace Bug

See General Pests: Lace Bug, page 10.

Leafhopper

See General Pests: Leafhopper, page 11.

Tamarisk

Apple Twig Borer

See Golden Rain Tree, page 18.

Yew (Taxus)

Black Vine Weevil

Black vine weevils are established in several Kansas counties including Johnson, Sedgwick, Shawnee and Wyandotte. They may be transported into other counties on contaminated nursery stock from out-of-state sources. Black vine weevils feed on numerous plant species. Yew is the most commonly infested plant in Kansas. Adult black vine weevils are blackish-brown snout beetles that are up to ½ inch in length. Some may have dots of yellowish hairs.

Most black vine weevils overwinter as grublike larvae in the soil around the roots of host plants. A few adults may overwinter. Larvae pupate in the spring and adults emerge soon after. Overwintered weevils may deposit some eggs, but most are deposited in the soil and leaf litter by new adults. All black vine weevils are females that reproduce parthenogenically. Eggs hatch in two to three weeks. Small larvae feed on rootlets but move to larger roots as they molt into larger growth stages. There is one generation per year.

Plants with severely damaged roots may turn yellow, become stunted and die. Plants with foliar damage look ragged due to the leaf-notching feeding of adult weevils.

Control

Black vine weevil infestations do not spread rapidly because adult weevils cannot fly and larvae are confined to their feeding areas. Direct treatments against adults when they appear in late May or early June and at three-week intervals until no adults are on plants, which is usually mid to late August. Treatments consist of 6-inch trunk bands of sticky material to intercept foraging weevils as they climb trees, or insecticidal spray treatments in the late afternoon or early evening before night-feeding. Soil-drench treatments can be used against weevil larvae.

Products for Black Vine Weevil Control

Active Ingredient	Commercial Trade Names
acephate	Dendrex, OrtheneTTO
azadirchitin	Azatin XL, Ornazin
bifenthrin	BifenthrinPro, Onyx, Talstar
cyfluthrin	Decathlon, Tempo
endosulfan	Endosulfan, Phaser, Thiodan
fenpropathin	Tame
imidacloprid	IMA-jet, Imicide, Imicide Hp, Pointer, Pointer II
lambda-cyhalothrin	Battle, Scimitar
permethrin	Astro

Fletcher (Soft) Scale

Fletcher scale produce one generation per year. They overwinter as small, slightly convex, amber or reddish-brown, second-instar nymphs on branches or fronds of yew. They rapidly mature in the spring and produce large amounts of honeydew. Mature females, which are round, 3 millimeters long and amber to reddish-brown, produce eggs. Crawlers emerge from eggs in late June and July, move a short distance, then feed. First-instar nymphs molt to the overwintering stage.

Control

See General Pests: Scale, page 12.

Dormant oil can be applied to overwintering scales, or treatments can be applied against crawlers.

Tulip Tree

Aphid

See General Pests: Aphid, page 9.

Oystershell Scale

See Elm, page 15.

San Jose Scale

See Cotoneaster, page 15.

Walnut

Fall Webworm

See General Pests: Webworm, page 12.

Scurfy Scale

See Elm, page 15.

Walnut Caterpillar

Walnut caterpillars overwinter as pupae underground beneath host trees. In late spring, moths emerge and deposit egg masses on lower leaf surfaces. By the end of June, newly emerged and gregarious larvae skeletonize leaves. Larger, hairy, brick-red larvae consume more leaf tissue, and nearly matured gray-colored larvae devour entire leaves, including petioles. Mature larvae, which are 2 inches long, drop to the ground where they enter the soil to pupate. A second generation occurs soon after, which produces overwintering pupae.

Control

Remove leaves with egg masses. This may be impractical where large trees are involved or there are too many infested leaves. Bands of tree tanglefoot could be used to catch larvae as they migrate to main branches or the tree trunk to molt. Chemical controls may be the most practical.

Products for Walnut Caterpillar Control

Active Ingredient	Commercial Trade Names
azadirchitin	Azatin XL, Ornazin
bifenthrin	Onyx, Talstar, BifenthrinPro
carbaryl	Sevin
cyfluthrin	Tempo Ultra WSP
deltamethrin	DeltaGard T&O
lambda-cyhalothrin	Scimitar CS
permethrin	Astro

Willow

Giant Willow Aphid

Giant willow aphids are long-legged aphids (up to ¼ inch in length) with a gray to black body. They also have many black spots and three prominent bumps (two cornicles and a dorsal tubercle) on their back.

Control

See General Pests: Aphid, page 9.

Giant willow aphids are not considered a threat. If control is desired, use water to dislodge them from trees.

Leaf Beetle

Several leaf beetles are associated with willows. Adults feed on leaves and tender bark, and larvae feed on the undersides of leaves. There may be two to three generations per year.

Products for Leaf Beetle Control

Active Ingredient	Commercial Trade Names
azadirchitin	Azatin XL, Ornazin
bifenthrin	Onyx, Talstar, BifenthrinPro
carbaryl	Sevin
horticultural oil	Horticultural Oil Insecticide, Saf-T-Side
imidacloprid	IMA-jet, Merit, Systemic Insecticide
spinosad	Conserve, Entrust, SpinTor

Chemical Information

Active Ingredient	Products	Manufacturer
abamectin	Abacide	J. J. Mauget Company
	Abasol	J. J. Mauget Company
	Avid	Syngenta
	Greyhound Insecticide	ArborSystems
	Vivid II	Florida Silvics. Inc.
acephate	Acecap 97	Creative Sales, Inc.
	Dendrex	Tree Tech Microinjection Systems
	OrtheneTTO	Valent
azadirachtin	Azatin XL	Olympic Horticultural Products
	Azatin XL Plus	CERTIS
	Neemix	CERTIS
	Ornazin	AMVAC, SePRO
Bacillus thuringiensis	Crymax, Deliver, Javelin, Lepinox	CERTIS
	DiPel Pro	Valent
Beauveria bassiana	BotaniGard	Mycotech
bifenazate	Floramite	Crompton Uniroyal Chemical
bifenthrin	BifenthrinPro	Micro Flo Company LLC
	Onyx	FMC
	TalstarOne	FMC
carbaryl	Sevin	Bayer Environmental Science
chlorfanapyr	Pylon	Olympic Horticultural Products
cyfluthrin	Decathlon	Olympic Horticultural Products
	Tempo	Bayer Environmental Science
deltamethrin	DeltaGard	Bayer Environmental Science
dicrotophos	Inject-A-Cide B	J. J. Mauget Company
diflubenzuron	Dimilin	Crompton Uniroyal Chemical
disulfoton	Di-Syston	Bayer Corporation
endosulfan	Endosulfan	Micro Flo Company LLC
	Phaser	Bayer Environmental Science
esfenvalerate	Asana	E. I. Du Pont de Nemours and Company
etoxazole	TetraSan	Valent
fenpropathrin	Tame	Valent
hexythiazox	Hexagon	Gowan Company
horticultural oil	Horticultural Oil Insecticide	Lesco
	Saf-T-Side	Brandt Consolidated
	Sunspray Ultra-Fine	Sun Company, Inc.
horticultural soap	Insecticidal Soap	Olympic Horticultural Soap
	M-Pede	Mycogen Corporation
imidacloprid	IMA-jet	Arborjet, Inc.
	Imicide	J. J. Mauget Company
	Imicide Hp	J. J. Mauget Company
	Imisol	J. J. Mauget Company
	Marathon	Olympic Horticultural Products
	Merit	Bayer Corporation
	Pointer II Insecticide	Arbor Systems
	Pointer Insecticide	Arbor Systems
	Systemic Insecticide	Lesco
lambda-cyhalothrin	Battle	Lesco

Active Ingredient	Products	Manufacturer
	Scimitar	Syngenta
malathion	Malathion	Gowan Company, Micro Flo Company LLC
neem oil	Triact	Olympic Horticultural Products
	Trilogy	CERTIS
oxydemeton-methyl	Harpoon	Tree Tech Microinjection Systems
	Inject-A-Cide	J. J. Mauget Company
permethrin	Astro	FMC
pymetrozine	Endeavor	Syngenta
pyridaben	Sanmite	BASF Corporation
pyriproxyfen	Distance	Valent
spinosad	Entrust, Conserve, SpinTor	Dow AgroSciences
thiomethoxam	Flagship	Syngenta
trichlorfon	Dylox	Bayer Corporation

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