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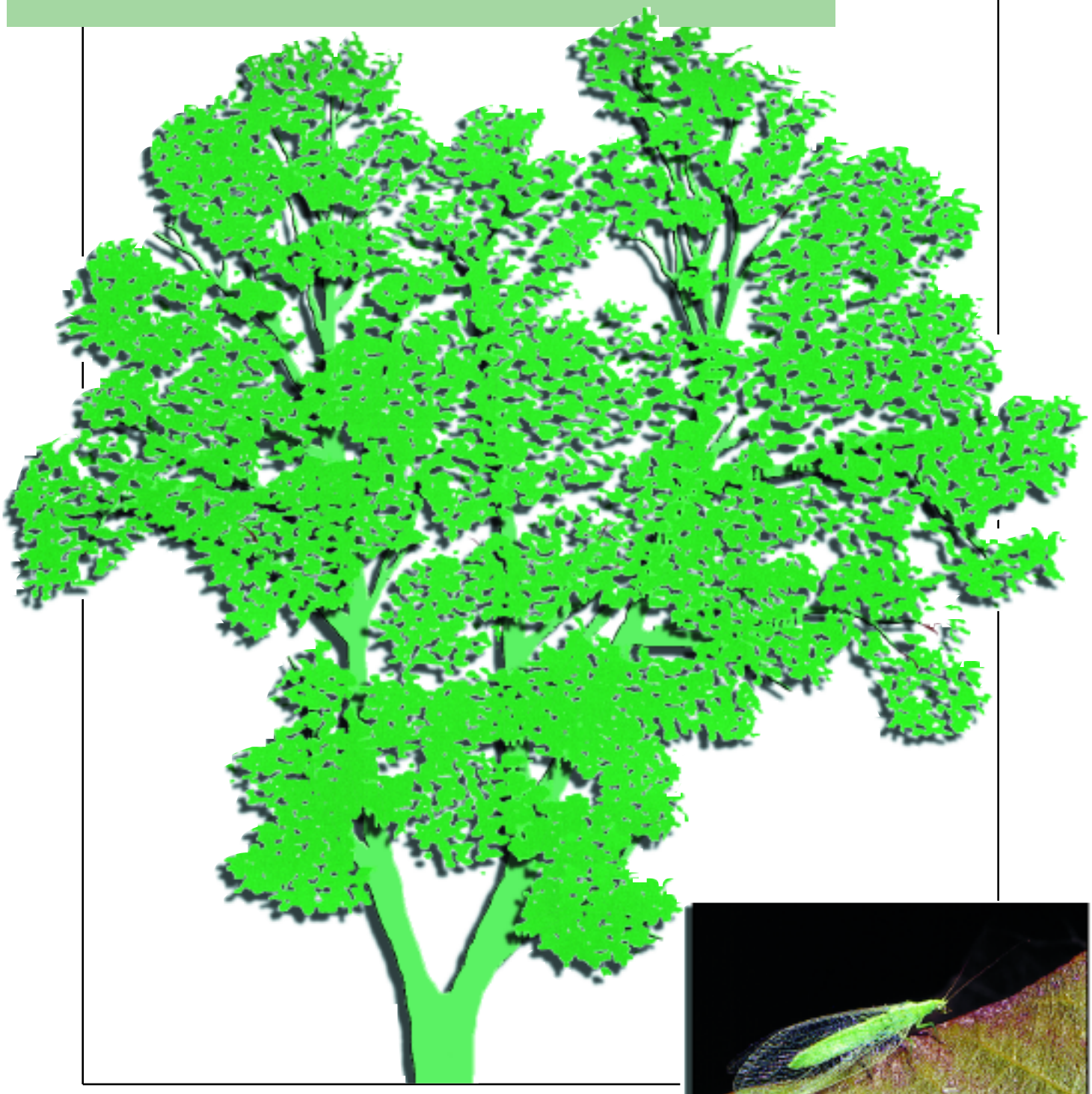
Managing Insect and Mite Pests of Commercial Pecans in Texas



Green lacewing adult

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Managing Insect and Mite Pests of Commercial Pecans in Texas

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The pecan is an important horticultural crop in Texas. The Texas Agricultural Statistics Service reported 2.265 million improved pecan trees growing on 67,500 acres in Texas in 1992. Texas also has about 700,000 acres of native pecans. Only about 10 percent of this acreage is managed.

Many insects feed on the leaves, nuts, branches and buds of the pecan tree, reducing the tree's productive potential. Some insects lower production directly by feeding on the nuts. Other pests cause indirect damage, as their feeding depletes the tree's reserves so that nut production is reduced the following year.

This guide discusses the management of insect and mite pests of commercial pecans. Extension publication E-145, *Homeowner's Fruit and Nut Spray Guide* (available at http://tcebookstore.org) describes how to control pests attacking pecans in home landscapes and in other noncommercial orchards. Information on identifying pest and beneficial insects of pecans is available in publication B-6055, *Field Guide to the Insects and Mites Associated with Pecan* (http://tcebookstore.org).

Pest management principles

For many years, growers minimized pest damage to pecans by spraying insecticides on a schedule based on crop development. This effective, relatively inexpensive approach fit well with a preventive fungicide and zinc spray program.

However, applying insecticides according to a schedule has had to be reevaluated because fewer effective insecticides are available due to high re-registration costs, lack of new insecticides, poor insecticide control, secondary pest outbreaks and renewed concerns about the effects of insecticides on humans and the environment. Routinely using insecticides leads to pesticide resistance, destroys natural enemies of pecan pests and increases production costs. "Pest management" is a philosophy used to design pest-control programs. It uses the most compatible and ecologically sound combination of pest suppression techniques available to provide long-term production profits. These management techniques include:

- Cultural control, such as destroying crop residues where some pests overwinter, and selecting varieties with pest resistance; and
- Biological control, using natural enemies to suppress pest populations.

Insecticides are important in managing pecan pests, but they should be used wisely and only when needed to prevent economic loss. Base your decision to apply an insecticide on established treatment thresholds of insect density or damage as determined by frequent orchard surveys. Do not add insecticides to fungicide or zinc sprays unless it has been determined that an insect pest has or will exceed a treatment threshold. Choose insecticides and rates carefully according to effectiveness, hazard to the applicator and impact on beneficial insects.

Studies have shown that insecticide applications are sometimes followed by outbreaks of aphids, mites or leaf miners. This may result from the destruction of natural enemies that were holding these secondary pests in check. Insecticides also may have physiological effects on the tree or pests that favor pest survival or increased reproduction.

Use of pyrethroid insecticides (see Table 12), carbaryl (Sevin®), or phosmet (Imidan®) may be followed by outbreaks of aphids or spider mites. If you use pyrethroid insecticides, limit them to control of late-season pests only. Pyrethroids should not be used in orchards with a history of mite or aphid outbreaks following their use. Frequent use of pesticides may increase aphid and mite infestations.

Biological control

Adverse weather, inadequate food supply or natural enemies may hold insect and mite populations below damaging levels. It is important to recognize the impact of these natural control factors and, where possible, encourage their action.

Biological control is the use of living organisms (parasites, predators and diseases) to reduce pest numbers. Important natural enemies of pecan pests include lacewings, spiders, lady beetles, assassin bugs, predatory mites and many kinds of tiny wasps that parasitize insect pests.

Biological control includes conserving, augmenting and importing natural enemies. Conserve existing populations of natural enemies in the orchard by minimizing insecticide applications and by using insecticides least toxic to the natural enemy.

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As examples, Confirm®, Intrepid®, Dimilin® and B.t. formulations are less toxic to beneficial insects and other non-target species than are carbamate, pyrethroid and organophosphate insecticides. Ground covers such as legumes can provide food and shelter for natural enemies. Unsprayed native pecans serve as reservoirs of natural enemies that can move into adjacent sprayed orchards.

Augmentation involves periodically buying and releasing natural enemies. Research to date has not shown releases of convergent lady beetles, lacewings or Trichogramma to provide significant pest control in pecans. Natural enemies can also be imported from other countries, then colonized and released. Once established, these natural enemies maintain themselves without further releases.

Insecticide application

Thorough tree coverage is essential for maximum pest control. Low-volume sprayers (mist blowers, air blast sprayers, speed sprayers, etc.) use forced air to deliver a concentrated spray mix and require proportionately less water than high-volume hydraulic sprayers. Concentrated low-volume spraying saves water and time. The amount of pesticide applied per acre must be consistent with the label and is the same regardless of how much water is applied.

To calibrate a sprayer, fill the spray tank with water only and spray a known acreage of trees (i.e., 5 acres). Measure the amount of water remaining in the tank to determine the number gallons of water applied. To determine the number of gallons applied per acre, divide the amount of water applied by the number of acres sprayed.

For example, if 300 gallons were used to treat 5 acres, then the sprayer is delivering 60 gallons per acre. In this example, a 500-gallon sprayer would treat 8.3 acres.

Then add the amount of formulated insecticide needed to treat the number of acres the spray tank treats. For example: If the label rate was 1 pint per acre, add 8.3 pints of pesticide to 500 gallons of water.

Recalibrate sprayers for different tree size and spacing, as these factors change the volume of spray required for coverage. **Carefully follow the sprayer manufacturer's directions for mixing spray materials and for calibration.**

Chemical use precautions

Select suggested materials for the most effective, safe and economical control. All suggested materials are poisonous, but proper handling reduces the hazards associated with their use. Comply with the manufacturer's label directions for handling all toxic chemicals.

Residues: The Environmental Protection Agency (EPA) has established pesticide residue tolerances on pecans. These regulations establish the amount of a specific chemical that can be present in or on pecans at harvest. Always consult the product label for specific restrictions, and be sure the pesticide is registered to use on pecans and is used only in accordance with specific application instructions.

Caution: All pesticides are potentially hazardous to humans, animals and nontarget crops. Use with caution. Store all pesticides out of reach of children, irresponsible people, livestock and household pets. Properly dispose of leftover spray materials and containers.

Pesticide drift: Avoid drift to nearby land and take precautions against pond and stream contamination.

Poisoning symptoms: Some symptoms of pesticide poisoning are headaches, nausea, cramps, diarrhea, weakness, blurred vision and muscular twitching. If you notice any of these symptoms during or after handling any pesticide, consult a physician immediately.

Policy statement on pest management suggestions

The information and suggestions included in this publication reflect the opinions of Extension entomologists based on field tests and use experience. Our management suggestions are a product of research and are believed to be reliable. However, it is impossible to eliminate all risk. Unforeseen or unexpected conditions or circumstances may result in less than satisfactory results even when these suggestions are used. The Texas Cooperative Extension assumes no responsibility for risks. Such risks shall be assumed by the user of this publication.

Suggested pesticides must be registered and labeled for use by the Environmental Protection Agency and the Texas Department of Agriculture. The status of pesticide label clearances is subject to change and may have changed since this publication was printed. County Extension agents and appropriate specialists are advised of changes as they occur.

The USERS are always responsible for the effects of pesticide residues on their livestock and crops, as well as for problems that could arise from drift or movement of the pesticide from their property to that of others. Always read and follow carefully the instructions on the container label.

Pecan pests

PHYLLOXERA

Damage: Phylloxera are tiny, soft-bodied insects closely related to aphids. These insects cause conspicuous swellings, called galls, to form on leaves, twigs and nuts. The two most important species attacking pecans are pecan leaf phylloxera and pecan phylloxera.

Pecan leaf phylloxera form galls on leaves only; extensive infestations may cause some defoliation. The pecan phylloxera is the most damaging species because it attacks shoots and nuts. Extensive infestations of this species can reduce yield and the tree's vitality and subsequent production.

Table 1. Suggested insecticides to control phylloxera.

Insecticide	Concentrate per 100 gals.	Concentrate per acre	Remarks
Dormant oil	4 gal		Use in dormant season only.
Chlorpyrifos Lorsban® 4E*		2-4 pt	Do not graze livestock in treated orchards.
Endosulfan Phaser® 3EC Thiodan® 3 EC Thiodan® 50 WSB	 0.66-1 qt 0.66-1 qt 1-1.5 lb		Do not graze livestock in treated orchards.
Imidacloprid Provado® 1.6F		3.5-7 oz	Do not graze livestock in treated orchards.
Malathion Malathion® 57% EC	 1-2 pt		Grazing permitted.

*Lorsban® 4E. Make 2 applications at 7- to 10-day intervals using a minimum of 1 pint per acre starting at bud swell.

Biology: Phylloxera survive the winter as eggs in bark crevices. In spring, tiny nymphs emerge during budbreak and feed on new growth. Nymphs secrete a substance while feeding that stimulates plant tissue to develop abnormally, creating galls. The young phylloxera are soon completely enclosed in the galls, which range from 1/10 to 1 inch in diameter. Phylloxera feed inside the gall and complete two generations. Galls then crack open and winged, adult phylloxera emerge to lay eggs.

The more destructive pecan phylloxera form no additional galls. Females hide in protected places on the bark and die, their eggs remaining inside the mothers' protective bodies throughout the winter. Some adult females of the pecan leaf phylloxera that emerge from spring galls may also overwinter. However, other leaf phylloxera females lay eggs, and the hatching nymphs form a second or third generation of galls during one season if new growth is available.

Control: Native trees and improved varieties vary in susceptibility to phylloxera. Because phylloxera cannot fly far, infestations move slowly from tree to tree. For these reasons, you can often control them by treating only those trees with phylloxera galls. Survey the orchard in May and mark trees with galls to treat the next spring.

Insecticides for phylloxera must be applied after egg hatch in the spring but before nymphs are protected inside galls. Treat after bud break when growth is 1 to 2 inches long. A dormant oil spray applied to tree trunks and limbs in the dormant season also reduces phylloxera infestations. Thorough coverage is essential to ensure that eggs are killed.

PECAN NUT CASEBEARER

Damage: Found in all pecan-growing areas of Texas, the pecan nut casebearer can cause serious crop loss almost every year if left uncontrolled. Casebearer larvae or caterpillars feed inside pecan nuts. First-generation larvae feed inside small nutlets from April to June. This generation is most damaging, as a single larva often destroys all the nutlets in a cluster. Larvae of later generations require just one or two nuts to complete their feeding, as pecans are larger at that time.

Biology: The adult casebearer is a gray moth about 1/3 inch long with a ridge of dark scales running across the forewings. The moths are active only at night when they mate and lay eggs on pecan nuts. Most eggs are found on the nutlet tips. Each female lays 50 to 150 eggs during her 5- to 8-day life. The greenish-white to white eggs change to pink or red before hatch.

Casebearer eggs hatch in 4 to 5 days; young larvae crawl to nearby buds below the nuts to begin feeding. The white empty egg shell remains on the nut. After feeding for a day or two on a bud below the nut cluster, the tiny larvae enter the pecan nut, often tunneling in at the base. Silk and black frass (excrement) are often visible on the outsides of infested nuts. Larvae feed inside pecan nuts for 3 to 4 weeks, depending on the temperature. They are olive gray and reach a length of about inch. Full-grown larvae pupate in the pecan nut; adult moths emerge about 9 to 14 days later.

The pecan nut casebearer completes several generations each year. Adults of the overwintering generation emerge in April and May and lay eggs on pecan nutlets soon after pollination. First-generation larvae mature to moths, which lay second-generation eggs in grooves on the tips or bases of nuts, or on buds. Second-generation larvae attack the nuts in midsummer about 42 days after nut entry by first-generation larvae.

Third-generation eggs are deposited on nuts from late July to early September. These larvae feed only in the shucks if the pecan shells have hardened to prevent penetration into the kernel. Many third- and later-generation larvae do not feed, but crawl to the base of a dormant bud and build tough, silken cocoons where they spend the winter.

Table 2. Suggested insecticides to control pecan nut casebearer.

Insecticides	Concentrate per 100 gal	Concentrate per acre	Remarks
Bacillus thuringiensis See Table 12 for product names		See product label	Livestock grazing permitted.
Carbaryl			Livestock grazing permitted.
Sevin® 80S	1.25-3 lb		
Sevin® 50W	2-5 lb		
Sevin® 4F	1-2.5 qt		
Sevin® XLR	1-2.5 qt		
Chlorpyrifos			Do not graze livestock.
Lorsban® 4E		1.5-4 pt	
Malathion			Livestock grazing permitted.
Malathion® 57% EC	1-2 pt		
Methoxyfenozide			Livestock grazing permitted.
Intrepid® 2F		4-8 oz	
Phosmet			Do not graze livestock.
Imidan® 70 W	2-3⅛ lbs		
Spinosad			Livestock grazing permitted.
Entrust*	0.3-0.75 oz	1.25-3 oz	
SpinTor® 2SC		4-10 oz	
Tebufenizide			Do not graze livestock in treated orchard.
Confirm® 2F		8-16 oz	

Note: Survey orchard for increases in aphid or mite infestations after using carbaryl.
*The spinosad formulation in Entrust® is classified as an organic substance by the USDA National Organic Standards Board.

In spring, these immature larvae leave the cocoon, called a hibernaculum. They feed on buds and tunnel in developing shoots until they are full-grown. Larvae then pupate in shoot tunnels or in bark crevices. Casebearer moths soon emerge to lay first-generation eggs on nutlets.

Control: Time insecticide applications accurately to control newly hatched casebearer larvae before they enter the nuts. Once inside nuts, larvae are protected from insecticides.

To determine whether treatment is needed and when to apply insecticide, examine nuts carefully in spring for casebearer eggs. Apply insecticides within 2 to 3 days after the first eggs hatch. At this time, the first larvae begin entering nuts. Infested clusters can be flagged to monitor egg hatch.

Delaying treatment until the first nut entry occurs maximizes the insecticide's residual activity. However, consider the time required to treat the orchard and possible weather delays so that insecticide is applied before significant nut entry occurs.

Often a single carefully timed insecticide application provides adequate control for first-generation casebearers. A second insecticide application may be required if unhatched eggs are found 7 to 10 days after the first application.

Peak egg lay often occurs during a 2-week period in late April to early May in the southern and coastal areas, or late May and early June in north Texas. Spring temperatures influence casebearer development; cool, rainy weather can delay moth activity and egg laying. Thus, the egg-laying period can vary as much as 2 weeks from year to year, depending on spring weather.

There are several ways to determine when to look for first-generation casebearer eggs. One approach is to predict egg-laying activity and nut entry based on spring temperatures and accumulated heat units. To calculate the number of heat units accumulated per day, add each day's high and low temperatures (F degrees), divide by 2 to obtain the average and subtract 38. If the average temperature is less than 38, record a 0 (zero) for the number of heat units accumulated for that day. Begin accumulating heat units 10 days before 50 percent budbreak occurs.

The first significant nut entry is expected to occur once 1,831 heat units have accumulated. Begin scouting for eggs at least a week before this anticipated date, as local weather conditions near the spray date can influence egg laying. Scout the orchard for eggs and nut entry to determine if infestations justify treatment and to confirm the predicted spray date. Monitoring moth flights with pheromone traps, as described below, is also effective in determining when to begin scouting the orchard for eggs and nut entry.

Inspect nuts to determine if casebearer infestations are large enough to justify treatment. A sampling plan has been developed to determine if infestations warrant an insecticide application. The plan is based on the assumption that treatment is justified when infestations are large enough to destroy 5 percent or more of the nuts expected to be harvested. The sampling plan, based on research in Texas, is as follows:

Begin searching for eggs 7 to 10 days before the predicted date of first nut entry (l,831 heat units) or 7 to 10 days after the first moths are captured in pheromone traps. Tag egg-infested clusters to monitor egg hatch.

About 2 to 3 days before the date of first significant nut entry (or when 1,730 to 1,760 heat units have accumulated), examine 10 nut clusters per tree on 31 trees. A cluster is considered infested if it has a casebearer egg or nut entry. If, on this date, two or more infested clusters are found before 310 nut clusters are sampled, the casebearer population is large enough to damage more than 5 percent of the nuts expected to be harvested. Apply an insecticide within the next few days.

If you find fewer than two infested clusters, sample again 2 to 3 days later (when heat units total 1,831). If you find two or more infested clusters before 310 clusters are examined, apply an insecticide treatment without delay.

If no treatment is indicated, sample again 2 days later. A third sample is especially important if cold, rainy nights have occurred, which can delay egg-laying. If you find fewer than three infested clusters, no treatment is warranted. Infestations of three or more infested clusters at this time indicate some damage may occur. Consider the effect of rainy weather on egg laying and crop load in making treatment decisions at this time.

Monitoring with pheromone traps

Pheromone-baited traps can help determine when to begin scouting for first-generation casebearer eggs. The casebearer pheromone is the unique chemical that female moths release to attract male moths. The pheromone is synthesized and placed inside a trap, where it attracts male casebearer moths. By periodically recording trap catch, you can detect and monitor the emergence of male casebearer. This information can be used to anticipate when eggs will be laid and when egg hatch and nut entry will occur.

Pheromone lures and traps can be bought from several distributors of pecan supplies. The following guidelines describe how to use pheromone traps and scouting for eggs and nut entry to determine the need to apply an insecticide to prevent economic damage from pecan nut casebearer:

- **Pheromone lures and traps are commonly sold together as kits.**

  There are many different trap designs, but kits sold for pecan nut casebearer use the Pherocon 3 Delta trap, the Pherocon 1C wing trap, or the Intercept-A trap. All three trap designs are effective in determining the pattern of moth activity. The Intercept-A trap has a removable liner, which makes it easier to use than the Pherocon 1C or similar wing-style trap. Pheromone lures should be kept frozen until used. Lures should be replaced every 6 to 8 weeks, removed from the orchard and discarded.

- **Three pheromone traps are enough to determine the pattern of moth activity in a given location.**

  As a general guide pending further research, consider three to five traps for orchards less than 50 acres in size and five or more traps for orchards larger than 50 acres. Consider additional trapping locations where orchard conditions vary, such as between river bottom sites and upland sites.

- **Separate traps at a location by at least several trees.**

  Place traps near the terminal of a nut-bearing limb at a convenient height. Traps placed in the lower canopy accurately reflect moth activity. Although data indicate that traps placed higher in the canopy capture more moths, the activity pattern is the same, so the extra effort to place traps high in the canopy is not rewarded.

- **Place pheromone-baited traps in the orchard four weeks before the expected spray date.**

  Traps must be in the orchard before the moth flight begins, to ensure that the date the first moth is captured represents the beginning of moth activity. In south Texas, traps should be in the orchard by April 1; in central Texas by April 15; and in north Texas, May 1.

- **Monitor traps at least every 3 to 4 days and three times a week if possible.**

  Frequent monitoring is necessary to detect the first flush of moth activity. Each time you check the trap, count and record the number of captured casebearers. Also record the trap location and sample date. Remove from the trap all moths, other insects and any leaves or twigs. Do not confuse pecan nut casebearer moths with pecan bud moths or other imposters (see photograph), which are sometimes captured in pheromone traps.

  Replace traps or trap liners when the sticky material becomes covered with moth scales, dust or other debris. To avoid contaminating the lure, use forceps or the tip of a pocketknife blade to transfer the pheromone lure to the new trap or liner.

- **Begin scouting the orchard for casebearer eggs 7 to 10 days after the first pecan nut casebearer moths are captured in the pheromone traps.**

  The first casebearer male moths are usually captured two weeks before the best time to apply an insecticide. During this time, trap catches usually increase and then begin to decline over a 2- to 3-week period. You may be tempted to apply an insecticide during peak moth capture, but the application would be a week or more before a properly timed treatment, if needed, should be applied.

  Research indicates that numbers of captured moths accurately reflect patterns of moth activity. *Trap catches cannot be used to predict the threat of damage by casebearer larvae or the need to apply an insecti-*

cide. For this reason, you need to scout nutlets closely for eggs and nut entry and use the sampling plan described above to determine if an infestation is damaging enough to justify applying insecticide.

- **Pheromone traps can also be used to monitor flights of later casebearer generations.**

  A second moth flight can be detected about 6 weeks after the spring flight. It follows a similar pattern of increase and decline during a 2- to 3-week flight. Nut entry, and thus the best time to apply insecticide for second summer-generation casebearer, *if needed*, occurs about 12 to 16 days after the second moth flight begins. As with the first summer generation, base your decision to treat the orchard on the presence of eggs and larvae, not the number of moths captured.

  The pheromone trap is attractive and will capture casebearer moths even when an economic infestation of larvae does not develop. Pheromone traps continue to capture moths of the third and fourth generations throughout the summer into November. However, these later generations rarely threaten nut production.

Bacillus thuringiensis insecticides

Several insecticides including Javelin® WG, Dipel® ES and others contain the active ingredient *Bacillus thuringiensis* and are labeled to control pecan nut casebearer in pecan. The active ingredient in these insecticides is the toxin of the bacteria *Bacillus thuringiensis*, or Bt, which kills only caterpillars of moths and butterflies.

Javelin® WG and Dipel® ES have low toxicity to humans, wildlife and beneficial insects; treated orchards can be grazed. Sunlight degrades these microbial insecticides, so their period of residual control is shorter than that of some other insecticides. Also unlike some insecticides, B.t.s do not kill casebearer moths. Accurate treatment timing to target hatching larvae and thorough spray coverage are especially critical for good control with B.t. insecticides.

Information is limited on the effectiveness of these B.t. insecticides for casebearer control in commercial production. Preliminary studies indicate good control of light to moderate infestations.

WALNUT CATERPILLAR

Walnut caterpillars feed together in large numbers on pecan leaves, but do not build silken webs like fall webworms. Larvae eat leaves, leaving only the mid-ribs and leaf stems. Large infestations can defoliate entire trees. This insect is found throughout Texas east of the Pecos River. Although economic infestations are uncommon, severe and widespread outbreaks of walnut caterpillar have occasionally occurred in Texas.

Biology: Walnut caterpillar moths emerge in spring, depositing eggs in masses of 500 or more on the undersides of leaves. The egg masses are round, about the size of a half-dollar and are not covered with hairs or scales. Eggs hatch in about 10 days; larvae feed for about 25 days. Young larvae are reddish-brown with yellow lines running the length of the body. Full-grown larvae are about 2 inches long, black with grayish lines and are covered with long, soft, gray hairs.

Larvae congregate in large masses on the trunk and scaffold branches to shed their skins before crawling back to complete feeding on leaves. These final-stage larvae consume most of the foliage, and defoliation can occur very quickly. Mature larvae crawl to the soil to pupate. A generation is completed in about 6 to 8 weeks. There are two to three generations each year.

Table 3. Suggested insecticides to control walnut caterpillars.

Insecticides	Concentrate per 100 gals	Concentrate per acre	Remarks
Bacillus thuringiensis			Livestock grazing permitted.
See Table 12 for product names		See product label	
Carbaryl			Livestock grazing permitted.
Sevin® 80S	1.25-3 lb		
Sevin® 50W	2-5 lb		
Sevin® 4F	1-2.5 qt		
Sevin® XLR	1-2.5 qt		
Malathion			Livestock grazing permitted.
Malathion® 57% EC	1-2 pt		
Methoxyfenozide			Livestock grazing permitted.
Intrepid® 2F		4-8 oz	
Spinosad			Livestock grazing permitted.
Entrust	0.3-0.75 oz	1.25-3 oz	
SpinTor® 2SC		4-10 oz	
Tebufinizide			Do not graze livestock.
Confirm® 2F		8-16 oz	

Control: Because walnut caterpillars do not build tents or webs, infestations often go unnoticed until leaf damage becomes obvious. To detect infestations early, look for egg masses or leaf feeding. Egg masses can be detected at night by shining a flashlight on the undersides of leaves and looking for white spots about the size of a half dollar.

Caterpillars cause 80 percent of their damage during the last 3 to 4 days of feeding. Smaller larvae are easier to kill with insecticides than larger larvae; control of this stage prevents serious damage. Insecticide treatment may be necessary if large infestations threaten to defoliate trees.

FALL WEBWORM

Fall webworm caterpillars build large silken webs in pecan trees. A hundred or more caterpillars may be found inside the web, where they feed on pecan leaves. Large infestations may cover the tree with webs, causing severe defoliation.

Biology: Mature larvae are about 1 inch long, pale yellow or green, and covered with tufts of long, white hairs. The adult is a white moth with dark spots on the wings. Female moths emerge in spring and deposit eggs in masses of several hundred on the undersides of pecan and other tree leaves. The greenish-white eggs are covered by gray hairs left by the female. There are two to four generations each year, depending on location in the state. The last or fall generation is usually the most damaging.

Control: Many insect parasites and predators feed on and reduce the number of fall webworm larvae. Also, insecticides applied for other pecan pests help reduce webworm densities. If webs are common and the potential defoliation appears unacceptable, spot spraying of infested trees may be practical. The insecticide spray must penetrate the web to be effective.

YELLOW APHIDS

Aphids are small, soft-bodied insects that suck sap from pecan leaves. There are two species of "yellow" or "honeydew" aphids, the blackmargined aphid, *Monellia caryella*, and the yellow pecan aphid, *Monelliopsis pecanis*.

The blackmargined aphid has a black stripe along the outside margin of its wings, which are held flat over the body. The yellow pecan aphid holds its wings roof-like over its body and lacks the black stripe along the wing margin. Immature aphids are difficult to identify because they lack wings. Infestations may contain both species.

Blackmargined aphid infestations typically increase to large numbers during June to August and then decline after about 3 weeks. Outbreaks on most cultivars (except possibly "Cheyenne") usually decline without causing measurable damage to foliage or yield.

The yellow pecan aphid occurs later in the season. Outbreaks of this species can cause defoliation and reduce yield and quality on most cultivars.

Damage: Both species of yellow aphids have piercing-sucking mouthparts for removing water and plant nutrients from leaf veins. As they feed, aphids excrete large amounts of excess sugars. This sticky material, called honeydew, collects on leaves.

Honeydew serves as a food source for sooty mold, which can cover leaves when humidity is high. The shading effect of sooty mold can reduce photosynthesis. Studies have also shown that aphid feeding can reduce leaf efficiency; large, persistent infestations of the yellow pecan aphid, *M. pecanis*, can defoliate trees. This leaf injury and loss can reduce current and subsequent yields and quality because of lower carbohydrate production.

Table 4. Suggested insecticides to control fall webworm.

Insecticide	Concentrate per 100 gals.	Concentrate per acre	Remarks
Bacillus thuringiensis			Livestock grazing permitted.
See Table 12 for product names		See product label	
Carbaryl			Livestock grazing permitted.
Sevin® 80S	1.25-3 lb		
Sevin® 50W	2-5 lb		
Sevin® 4F	1-2.5 qt		
Sevin® XLR	1-2.5 qt		
Malathion			Livestock grazing permitted.
Malathion® 57% EC	1-2 pt		
Methoxyfenozide			Livestock grazing permitted.
Intrepid® 2F		4-8 oz	
Phosmet			Do not graze livestock.
Imidan® 70 W	2-3⅛ lbs		
Spinosad			Livestock grazing permitted.
Entrust®	0.3-0.75 oz	1.25-3 oz	
SpinTor® 2SC		4-10 oz	
Tebufinizide			Do not graze livestock.
Confirm® 2F	8-16 oz		

Table 5. Suggested insecticides to control blackmargined and yellow pecan aphids.

Insecticide	Concentrate per acre	Remarks
Imidacloprid		Do not graze livestock.
Provado® 1.6F	3.5-7 oz	
Admire® 2F*	20-32 oz	

*Admire® 2F: Labeled for yellow pecan, blackmargined and black pecan aphid and spittle bug but only as a soil application. Apply only to orchards that have been established on trickle irrigation for at least 5 years.

Biology: Yellow aphid eggs survive the winter hidden in bark crevices on twigs and tree trunks. Immature aphids, called nymphs, hatch from eggs in spring and begin to feed on newly expanded leaves. Nymphs mature in about a week and give birth to live young. All individuals are females that reproduce without males during spring and summer. In late September and October, males and females develop, and females deposit overwintering eggs.

Control: Aphids have a short life cycle and high reproductive capacity, so infestations can increase quickly under favorable conditions. Natural enemies, including lacewings, lady beetles, spiders and other insects, can suppress aphid infestations if there are enough of them. Insecticides applied for aphids or other pests can sometimes destroy these natural enemies, allowing aphids to increase to even greater densities than before treatment.

Inspect leaves frequently to monitor yellow aphid densities. Treatment of either species of yellow aphid may be justified on "Cheyenne" when aphid densities are high and persist for several weeks. "Pawnee" is the least susceptible cultivar to yellow aphids and normally needs no protection with insecticides.

Consider treatment when infestations of yellow pecan aphid exceed 25 per compound leaf, indicating the onset of an outbreak. Scouting the orchard on a 4- to 5-day schedule will determine if yellow pecan aphid numbers are increasing or decreasing and indicate the need for insecticide treatment. Do not base the need for treatment on the amount of honeydew alone, as infestations often decline rapidly ("crash") because of weather or physiological effects.

Insecticides do not consistently control either species of yellow aphids. Aphids may become tolerant to an insecticide used frequently in an orchard. An insecticide that is effective in one orchard may be ineffective in a nearby orchard. Studies have shown that in some cases, applications of pyrethroid insecticides (Asana®, Ammo®, Cymbush®) to control casebearers or aphids may be followed by large increases in yellow aphids.

HICKORY SHUCKWORM

Hickory shuckworm is an important mid- and late-season pest of pecans throughout much of Texas.

Damage: Shuckworm larvae tunnel in the shuck, interrupting the flow of nutrients and water needed for normal kernel development. Infested nuts are scarred, late in maturing and of poor quality. Damaged shucks stick to the nuts and fail to open, creating "sticktights" that reduce harvesting efficiency. Infestations occurring before shell hardening may cause nuts to fall.

Biology: Adult shuckworms are dark brown to grayish-black moths about 3/8 inch long. They are active in spring before pecan nuts are available. Adults deposit eggs on hickory nuts and pecan buds. Larvae on pecan feed in phylloxera galls in spring. Later in the season when pecan nuts are present, moths deposit eggs singly on the nuts.

The egg is attached to the shuck with a creamy white substance visible on the shuck surface. The tiny larva hatches in a few days and burrows into the shuck to feed for about 15 to 20 days. Mature larvae are about 1/2 inch long, and cream colored with light brown heads. Pupation occurs in the shuck and the moth soon emerges.

Several generations are completed each year. Shuckworms overwinter as full-grown larvae in old pecan shucks on the tree or the orchard floor.

Control: Pecans are most susceptible to hickory shuckworm damage during the water through gel stages. If the orchard has a history of shuckworm damage, treat with insecticide when pecans reach the half-shell hardening stage. A second application 10 to 14 days later may be needed.

Cultivars such as "Pawnee" and other early-maturing varieties that reach half-shell hardening earlier than other varieties must be treated earlier for hickory shuckworm. Removing and destroying old shucks and dropped nuts, where shuckworms overwinter, can reduce shuckworm infestations.

Pheromone traps are available that attract and capture hickory shuckworm moths. Guidelines for using trap catches to determine the need for treatment have not been validated in Texas.

SPIDER MITES

The pecan leaf scorch mite is the most important spider mite attacking pecans.

Damage: Large numbers of these tiny mites feed on the undersides of pecan leaves. Mites suck plant sap, causing irregular brown spots on infested leaves. Infestations often develop first along the leaf midrib. Damaged leaves appear russeted or scorched. Large infestations can result in leaf loss, especially if trees are under moisture stress.

Table 6. Suggested insecticides to control hickory shuckworm.

Insecticide	Concentrate per 100 gal	Concentrate per acre	Remarks
Carbaryl			Livestock grazing permitted.
Sevin® 80S	1.25-3 lb		
Sevin® 50W	2-5 lb		
Sevin® 4F	1-2.5 qt		
Sevin® XLR	1-2.5 qt		
Chlorpyrifos			Do not graze livestock.
Lorsban® 4E	2-4 pt		
Cypermethrin			Do not graze livestock.
Ammo® 2.5EC	3-5 oz		
Esfenvalerate			Do not graze livestock.
Asana® XL		2.56-4.27 oz	
Methoxyfenozide			Livestock grazing permitted.
Intrepid® 2F		4-8 oz	
Phosmet			Do not graze livestock.
Imidan® 70W	2-3-⅛ lbs		
Spinosad			Livestock grazing permitted.
Entrust®	0.3-0.75 oz	1.25-3 oz	
SpinTor® 2SC		4-10 oz	
Tebufinizide			Do not graze livestock.
Confirm® 2F	8-16 oz		
Lambda-cyhalothrin			Do not graze livestock.
Warrior®		2.56-5.12 oz	

Note: Survey orchards for increases in aphid or mite infestations after using esfenvalerate, cypermethrin or carbaryl.

Biology: Scorch mites overwinter as adults in the rough bark of limbs. Adult females begin laying eggs in spring. Mites can complete a generation in 5 to 15 days and are more numerous during hot, dry weather. Natural enemies of scorch mites, including predatory mite species, are important in controlling these pests.

Control: Because scorch mites prefer the shady, interior portion of the tree, significant damage can occur before infestations are detected. Check water sprouts and shady, lower branches to detect early mite infestations. Mites may increase after some insecticides (e.g., Sevin®) are applied for hickory shuckworm, aphids or other pests. Monitor the orchard for mites when the weather is hot and dry and after insecticides are used. Spray when mites are present and damaging leaves. Mark infested trees or areas to determine if spot treatment is practical.

BLACK PECAN APHID

The black pecan aphid is much more destructive than the two species of yellow aphid. Three black pecan aphids per compound leaf can cause severe leaf damage and defoliation. Like yellow aphids, the black pecan aphid feeds on the undersides of leaves and occurs throughout the pecan growing region of Texas.

Damage: While feeding, black pecan aphids inject a toxin that turns the leaf tissue between major veins bright yellow. These damaged areas, up to 1/4 inch across, turn brown and die. Infested leaves soon fall. Premature defoliation reduces nut fill and the next year's production.

Biology: The black pecan aphid is pear-shaped. Nymphs are dark olive-green while adults, which may be winged, are black. Like yellow aphids, all summer forms are females that reproduce without mating. Male and female forms

Table 7. Suggested insecticides to control pecan leaf scorch mite.

Insecticide	Concentrate per 100 gal	Concentrate per acre	Remarks
Fenbutatin-oxide			Do not apply within 14 days of harvest.
Vendex® 50 WP	4-8 oz.		
Dicofol			Do not apply within 7 days of harvest.
Kelthane® MF		1.5-2 qt	
Dimethoate			Do not graze livestock.
Dimethoate® E267		1 pt	
Hexythiazox			For nonbearing orchards only. Do not graze
Savey® 50WP		3-6 oz	livestock.
Bifenazate			Do not graze.
Acramite® 50WS		0.75-1 lb	

Table 8. Suggested insecticides to control black pecan aphid.

Insecticide	Concentrate per 100 gal	Concentrate per acre	Remarks
Chlorpyrifos			Do not graze livestock.
Lorsban® 4E		2-4 pt	
Dimethoate			Do not graze livestock.
Dimethoate® E267		1 pt	
Imidacloprid			Do not graze livestock.
Provado® 1.6F		7-14 oz	
Admire® 2F*	20-32 oz		
Malathion			Livestock grazing permitted.
Malathion® 57% EC	1-2 pt		
Phosmet			Do not graze livestock.
Imidan® 70 W	2-3⅛ lbs		

*Admire® 2F: Labeled for yellow pecan, blackmargined and black pecan aphid and spittle bug but only as a soil application. Apply only to orchards that have been established on trickle irrigation for at least 5 years.

appear in fall and females lay eggs that overwinter on branches. Densities often are very low until August or September, when infestations often increase rapidly.

Control: Monitor the orchard frequently for black pecan aphids and their characteristic leaf injury. Because these aphids feed singly and can be damaging in low numbers, examine leaves closely. Examine the interior of the canopy, where infestation often begins. In general, treat when black pecan aphids average two to three per compound leaf.

In most cases, black pecan aphids are easier than yellow aphids to control with insecticides. Natural enemies are important in maintaining low numbers of black pecan aphids.

STINK BUGS AND LEAFFOOTED BUGS

Several species of stink bugs and leaffooted bugs feed on pecan nuts. Infestations often develop on field crops or weeds and then move into pecans.

Damage: Stink bugs and leaffooted bugs suck sap from developing nuts. Nuts injured before the shells harden fall from the tree. Feeding after shell hardening causes brown or black spots on the kernel. Affected areas taste bitter.

Biology: As adults, these bugs overwinter under fallen leaves and in other sheltered places on the ground. Adults lay eggs on many crops and weeds, where populations increase in summer. Fields of soybeans, other legumes and sorghum may be sources of adults that fly to pecans. Infestations are usually greatest from September through shuck split.

Control: Weed control in and near the orchard helps suppress stink bugs and lower the possibility of their moving into pecans. Cypermethrin (Ammo®, Cymbush®), phosmet (Imidan®) and carbaryl (Sevin®) are labeled for control of stink bugs on pecans.

These kernel-feeding insects can also be managed by planting certain host or "trap crops," which lure adult stink bugs and leaffooted bugs away from pecans in September, October and November. Planting plots or single rows of peas (blackeye, purple hull, crowder, etc.) along the edge of the pecan orchard in the last week of July through the first week of August produces an attractive trap crop for these pests.

The trap crop does not have to be continuous around the entire orchard. Small plantings in several selected locations can be enough. To help ensure having an attractive trap crop longer into the fall, stagger the plantings by a couple of weeks. Monitor the peas for adult leaffooted and stink bugs when the plants begin to bloom and set pods.

Apply an insecticide to the trap crop to kill stink bugs and leaffooted bugs once the crop stops blooming and setting pods. This treatment is necessary to kill the bugs before they have a chance to leave and fly into the pecans. Before planting a trap crop, consider these factors: having available water to obtain a stand; planting a variety of pea suited to the soil type and soil pH of the orchard; weed control; and grazing of plots by wildlife and livestock.

PECAN WEEVIL

Where it is found in Texas, the pecan weevil is the most damaging late-season pecan pest. Infestations are often localized and vary greatly within orchards.

Damage: In August, adult weevils begin to emerge from the soil and feed on nuts in the water stage, causing them to drop. After the kernel has entered the gel stage, the nut is susceptible to egg laying and attack by pecan weevil larvae. Infested nuts remain on the tree while the developing larvae consume the kernel. Full-grown larvae emerge from the nut in late fall or early winter through a round hole chewed through the shell.

Biology: The life cycle of the pecan weevil egg, larva, pupa and adult usually is completed in 2 years but can require 3. Adult weevils begin emerging from the soil in August; their numbers peak from late August through early

Table 9. Suggested insecticides to control pecan weevil.

Insecticide	Concentrate per 100 gal	Concentrate per acre	Remarks
Carbaryl			Livestock grazing permitted.
Sevin® 80S	1.25-3 lb		
Sevin® 50W	2-5 lb		
Sevin® 4F	1-2.5 qt		
Sevin® XLR	1-2.5 qt		
Lambda-cyhalothrin			Grazing not permitted.
Warrior®		2.56-5.12 oz	
Zeta-cypermethrin			Grazing not permitted.
Fury® 1.5 EC		2.82-4.26 oz	

Note: Survey orchard for increases in aphid or mite infestations after using carbaryl.

September. Rainfall, soil moisture and soil type influence the ability of the weevils to emerge from the soil. Drought can delay adult emergence until rain or irrigation loosens the soil.

Adult weevils feed on nuts and live for several weeks. Once nuts reach the gel stage, they are suitable for egg laying. For this reason, early-maturing varieties are infested first. The female weevil drills a hole through the shell and deposits one or more eggs within the developing kernel. A single female lays eggs in about 30 nuts.

Larvae hatch from the eggs and feed inside the nut, destroying the kernel. Larvae emerge from the nuts about 42 days after the eggs are deposited. Emergence of full-grown larvae from nuts begins in late September and continues as late as December.

Larvae burrow 4 to 12 inches into the soil and build a cell, where they remain for 8 to 10 months. Most of the larvae then pupate and transform to the adult stage within a few weeks. However, the adults remain in the underground cell for an additional (second) year before emerging from the soil the following summer. Those larvae (about 10 percent) not pupating after the first year remain as larvae for 2 years and then emerge from the soil as adults the third year.

Monitoring pecan weevils

In most years, if adult weevils can be detected in the orchard, economic damage occurs if they are left untreated. Monitoring weevil emergence from the soil helps determine the optimum timing of insecticide treatments and the need to reapply insecticides.

Depending on environmental conditions, adult weevils may emerge quickly, completing emergence in a week or less, or emergence can extend over 4 to 5 weeks or more. Peak emergence typically occurs in August through mid-September. These variations are caused primarily by differences in soil hardness as influenced by soil texture and rainfall or irrigation.

Several methods have been developed to detect and monitor adult weevils. One involves jarring limbs to knock adult weevils onto a sheet placed on the ground where they are easily seen. Fallen pecans can also be examined for feeding and egg-laying punctures made by adults.

Trapping weevils is the most reliable way to determine adult weevil emergence and various traps have been designed to capture adult weevils. One (the pyramid trap) can be bought, but it and the others can be built easily following instructions available from your local office of Texas Cooperative Extension.

Monitor traps beginning about 1 to 2 weeks before the first pecans enter the gel stage. In Central Texas, begin trapping about the first week of August and continue through mid-September.

Wire cone traps. Wire cone traps are built from 1/8-inch mesh hardware cloth. Place traps on the soil beneath "scout" trees known to have a history of high weevil numbers. Weevils emerging from the soil beneath the trap crawl up the sides of the trap and are captured inside the jar at the top.

Inspect traps every 2 to 3 days and record and remove the captured weevils from the traps. The number of traps needed to monitor weevil emergence depends on the orchard size and weevil density. Ten to 15 traps per orchard are often enough to monitor weevil *activity*. To estimate weevil *density*, arrange 12 traps per tree under each of 10 trees (120 traps). This is the only method that provides an accurate treatment threshold based on the number of weevils captured in traps.

Pyramid or "Tedders" traps. Pyramid traps are built of two triangular-shaped pieces of 1/2-inch hardboard that interlock to form a 4-foot-tall pyramid. The trap is painted a dark color and fitted with a container at the top in which weevils are captured. Pyramid traps can be bought or easily built.

When placed in the orchard, pyramid traps apparently simulate a tree trunk and attract adult pecan weevils emerging from the soil. Weevils walk or fly to the trap and crawl up the sides until captured in the container at the top. Place one trap beneath the canopy of each scout tree. Remove grass, weeds, and fallen branches from around the tree and trap to increase its attractiveness. Also, painting the adjacent

tree trunk with whitewash or paint decreases its attractiveness to weevils and increases the number of weevils attracted to the dark pyramid trap.

As with cone traps, record the number of captured weevils and remove them and other insects and spiders from the traps every 2 to 3 days. The number of traps needed to monitor weevil emergence depends on orchard size and weevil density. Ten to 15 traps per orchard is often enough to monitor weevil activity.

Trunk trap and circle trap. Because wire cone and pyramid traps are placed on the orchard floor, they interfere with mowing and can be damaged by grazing cattle. Trunk and circle traps were designed to avoid these problems, as they are placed on the tree trunk. Also, these traps can be left in the orchard, unlike wire-cone and pyramid traps, which must be removed for harvest.

A trunk trap is built from a large tire inner tube placed around the tree trunk. Treat the trunk weekly with Sevin® insecticide. Adult weevils crawling up the trunk are poisoned by the insecticide and fall into the trap, where they are easily counted.

A circle trap is built much like the wire cone trap and fastened to the trunk of the pecan tree. Adult weevils crawling up the tree trunk are funneled into the trap and captured in a container at the top.

All these trap designs—wire-cone, pyramid, trunk and circle traps—only indicate the presence and relative abundance of adult pecan weevils. Except when large numbers of wire cone traps are used, the actual number of weevils captured does not indicate the need to treat or not to treat. The pattern of trap catches, as described above, is helpful in determining when adult weevils begin to emerge and the need to reapply insecticides to protect nuts from later emerging adults.

Control: Pecan weevils are controlled by foliar insecticides, which kill adults. Once nuts reach the gel stage, apply insecticide if adult weevils are present. A second application 7 to 10 days later is usually necessary, unless drought has delayed weevil emergence from the soil. In this situation, continue to monitor weevil emergence and reapply the insecticide at 7- to 10-day intervals if weevils are emerging.

Pecan weevil infestations spread slowly unless aided by humans. Do not transport infested nuts to weevil-free orchards, as they can be the source of a new infestation. Also, destroy infested nuts after harvest.

Harvesting early, before weevil grubs have exited the nuts, also aids in control. Because grubs are physically removed from the orchard by early harvest, this practice can reduce weevil in infestations if done each year.

RED IMPORTED FIRE ANT

Fire ants can interfere with pecan operations such as grafting, mowing and harvesting, and they may also damage equipment such as electrical motors and irrigation systems. In addition, fire ant stings can be a serious problem for orchard workers. Chlorpyrifos (Lorsban®) is applied as a spray to the orchard floor for temporary reduction of fire ant activity. Methoprene (Extinguish®), pyriproxyfen (Esteem®, Distance®), fenoxycarb (Logic®) and hydramethylnon (Amdro®) are baits which are broadcast across the orchard. Fire ants collect the bait particles and carry them back to the colony. The colonies die over a period of weeks, depending on the bait product used.

For additional information on fire ants, see Extension publication B-6076, *Managing Red Imported Fire Ants in Agriculture* (http://tcebookstore.org) or visit the Texas A&M fire ant Web site at http://fireant.tamu.edu.

Table 10. Suggested insecticides to control red imported fire ants.

Insecticide	Rate per acre	Remarks
Bearing and nonbearing orchards[1]		
Chlorpyrifos Lorsban® 4E[2]	2-4 pt	Do not graze livestock.
Methoprene Extinguish®	1.5 lb	Livestock grazing permitted.
Pyriproxyfen Esteem®	1.5-2 lb	Do not graze livestock.
Nonbearing orchards only[2]		
Hydramethylnon Amdro®	1-1.5 lb	Livestock grazing permitted.
Fenoxycarb Logic®	1-1.5 lb	Livestock grazing permitted.
Pyriproxyfen Distance®	1.5-2 lb	Do not graze livestock.

[1] Nonbearing orchards are considered those orchards that have not yet started to bear pecans.

[2] Applied as an orchard floor spray. Do not apply within 28 days of harvest.

For more information

Additional information on commercial pecan management can be found at the following Web sites:

Texas A&M University Entomology Department
http://insects.tamu.edu

Texas Pecan IPM Web site
http://pecankernel.tamu.edu

Texas Pecan Growers Association
http://tpga.org

Texas A&M University Horticulture Department
http://aggiehorticulture.tamu.edu

Protecting bees and other pollinators from insecticides

Pollination is important in producing many seed crops that may be planted near pecan orchards. Bees may be killed if cover crops such as clovers, alfalfa or vetch are flowering in the orchard during insecticide application. Insecticide applicators and beekeepers should cooperate closely to minimize bee losses.

To prevent heavy bee losses, do not spray or allow insecticide to drift directly on colonies. Bees cluster on the fronts of their hives on hot evenings. Pesticide drift or direct spray at this time generally kills many bees.

Table 11. Insecticides grouped according to their relative hazards to honey bees.

Insecticides	Remarks
Group 1–Highly Toxic Carbaryl (Sevin®) Chlorpyrifos (Lorsban®) Cypermethrin (Ammo®, Cymbush®) Dimethoate (Cygon®) Esfenvalerate (Asana®) Imidacloprid (Admire®, Provado®) Imidan® Lambda-cyhalothrin (Warrior®) Malathion (wettable powder or ULV) Parathion Thiamethoxam (Centric®) Zeta-cypermethrin (Fury®, Mustang Max®)	This group includes materials that kill bees on contact or for several days afterward. Remove bees from the area if these insecticides are used on plants being visited by bees. Malathion occasionally causes heavy bee losses, particularly during periods of extremely high temperatures. Make malathion applications in the evening after all bees have completed foraging. Avoid ultra-low volume malathion after blooms appear.
Group 2–Moderately Toxic Malathion (EC) Spinosad (Entrust®, SpinTor®)	Do not apply when bees are working in the field. Apply in late evening.
Group 3–Relatively Nontoxic *Bacillus thuringiensis* Confirm® 2F Dimilin® Intrepid® Kelthane® Logic Fire Ant Bait® Vendex®	Apply in late evening or early morning when bees are not foraging.

Additional Resources

These publications can be downloaded or ordered from *http://tcebookstore.org*:

E-145 *Homeowner's Fruit and Nut Spray Guide*

B-6055 *Field Guide to the Insects and Mites Associated with Pecan*

L-5134 *Controlling the Pecan Nut Casebearer*

L-5362 *Controlling the Pecan Weevil*

Table 12. Toxicity ratings, purchase restrictions and re-entry, grazing and harvest restrictions for insecticides registered for pecans.

Chemical name	Trade name	Signal word[1]	Restricted Use Pesticide[2]	Class[3]	Waiting period to		
					Reentry[4]	Grazing	Harvest[5]
Aldicarb	Temik 15G	Danger	Yes	C	See label	Do not graze	See label
Azadractin	Neemix 4.5	Warning	No	IGR	12 hours	Do not graze	Not stated
Bifenazate	Acramite 50WS	Caution	No	Other	12 hours	Do not graze	14 days
B.t. (*Bacillus thuringiensis*)	Dipel ES	Caution	No	B.t.	24 hours	0 days	0 days
	Javelin	Caution	No	B.t.	24 hours	0 days	0 days
	Agree						
	Deliver						
	Crymax						
	Lipinox						
	Biobit						
	Xentari						
Carbaryl	Sevin (all)	Warning	No	C	24 hours	0 days	0 days
Chlorpyrifos	Lorsban 4E, 50W	Warning	No	OP	24 hours	Do not graze	28 days
Cypermethrin	Ammo 2.5EC	Caution	Yes	PY	24 hours	Do not graze	21 days
Dicofol	Kelthane MF	Caution	No	OC	24 hours	Do not graze	7 days
Diflubenzuron	Dimilin 2L	Caution	No	IGR	12 hours	Do not graze	28 days
Dimethoate	Dimethoate 267	Warning	No	OP	48 hours	Do not graze	21days
Disulfoton	Di-Syston 15 G	Danger	Yes	OP	24 hours	Do not graze	80 days
Endosulfan	Thiodan 3EC	Danger	Yes	OC	24 hours	Do not graze	See label
	Phaser 3EC	Danger	Yes	OC	24 hours	Do not graze	Footnote[5]
Esfenvalerate	Asana XL	Warning	Yes	PY	24 hours	Do not graze	21 days
Fenbutatin-oxide	Vendex 50WP	Danger	Yes	—	24 hours	Do not graze	14 days
Fenoxycarb	Logic Fire Ant	Caution	No	C	12 hours	Do not graze	No harvest
Hexythiazox	Savey 50WP	Caution	No	—	12 hours	Do not graze	Footnote[6]
Hydramethylnon	Amdro Pro	Caution	No	MI	12 hours	Footnote[7]	Footnote[6]
Imidacloprid	Admire 2F	Caution	No	CH	12 hours	0 days	12 hours
	Provado 1.6F						
Lambda-cyhalothrin	Warrior®	Warning	Yes	PY	24 hours	Do not graze	14 days
Malathion	Malathion	Caution	No	OP	24 hours	0 days	0 days
Methoprene	Extinguish	Caution	No	IGR	4 hours	0 days	0 days
Methoxyfenozide	Intrepid 2F	Caution	No	IGR	4 hours	0 days	14 days
Phosmet	Imidan (70W)	Warning	No	OP	24 hours	Do not graze	14 days
Pymetrozine	Fulfill	Caution	No	Other	12 hours	Not stated	Not stated
Pyriproxyfen	Distance	Caution	No	IGR	12 hours	Do not graze	No harvest
	Esteem	Caution	No	IGR	12 hours	Do not graze	24 hours
Spinosad	Entrust	Caution	No	SP	4 hours	0 days	14 days
	SpinTor	Caution	No	SP	4 hours	0 days	14 days
Tebufenizide	Confirm 2F	Caution	No	IGR	4 hours	Do not graze	14 days
Thiamethoxam	Centric® 40WG	Caution	No	—	12 hours	0 days	14 days
Zeta-cypermethrin	Fury 1.5 ES	Warning	Yes	PY	24 hours	Do not graze	21days
	Mustang Max	Warning	Yes	PY	24 hours	Do not graze	21days

[1] Danger means highly toxic. Warning means moderately toxic. Caution means low order of toxicity.

[2] Restricted use pesticides are available only to certified applicators or people under their direct supervision.

[3] Pyrethroid = PY, Carbamate = C, Organophosphate = OP, Organochlorine = OC, B.t.= *Bacillus thuringiensis,* CH = Chloronicotinyl, Spinosyn=SP

[4] Reentry time is the length of time from application until workers can reenter the area without protective clothing.

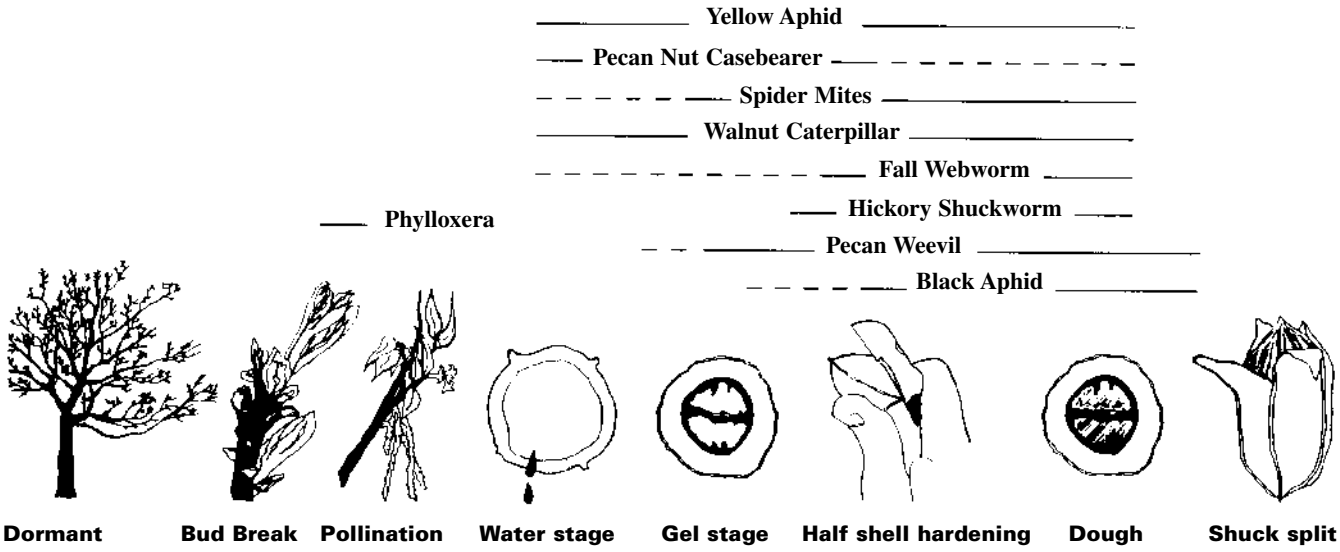
[5] Do not apply Thiodan or Phaser after shuck split.

[6] Nonbearing orchards only.

[7] Grazing permitted for companion animals only.

Seasonal Pecan Pest Profile

The development of various pecan pests is usually closely related to the seasonal development of the pecan. Although the severity of insect problems cannot be predicted on a seasonal basis, producers should frequently determine tree and nut development to aid them in predicting insect problems associated with various developmental stages of the pecan.



Developmental Stages of the Pecan

Dormant: Period from leaf drop to bud break.

Bud break: The bud scale splits and the leaf begins to expand.

Pollination: Catkins are shedding pollen and stigmas are receptive.

Water stage: The nut interior is filled with water.

Gel stage: Interior of the immature kernel is filled with a gel-like substance.

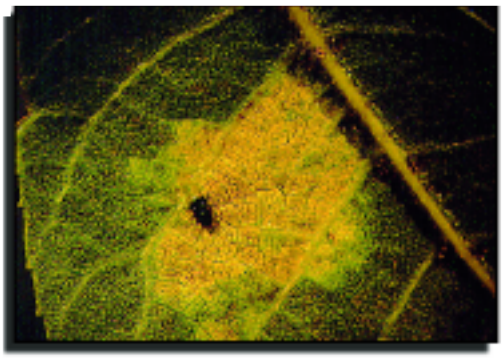
Half shell hardening: Resistance can be felt when making a cross-section cut through the middle of the pecan nut.

Dough: The gel of the kernel begins to solidify.

Shuck split: Shucks begin to split, exposing the shell.

Yellow aphid

Phylloxera galls



Black aphid

Stink bug

Pecan weevil

Pecan nut casebearer eggs

Walnut caterpillar

Green lacewing larva

Hickory shuckworm damage

Ash gray lady beetle

Pecan nut casebearer moth (left) and pecan bud moth (right)

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