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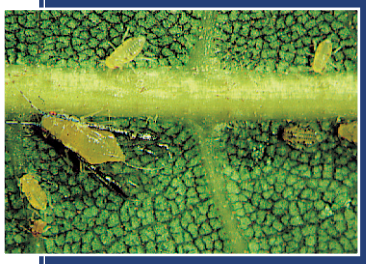
Managing Insect and Mite Pests of Commercial Pecans in Texas




Managing Insect and Mite Pests of Commercial Pecans in Texas

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The pecan is an important horticultural crop in Texas. In 2007, the Texas Agricultural Statistics Service reported that 83,030 acres of improved varieties and 91,900 acres of native pecans were managed in Texas.

Many insects feed on the leaves, nuts, branches and buds of the pecan tree, reducing the tree's production 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 Guide to Pests of Peaches, Plums and Pecans* (available from your local Texas Agrilife Extension office and online at *http://agrilifebookstore.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 E-341, *Field Guide to the Insects and Mites Associated with Pecan* (*http://agrilifebookstore.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 may no longer be the best approach because

- fewer effective insecticides are available,
- some products give poor control,
- secondary pest outbreaks often occur, and
- there are 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 sustain profitability. These management techniques include:

- **cultural control**—such as destroying crop residues where some pests overwinter;
- **host plant resistance**—selecting pecan varieties that are well adapted and, when available, have genetic resistance to pests;
- **chemical control**—using insecticides only when pest densities exceed economically damaging levels and, when available, selecting effective insecticides that have the least impact on natural enemies and non-target organisms; and
- **biological control**—recognizing and protecting, when possible, natural enemies that 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 the 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 their effectiveness, the hazard they pose to the applicator, and their 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 on pests that favor pest survival or increased reproduction.

Outbreaks of aphids or spider mites may follow the use of pyrethroid insecticides (see Table 12), carbaryl or phosmet (Imidan®). Use these insecticides only to control late-season pests. Pyrethroids should not be used in orchards where mite or aphid outbreaks have occurred following their use.

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The frequent use of some insecticides can cause some insect pests to become resistant. These resistant insects survive and pass on their genes for resistance to their offspring. Each time the insecticide is applied, the proportion of resistant insects in the population increases. As a result, the insecticide is no longer effective.

Insecticides are classified according to their modes of action, or the ways they kill insect pests. The development of insecticide resistance can be managed by using insecticides only when necessary and rotating the use of insecticides with different modes of action. It is difficult for an insect to develop resistance to two insecticides that have different modes of action. So, rotating insecticides with different modes of action is a good resistance management tactic. The mode of action of labeled pecan insecticides is identified by a number (see Table 12). To rotate insecticides, choose effective insecticides with different mode of action numbers. Rotating by brand name may not be effective because the same active ingredient, (and same mode of action) is often sold under different brand names. For example, the active ingredient imidacloprid is sold under 13 different brand names. Rotating among these 13 products would not be effective as they are all group 4 insecticides, as shown in Table 12. These imidacloprid products should be rotated with any other effective insecticide that is not a group 4 insecticide. When rotating insecticides, refer to the insecticide modes of action numbering system shown in Table 12.

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 them.

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. As examples, Confirm®, Intrepid®, spinosad and *B.t.* formulations are less toxic to most 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. However, research to date has shown that releasing convergent lady beetles, lacewings or Trichogramma wasps does not provide significant pest control in pecans.

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 (e.g., 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 sizes and spacings, 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 the suggested insecticide which provides 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. Be sure the pesticide is registered for use

on pecans and is used only in accordance with specific application instructions.

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

Pesticide drift: Do not let pesticide drift to nearby land or contaminate ponds and streams.

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 research, 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 AgriLife Extension Service 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 galls

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 for controlling phylloxera. Read and follow label directions.

Insecticide		Concentrate per		
Active ingredient	Brand name	100 gal	acre	Remarks
Chlorpyrifos	Govern® 4E		2 – 4 pt	Do not graze livestock in treated orchards.
	Hatchet®		2 – 4 pt	
	Lorsban® 4E		2 – 4 pt	
	Lorsban® 50W	1 lb		
	Lorsban® 75WG		1.33 – 2.67 lb	
	Nufos® 4E		2 – 4 pt	
	Warhawk®		2 – 4 pt	
	Whirlwind®		2 – 4 pt	
	Yuma 4E®		2 – 4 pt	
Dormant oil	Several products	4 gal		Apply during dormant season only.
Imidachloprid	Provado® 1.6 F		3.5 – 7 oz	Do not graze livestock in treated orchards.
	Malice® 75 WSP		2.1 oz	
	Montana® 2F		2.8 – 5.6 oz	
	Pasada® 1.6F		3.5 – 7 oz	
	Trimax Pro®		1.3 – 2.6 oz	
Malathion	Malathion® 5EC		7.5 – 10 pt	Grazing allowed.
	Malathion® 8EC		2.5 – 12 pt	

Biology

Both species of Phylloxera survive the winter as eggs in bark crevices. In spring, tiny nymphs emerge during bud break and feed on new growth. As they feed, nymphs secrete a substance 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 and complete two generations inside the gall. Galls then crack open and winged, adult phylloxera emerge.

Some female leaf phylloxera adults deposit eggs and the hatching nymphs result in a second and sometimes third generation of galls if new growth is available during the season. Other females overwinter and deposit eggs the following spring. The more destructive pecan phylloxera form no additional galls. These females hide in protected places on the bark and die, their eggs remaining inside the mothers' protective bodies throughout the winter.

Control

Native trees and improved varieties vary in susceptibility to phylloxera. Because phylloxera cannot fly far, infestations move slowly from tree to tree. 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 ⅓ inch long with a ridge of dark scales 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.

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

Casebearer eggs hatch in 4 to 5 days; young larvae crawl to nearby buds below the nuts to begin feeding. The empty white 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 1 inch. Full-grown larvae pupate in the pecan nut; adult moths emerge about 9 to 14 days later.


Pecan nut casebearer eggs

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 feed on nutlets and mature to moths. These moths 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, tiny, silken cocoons where they spend the winter. 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

Often a single, carefully timed insecticide application adequately controls first-generation casebearers. A second insecticide application may be required if unhatched eggs are found 7 to 10 days after the first application. 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. Infested clusters can be flagged to monitor egg hatch. Once they emerge from the egg, the tiny larvae feed for 1 to 2 days on a secondary bud just below the nut cluster and then tunnel into a nutlet. Delaying treatment until the first nut entry is observed maximizes the insecticide's residual activity. However, consider the time required to treat the orchard, including possible weather delays, so that insecticide is applied before most larvae have entered nuts.

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. Knowing when to scout the orchard for eggs and when to apply an insecticide, if needed, are two important components of managing pecan nut casebearer.

When to Scout for Eggs

Two online resources are available to help pecan growers anticipate when to scout for casebearer eggs in the spring and anticipate optimum treatment timing. At *http://pecan.ipmpipe.org* you will find a map of the southern U.S. with locations where casebearer activity has been predicted based upon trapping moths in pheromone traps. From the map, you can find the reporting station nearest your orchard. A flag at this location will indicate when pecan orchards at this location should be sampled for eggs. This sampling period is termed the "decision window" because sampling during this time should be sufficient to determine if the number of eggs justifies the cost of applying an insecticide. By monitoring this site, you can observe PNC activity progressing across the state with time. This site has other resources on managing pecan nut casebearer and other pecan pests and is an important resource for pecan producers.

The second tool for determining when to scout for eggs is the PNCforecast System, which can be found at *http://pncforecast.tamu.edu/.* This system is useful if the *pecan.ipmpipe.org* site does not have a reporting location near your orchard or if you want to generate your own forecast using pheromone trap data from your orchard. The PNCforecast system also provides more detailed information about casebearer activity, but to use it you must monitor pheromone traps in your orchard.

With the PNCforecast System you can predict activity of first-generation pecan nut casebearer in your orchard using data from pheromone traps and local temperatures. The system predicts dates when 1) first-generation eggs are expected to be found in the orchard and 2) larvae will begin feeding on pecan nutlets (nut entry).

To generate a PNCforecast for your orchard, log on to *http://pncforecast.tamu.edu/* and select "Make a Forecast" from the menu and enter the county in which your orchard is located and the date when you first captured casebearer moths in the pheromone traps in your orchard. The system does not predict whether you need to apply an insecticide, but only estimates the optimum dates for scouting the orchard to determine whether an economic infestation of first-generation casebearers is present.

The date when you first capture caseberer moths in your traps is very important in generating a reliable forecast. Traps must be placed in the orchard early, before the first moths are active. Traps should be examined every day or two to know when the first moths appear in the traps. Sometimes one or two moths are captured and then none are captured on subsequent dates. Ignore these early "stragglers" if no new moths are caught on the next inspection date. Once you capture PNC moths on *two consecutive dates,* the sustained moth flight is underway. Choose the *first* of the two consecutive dates as the date of first moth capture and enter this date into the PNCforecast System.

Examples

	May 1	May 2	May 3	May 6	May 8	May 9	"First" Moth
Orchard A	0	1	2	1	6	8	May 2
Orchard B	0	1	0	0	3	5	May 8
Orchard C	0	4	0	1	3	0	May 6

Once you have entered the date of first moth capture and selected the weather station nearest your orchard, select "Generate." The model will then generate a PNCforecast like the following example:

Example

PNCforecast System Output	
Forecast Event Dates	
Percent of total first-generation eggs expected in orchard	**Date**
10%	May 7
25%	May 10
50%	May 13
75%	May 16
90%	May 19
First nut entry:	May 19

Begin scouting for casebearer eggs on the dates of 25 to 50 percent egg-lay. The table above gives the dates when 10, 25, 50, 75 and 90 percent of all the first-generation eggs are expected to be present in the orchard. In the example above, 50 percent of the total eggs expected in the orchard during the first-generation flight are expected to be present on May 13, and most (90 percent) of the eggs are expected to be present on May 19.

The period when 25 to 50 percent of eggs should be present is called the "decision window" because orchard scouting at this time can often find a sufficient number of eggs to make a decision regarding an insecticide treatment. (Guidelines for deciding when an infestation justifies an insecticide treatment are discussed below.) However, if the percent infested cluster is below the treatment level during the period of 25 to 50 percent egg-lay, scout for eggs and larvae again on the dates of 50 to 75 percent oviposition. If eggs and larvae numbers are still too low to justify an insecticide treatment, scout a third time on the dates of 75 to 90 percent oviposition to determine if the casebearer infestation has increased. If densities of eggs and larvae are still below the treatment level on the date of 90 percent egg-lay, then treatment during the first generation may not be justified.

Note that the percentages in the table (generated by the PNCforecast Sytem) are NOT the expected percent of nutlets infested with eggs, but rather the proportion of the total eggs expected to be present in the orchard during the first generation (spring). Only orchard scouting can determine how many nutlets have casebearer eggs or larvae.

The date of the first nut entry (see table above) is the date when nut entry should first be observable in the orchard. **If egg numbers exceed the treatment threshold, the anticipated spray date is 2 to 3 days before the predicted date of first nut entry.** This timing ensures that the insecticide is present when the first eggs hatch and young larvae begin feeding on buds. Plan orchard spraying, if needed, so that all trees are treated at least 2 to 3 days before this date. Confirm this decision with orchard scouting information.

The PNCforecast System also provides information on casebearer egg-laying activity and nut entry from selected sites in Texas. These forecasts are based upon data collected by Extension agents, entomologists with Texas AgriLife Extension, Master Gardeners, and pecan growers working with AgriLife Extension. This information may be of interest if you are not monitoring traps yourself or want to see casebearer activity at other locations. To view these PNCforecasts, log on to *http://pncforecast.tamu.edu/* and select "View PNCforecasts for Texas and Oklahoma."

Do not rely only on the PNCforecast System to make management decisions. The system is only a tool to help you plan orchard scouting and insecticide treatment, if needed. Information provided by this application is for educational purposes only. Treatment decisions should not be based solely on PNCforecast output. The PNCforecast cannot account for differences in environmental conditions at weather stations and actual orchard conditions. Growers should base management decisions on their assessment of eggs and larvae in their orchards, crop load, characteristics of the insecticide used, time needed to treat the orchard, and other factors unique to their operations.

Scouting to Determine the Need for Control

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 an infestation is 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:

If you are using the PNCforecast System, begin searching for eggs on the dates of predicted 25 to 50 percent egg-lay. If you are using *http://pecan.ipmpipe.org*, begin scouting on the Decision Window dates for your location. Another option is to begin scouting 7 to 10 days after the first moths are captured in pheromone traps. You can also monitor egg hatch and time treatment by tagging and observing eggs on infested clusters.

To assess egg infestations, examine 10 nut clusters per tree on 31 trees. A cluster is considered infested if it has a casebearer egg or nut entry. If 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 and an insecticide treatment is needed to prevent this economic loss.

If you find fewer than two infested clusters, sample again 2 to 3 days later (at 50 to 75 percent predicted egg-lay). If no treatment is indicated, sample again 2 days later (at 75 to 90 percent predicted egg-lay). A third sample is especially important if nights have been cold and rainy, because this can delay egg laying. If you find fewer than three infested clusters, no treatment is warranted. Finding three or more infested clusters at this time indicates some damage may occur. Consider the effect of rainy weather on egg laying and crop load in making treatment decisions at this time.

Monitoring Pecan Nut Casebearer Moth Activity with Pheromone Traps

Information from pheromone-baited traps can be used with the PNCforecast System to 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 loaded into a rubber lure placed inside a sticky 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 nut entry will occur.

Pheromone lures and traps are commonly sold together as kits. Kits sold for pecan nut casebearer use the Pherocon 3 Delta trap, the Pherocon VI trap, or the Intercept-A trap. All of these trap designs are effective in determining the pattern of moth activity. For a list of suppliers selling traps and lures, see *http://pecankernel.tamu.edu*. When traps have a removable liner it is easier to see and identify the casebearer moths.

Pheromone lures should be kept frozen until used. Lures should be replaced every 6 to 8 weeks, removed from the orchard and discarded.

Three to five pheromone traps are enough to determine the pattern of moth activity in a given location. As a general guide, monitor three to five traps for orchards smaller than 50 acres and five to ten traps for orchards larger than 50 acres. Place traps throughout the orchards, especially where temperature conditions vary, such as between river bottom sites and upland sites. Place traps near the terminal of a nut-bearing limb at a convenient height. Traps must be in the orchard

Table 2. Suggested insecticides for controlling pecan nut casebearer. Read and follow label directions.

Insecticide		Concentrate per		
Active ingredient	Brand name	100 gal	acre	Remarks
Bacillus thuringiensis	Javelin-WG® Crymax® Deliver®		0.25 – 4 lb 0.5 – 2 lb 0.5 – 2 lb	*Bt* insecticides have short residual activity; multiple applications may be needed for control.
Chlorpyrifos	Chlorpyrifos® 4E AG Govern® 4E Hatchet® Lorsban® 4E, Lorsban® 50W Lorsban® 75WG Nufos® 4E Warhawk® Whirlwind® Yuma®	 1 lb 	1.5 – 4 pt 1.5 – 4 pt 1.5 – 4 pt 2 – 4 pt 1 – 2.67 lb 1.5 – 4 pt 1.5 – 4 pt 1.5 – 4 pt 1.5 – 4 pt	Do not graze livestock in treated orchards.
Malathion	Malathion® 5EC Malathion® 8EC		6.25 pt 2.5 – 12 pt	Grazing allowed.
Methoxyfenozide	Intrepid® 2F		4 – 8 oz	Grazing allowed.
Spinotram	Delegate®		4.5 – 7 oz	Grazing allowed.
Spinosad	Entrust*® SpinTor® 2SC, Success®	0.3-0.75 oz 1-2.5 oz	1.25 – 3 oz 4 – 10 oz	Livestock grazing permitted.
Tebufenizide	Confirm® 2F		8 – 16 oz	Do not graze livestock in treated orchards.

*The spinosad formulation of Entrust® is approved for organic production by the Organic Materials Review Institute (OMRI).

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 and southwest Texas, by April 10; and in north and northwest Texas, by April 20.

Monitor traps at least every 1 to 2 days until casebearer moths are captured on at least two consecutive dates (see above discussion). Frequent monitoring is necessary to detect the first flush of moth activity. Once you have captured moths on two consecutive dates, further monitoring is not needed for the PNCforecast system. However, you may want to continue recording trap captures every 4 to 5 days for 2 to 3 weeks to maintain a record of moth flight for future reference. Each time you check the trap, count and record the number of captured casebearers and record the 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 on p. 5) 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.

The first casebearer male moths are usually captured 2 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 when large numbers of casebearer moths appear in the traps. However, this could be a week or more before treatment, if needed, should be applied.

Research indicates that the number of captured moths accurately reflects patterns of moth activity. *Trap catches cannot be used to predict the threat of damage by casebearer larvae or the need to apply an insecticide.* 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 occurs about 12 to 16 days after the second moth flight begins. This is the best time to apply insecticide for second summer-generation casebearer, *if needed.* 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 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 and into November. However, these later generations rarely threaten nut production.

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.


Walnut caterpillar

Table 3. Suggested insecticides for controlling walnut caterpillar. Read and follow label directions.

Insecticide		Concentrate per		
Active ingredient	Brand name	100 gal	acre	Remarks
Bacillus thuringiensis	Javelin-WG® Crymax® Deliver®		0.25 – 4 lb 0.5 – 2 lb 0.5 – 2 lb	*Bt* insecticides have short residual activity; multiple applications may be needed for control.
Methoxyfenozide	Intrepid® 2F		4 – 8 oz	Grazing allowed.
Spinosad	Entrust*® SpinTor® 2SC		1.25 – 3 oz 4 – 10 oz	Livestock grazing permitted.
Tebufenizide	Confirm® 2F		8 – 16 oz	Do not graze livestock in treated orchards.

*The spinosad formulation of Entrust® is approved for organic production by the Organic Materials Review Institute (OMRI).

Biology

Walnut caterpillar moths emerge in spring and deposit 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.

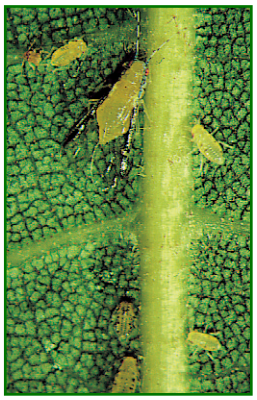
Control

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; controlling this stage prevents serious damage. Insecticide treatment may be necessary if large infestations threaten to defoliate trees.

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.*



Yellow aphid

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 defoliate trees 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 is 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 shown that aphid feeding can reduce leaf efficiency and 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.

Biology

Yellow aphid eggs survive the winter hidden in bark crevices on twigs and tree trunks. Immature aphids, called nymphs, hatch 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, which 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. However, 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 insecticide treatment for yellow aphids is not normally needed on this variety.

Table 4. Suggested insecticide for controlling blackmargined and yellow pecan aphids. Read and follow label directions.

Insecticide		Concentrate per		
Active ingredient	Brand name	100 gal	acre	Remarks
Imidachloprid*	Admire® Pro**		7 – 14 oz	Do not graze livestock.
	Advise® 2 FL, Max		16 – 32 oz	
	Couraze® 1.6F		3.5 – 7 oz	
	Couraze® 2F		16 – 32 oz	
	Imida® E-AG 1.6 F		3.5 – 7.0 oz	
	Imida® E-AG 2F		16 – 32 oz	
	Impulse® 1.6 F		3.5 – 7 oz	
	Macho® 2.0 FL**		16 – 32 oz	
	Malice® 75WSP		2.1 oz	
	Mana® Alias 4F		8 – 16 oz	
	Merit® 2F, 75WSP		6 oz	
	Montana® 2F		2.8 – 5.6 oz	
	Nuprid® 1.6F		3.5 – 7 oz	
	Nuprid® 2F		16 – 32 oz	
	Nuprid® 4F		1.5 – 3 oz	
	Pasada® 1.6F		3.5 – 7 oz	
	Prey® 1.6		3.5 – 7 oz	
	Provado® 1.6F		3.5 – 7 oz	
	Sherpa®		3.5 – 7 oz	
	Trimax Pro®		1.3 – 2.6 oz	
	Widow®**		16 – 32 oz	
Lamda-cyhalothrin	Warrior®		2.5 – 5.2 oz	Grazing allowed.
	Warrior II®		1.3 – 2.6 oz	
	Grizzly Z®		2.56 – 5.12 oz	
	Kaiso® 24 WG		1.33 – 2.67 oz	
	Karate® w/ zeon® tech		1.28 – 2.56 oz	
	Lambda-CY® EC		2.56 – 5.12 oz	
	Province®		2.56 – 5.12 oz	
Zeta-cypermethrin and bifenthrin	Hero®		10.3 oz	
Chlorpyrifos and gamma cyhalothrin	Cobalt®		19 – 57 oz	

*Repeated application of imidachloprid can cause insecticide resistance in aphids and lead to control failures.
**Admire, Macho and Widow are labeled only for soil application though the irrigation system. See the label.

Consider treatment when infestations of yellow pecan aphid exceed 25 per compound leaf. Scouting the orchard on a 4- to 5-day schedule will reveal whether 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 aphid. Aphids may become resistant 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 (lamda-cyhalothrin, zeta-cypermethrin, etc.) to control case-bearers or aphids may be followed by large increases in yellow aphids. In some orchards, yellow aphid infestations have rapidly increased following the use of chlopyrifos, a class 1 insecticide. If this occurs, rotate to another active ingredient which will have a different mode of action (see Table 12). Also, frequent use of products containing imidacloprid may increase aphid resistance to this class 4 insecticide, leading to control failures. To reduce this risk, rotate with an insecticide not in the class 4 group, such as Cobalt, which is a combination of class 1 and 3 insecticides, or Hero, a class 3 insecticide (see Table 12). For further information on managing insecticide resistance, see the discussion under Pest Management Principles.

HICKORY SHUCKWORM

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

Damage


Hickory shuckworm 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 before shell hardening may cause nuts to fall.

Biology

Adult shuckworms are dark brown to grayish black moths about ⅜ 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 ½ 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.

Early-maturing varieties such as "Pawnee" must be treated earlier for hickory shuckworm. Removing and destroying old shucks and dropped nuts, where shuckworms overwinter, can reduce shuckworm infestations.

There are pheromone traps that attract and capture hickory shuckworm moths. However, there are no reliable guidelines for using trap catches to time scouting for eggs or insecticide application.

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.

Table 5. Suggested insecticides for controlling hickory shuckworm. Read and follow label directions.

Insecticide		Concentrate per		
Active ingredient	Brand name	100 gal	acre	Remarks
Chlorpyrifos	Chlorpyrifos® 4E AG*		2 – 4 pt	Do not graze livestock in treated orchards.
	Govern® 4E		2 – 4 pt	
	Hatchet®		2 – 4 pt	
	Lorsban® 4E,		2 – 4 pt	
	Lorsban® 50W	2 lb		
	Lorsban® 75WG		1.33 – 2.67 lb	
	Nufos® 4E		2 – 4 pt	
	Warhawk®*		2 – 4 pt	
	Whirlwind®		2 – 4 pt	
	Yuma® 4E		2 – 4 pt	
Methoxyfenozide	Intrepid® 2F		4 – 8 oz	Grazing allowed.
Spinosad	Entrust®**		1.25 – 3 oz	Livestock grazing permitted.
	SpinTor® 2SC		4 – 10 oz	
Tebufenizide	Confirm® 2F		8 – 16 oz	Do not graze livestock in treated orchards.

*Chlorpyrifos 4E AG and Warhawk are not labeled for control of fall webworm.
**The spinosad formulation of Entrust is approved for organic production by the Organic Materials Review Institute (OMRI).

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. Insecticides listed in Table 5 for the control of hickory shuckworm are also effective in controlling fall webworm.

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.

Biology

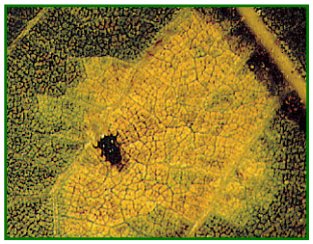
Scorch mites overwinter as adults in the rough bark of limbs. Adult females begin laying eggs in spring. Mites can complete a generation in 5 to 15 days and are more numerous during hot, dry weather. Natural enemies of scorch mites, including predatory mite species, are important in controlling these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



Black aphid

Damage

While feeding, black pecan aphids inject a toxin that turns the leaf tissue between major veins bright yellow. These damaged areas, up to ¼ inch across, turn brown and die, and infested leaves soon fall. Premature defoliation reduces nut fill and the next year's production.

Table 6. Suggested insecticides for controlling pecan leaf scorch mite. Read and follow label directions.

Insecticide		Concentrate per		
Active ingredient	Brand name	100 gal	acre	Remarks
Fenbutatin-oxide	Vendex® 50 WP		1 – 2.5 lb	Do not apply within 14 days of harvest.
Dicofol	Kelthane® MF		4 pt	Do not apply within 7 days of harvest.
Hexythiazox	Onager® Savey® 50 DF		12 – 24 oz 3 – 6 oz	For non-bearing orchards only. Do not graze treated orchards.
Bifenazate	Acramite® 50 SC		12 – 16 oz	Do not graze treated orchards.
Spirodiclofen	Envidor® 2 SC		14 – 18 oz	Grazing allowed.

Table 7. Suggested insecticides for controlling black pecan aphid. Read and follow label directions.

Insecticide		Concentrate per		
Active ingredient	Brand name	100 gal	acre	Remarks
Chlorpyrifos	Chlorpyrifos® 4E AG		2 – 4 pt	Do not graze livestock in treated orchards.
	Govern® 4E		2 – 4 pt	
	Hatchet®		2 – 4 pt	
	Lorsban® 4E*		2 – 4 pt	
	Lorsban® 50W*	2 lb		
	Lorsban® 75WG*		1.33 – 2.67 lb	
	Nufos® 4E		2 – 4 pt	
	Warhawk®		2 – 4 pt	
	Whirlwind®		2 – 4 pt	
	Yuma® 4E		2 – 4 pt	
Dimethoate	Dimethoate® 4E		0.66 pt	Do not graze livestock in treated orchards.
	Dimate® 4EC, 4E		0.66 pt	
	Dimethoate® 4EC		0.66 pt	
	Dimethoate® 5lb		8.4 oz	
Imidachloprid	Admire Pro®		7 – 14 oz	Do not graze livestock in treated orchards.
	Advise® 2 FL, Max		16 – 32 oz	
	Couraze® 1.6F		3.5 – 7 oz	
	Couraze® 2F		16 – 32 oz	
	Imida E-AG® 1.6 F		3.5 – 7 oz	
	Imida E-AG® 2F		16 – 32 oz	
	Impulse® 1.6 F		3.5 – 7 oz	
	Macho® 2.0 FL		16 – 32 oz	
	Malice® 75WSP		2.1 oz	
	Mana Alias® 4F		8 – 16 oz	
	Montana® 2F		6.4 oz	
	Nuprid® 1.6F		3.5 – 7 oz	
	Nuprid® 2F		16 – 32 oz	
	Nuprid® 4F		1.5 – 3 oz	
	Pasada® 1.6F		3.5 – 7 oz	
	Prey® 1.6		3.5 – 7 oz	
	Provado® 1.6F		7 – 14 oz	
Malathion	Malathion® 5EC		7.5 – 10 pt	Grazing allowed.
	Malathion® 8EC		2.5 – 12 pt	
Zeta-cypermethrin and bifenthrin	Hero®		10.3 oz	Do not graze treated orchards.
Chlorpyrifos and gamma cyhalothrin	Cobalt®		19 – 57 oz	Do not graze treated orchards.
Imidacloprid and cyfluthrin	Leverage® 2.7 SE		3.8 – 5.1 oz	Do not graze treated orchards.

*In combination with a pyrethroid insecticide, see label.

Biology

The black pecan aphid is pear-shaped. Nymphs are dark olive-green and adults, which may be winged, are black. Like yellow aphids, all summer forms are females that reproduce without mating. Male and female forms 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 to control with insecticides than yellow aphids. Natural enemies are important in keeping the number of black pecan aphids low.

STINK BUGS AND LEAFFOOTED BUGS

Several species of brown and green stink bugs and leaffooted bugs feed on pecan nuts. Infestations often develop on soybeans, sorghum, other field crops or weeds and then move into pecans in late summer and fall.

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

These bugs overwinter as adults under fallen leaves and in other sheltered places on the ground. Populations increase in summer when adults lay eggs on many crops and weeds. Fields of soybeans, other legumes and sorghum may be sources of adults that fly to pecans. Infestations are usually largest from September through shuck split.

Stink bug

Control

Brown stinkbugs are more difficult to kill with insecticides than are green stinkbugs and leaffooted bugs.

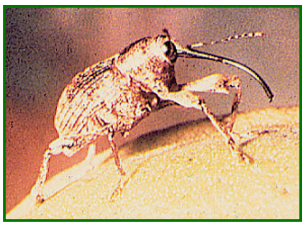
Weed control in and near the orchard helps suppress stink bugs and lower the possibility of their moving into pecans. Some growers also have planted "trap crops" to lure adult stinkbugs and leaffooted bugs away from pecans. Black eye, purple hull and crowder peas or millet planted in plots or in a single row along the edge of the pecan orchard in the last week of July through the first week of August are attractive crops for these pests. To maintain a trap crop longer into the fall, stagger the plantings by a couple of weeks. Monitor the peas or millet 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 leave and fly into the pecans. Before planting a trap crop, make sure you have enough available water to obtain a stand and are planting a variety of pea suited to the soil type and soil pH of the orchard. You will also need to control weeds and prevent livestock and wildlife from grazing plots.

Table 8. Suggested insecticides for controlling stinkbugs and leaffooted bugs. Read and follow label directions.

Insecticide		Concentrate per		
Active ingredient	Brand name	100 gal	acre	Remarks
Bifenthrin	Brigade® WSB	8 – 32 oz	21 days	Do not graze treated orchards.
Lambda-cyhalothrin and thiamethoxam	Endigo® ZC	3 – 5.5 oz	14 days	Do not graze treated orchards.
Zeta-cypermethrin and bifenthrin	Hero®	10.3 oz	21 days	Do not graze treated orchards.
Lambda-cyhalothrin	Grizzly Z®	2.56 – 5.12 oz	14 days	Grazing permitted.
	Kaiso 24® WG	1.33 – 2.67 oz	14 days	
	Karate® w/ zeon® tech	1.28 – 2.56 oz	14 days	
	Lambda-CY® EC	2.56 – 5.12 oz	14 days	
	Province®	2.56 – 5.12 oz	14 days	
	Silencer®	2.56 – 5.12 oz	14 days	
	Taiga Z®	2.56 – 5.12 oz	14 days	
	Warrior®	2.60 – 5.2 oz	14 days	
	Warrior II®	1.30 – 2.6 oz	14 days	
Zeta-cypermethrin	Mustang Max®	2.56 – 4 oz	21 days	Do not graze treated orchards.
	Mustang Max EC	3.20 – 4 oz	21 days	
	Respect® EC	3.20 – 4 oz	21 days	

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.



Pecan weevil

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 kernels. Full-grown larvae emerge from nuts 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 may require 3. Adult weevils begin emerging from the soil in August; their numbers peak from late August through early 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 cells, 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 cells for a 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

In most years, economic damage occurs if pecan weevils 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, the emergence of adult weevils may be completed in a week or less or last for 4 to 5 weeks or more. These variations are caused primarily by differences in soil hardness, as influenced by soil texture and rainfall or irrigation. Peak emergence typically occurs from August through mid-September.

There are several methods of detecting and monitoring 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. The pyramid trap can be bought, but it and the other types of traps can be built easily following instructions found at *http://pecankernel.tamu.edu*. Begin monitoring traps 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 shuck split.

Wire cone traps. Wire cone traps are built from ⅛-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, record the captured weevils and remove them from the traps. The number of traps you will need 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 gives an accurate population estimate that can be compared with the treatment threshold.

Pyramid or "Tedders" traps. Pyramid traps are built of two triangular pieces of ½-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 for capturing weevils.

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. 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.

Table 9. Suggested insecticides for controlling pecan weevil. Read and follow label directions.

Insecticide		Concentrate per		
Active ingredient	Brand name	100 gal	acre	Remarks
Bifenthrin	Brigade® WSB	12.8 – 32 oz	21 days	Do not graze treated orchards.
Carbaryl	Sevin® 80WSP, Sevin®80S	2.5 – 6.25 lb	14 days	Grazing allowed.
	Carbaryl® 4L	2 – 5 qt		
	Prokoz Sevin® SL	2 – 5 qt		
Lamda-cyhalothrin	Warrior®	2.6 – 5.2 oz	14 days	Grazing allowed.
	Warrior II®	1.3 – 2.6 oz	14 days	
	Grizzly Z®	2.56 – 5.12 oz	14 days	
	Kaiso 24® WG	1.33 – 2.67 oz	14 days	
	Karate® w/ zeon® tech	1.28 – 2.56 oz	14 days	
	Lambda-CY® EC	2.56 – 5.12 oz	14 days	
	Province®	2.56 – 5.12 oz	14 days	
Zeta-cypermethrin	Mustang Max® EC	3.20 – 4 oz	21 days	Do not graze treated orchards.
	Mustang Max®	2.56 – 4 oz		
	Respect® EC	3.20 – 4 oz		
Zeta-cypermethrin and bifenthrin	Hero®	10.3 oz	21 days	Do not graze treated orchards.

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.

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 other types that must be removed for harvest.

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.

Trapping merely indicates the presence and relative abundance of adult pecan weevils. The pattern of trap catches, as described above, is helpful in determining when adult weevils begin to emerge and when insecticide should be reapplied 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. This first insecticide treatment is usually made about August 20-22. A second application 7 to 10 days later is usually necessary unless drought has delayed weevil emergence from the soil. If weevils are late emerging, continue to monitor emergence and reapply the insecticide at 7- to 10-day intervals if weevils continue to emerge. Aphid infestations may increase following insecticide application for pecan weevil control.

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, physically removes grubs from the orchard and can reduce weevil infestations if done each year.

RED IMPORTED FIRE ANT

Fire ants can interfere with pecan operations such as grafting, mowing and harvesting. 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. Some formulations of chlorpyrifos are labeled for application as a broadcast spray to the orchard floor and temporarily reduce fire ants. Methoprene (Extinguish®), pyriproxyfen (Esteem®, Distance®), and hydramethylnon (AmdroPro®) are baits that 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 or months, depending on the bait product used. For additional information on fire ants, visit the Texas A&M fire ant website at *http://fireant.tamu.edu.*

Table 10. Suggested insecticides for controlling red imported fire ant. Read and follow label directions.

Insecticide		Concentrate per		
Active ingredient	Brand name	100 gal	acre	Remarks
Bearing and nonbearing orchards				
Chlorpyrifos	Lorsban® 50-W Whirlwind® Hatchet®		2 lb 4 – 8 pt 4 – 8 pt	Do not graze livestock in treated orchards. Broadcast spray applied to the orchard floor.
Methoprene	Extinguish®		1 – 1.5 lb	Livestock grazing permitted.
Pyriproxyfen	Esteem®		1.5 – 2 lb	See label.
Nonbearing orchards only				
Hydramethylnon	Amdro Pro®		1 – 1.5 lb	Do not harvest food or feed from nonbearing orchards within 1 year of application. Do not graze.
Pyriproxyfen	Distance®		1 – 1.5 lb	Do not harvest food or feed from nonbearing orchards within 1 year of application. Do not graze.

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.

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

Insecticides	Remarks
Group 1–Highly toxic Carbaryl Chlorpyrifos Cypermethrin Dimethoate Esfenvalerate Imidacloprid Imidan® Lambda-cyhalothrin Malathion Zeta-cypermethrin	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 sprays 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® Vendex®	Apply in late evening or early morning when bees are not foraging.

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

Additional Resources

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

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

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

Texas Pecan Growers Association
http://tpga.org

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

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

E-145, *Homeowner's Guide to Pests of Peaches, Plums and Pecans*

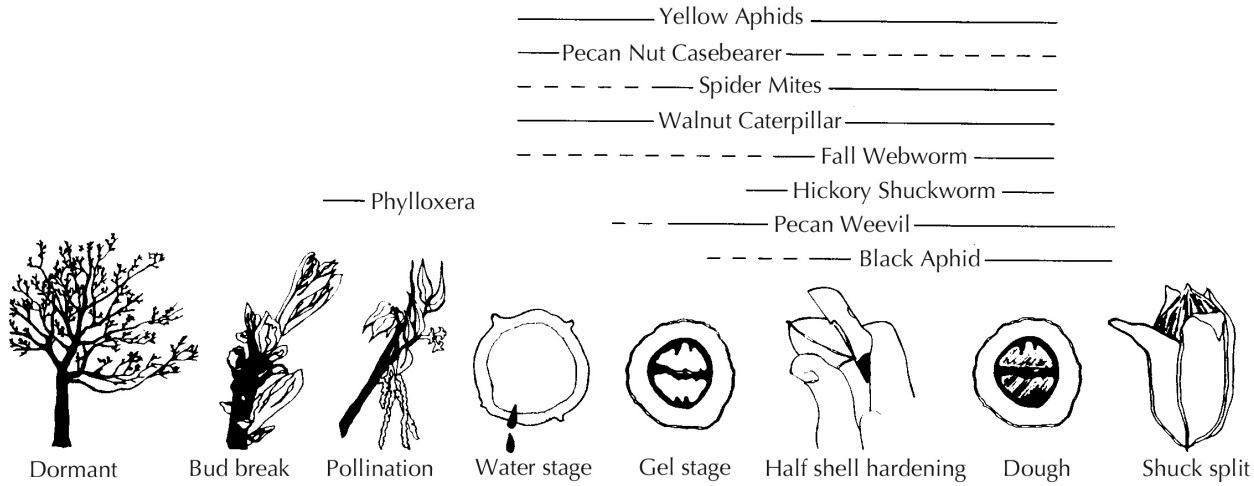
E-341, *Field Guide to the Insects and Mites Associated with Pecan*

E-173, *Controlling the Pecan Nut Casebearer*

E-343, *Controlling the Pecan Weevil*

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 monitor tree and nut development closely 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.

Table 12. Insecticides labeled for use on pecans. Read and follow label directions.

Chemical name	Trade name	Percent active ingredient (AI)	Signal word	Restricted use pesticide	Mode of action	Class	Re-entry	Grazing restrictions	PHI	OMRI Listed
Acetamiprid	Assail 30 SG	30.00	Caution	No	4	Neonicotinoid	12 hrs	allowed	14 days	No
Azadirachtin	AZA-Direct	1.20	Caution	No	unknown	Growth regulator	4 hrs	allowed	0 days	Yes
	Azatin XL	3.00	Caution	No	unknown	Growth regulator	4 hrs	allowed	0 days	No
	Azatrol EC	1.20	Caution	No	unknown	Growth regulator	4 hrs	allowed	0 days	Yes
	Ecozin 3% EC	3.00	Warning	No	unknown	Growth regulator	12 hrs	allowed	0 days	Yes
	Neemix 4.5	4.50	Warning	No	unknown	Growth regulator	12 hrs	allowed	0 days	Yes
Bifenazate	Acramite 4SC	43.20	Caution	No	unknown	unknown	12 hrs	allowed	14 days	No
Bifenthrin	Brigade WSB	10.00	Warning	Yes	3	Pyrethroid	12 hrs	no grazing	21 days	No
Bt. - kurstaki	Biobit HP	58.20	Caution	No	11	*Bacillus thuringiensis*	4 hrs	allowed	0 days	No*
	Crymax	40.00	Caution	No	11	*Bacillus thuringiensis*	4 hrs	allowed	0 days	No
	Deliver	85.00	Caution	No	11	*Bacillus thuringiensis*	4 hrs	allowed	0 days	Yes
	Dipel DF	54.00	Caution	No	11	*Bacillus thuringiensis*	4 hrs	allowed	0 days	Yes
	Dipel ES	23.70	Caution	No	11	*Bacillus thuringiensis*	4 hrs	allowed	0 days	No
	Javelin-WG	85.00	Caution	No	11	*Bacillus thuringiensis*	4 hrs	allowed	0 days	Yes
Bt. - aizawai	Agree WG	50.00	Caution	No	11	*Bacillus thuringiensis*	4 hrs	allowed	0 days	Yes
	Jackpot WP	50.00	Caution	No	11	*Bacillus thuringiensis*	4 hrs	allowed	0 days	No
	Xentari DF	54.00	Caution	No	11	*Bacillus thuringiensis*	4 hrs	allowed	0 days	No
Carbaryl	Carbaryl	43.40	Caution	No	1	Carbamate	12 hrs	allowed	14 days	No
	Prokoz Sevin SL	43.00	Caution	No	1	Carbamate	12 hrs	allowed	14 days	No
	Sevin 4F, 80WSP, 80S, XLR	several	Warning	No	1	Carbamate	12 hrs	allowed	14 days	No
Chlorantraniliprole	Altacor	35.00		No	28	Diamides	4 hrs	allowed	10 days	No
Chlorpyrifos	Chlorpyrifos 4E AG	42.50	Warning	Yes	1	Organophosphate	24 hrs	no grazing	28 days	No
	Govern 4E	44.90	Warning	Yes	1	Organophosphate	24 hrs	no grazing	28 days	No
	Hatchet	44.90	Warning	Yes	1	Organophosphate	24 hrs	no grazing	28 days	No
	Lorsban 4E, 50W	44.90	Warning	Yes	1	Organophosphate	24 hrs	no grazing	28 days	No
	Lorsban 75WG	75.00	Warning	Yes	1	Organophosphate	24 hrs	no grazing	28 days	No
	Nufos 4E	44.90	Warning	Yes	1	Organophosphate	24 hrs	no grazing	28 days	No
	Warhawk	44.90	Warning	Yes	1	Organophosphate	24 hrs	no grazing	28 days	No
	Whirlwind	44.90	Warning	Yes	1	Organophosphate	24 hrs	no grazing	28 days	No
	Yuma	44.90	Warning	Yes	1	Organophosphate	24 hrs	no grazing	28 days	No
Clothianidin	Arena 50WDG	50.00	Caution	No	4	Neonicotinoid		nonbearing trees		No
Cyfluthrin	Baythroid XL	12.70	Warning	Yes	3	Pyrethroid	12 hrs	allowed	14 days	No
	Renounce 20WP	20.00	Caution	Yes	3	Pyrethroid	12 hrs	allowed	14 days	No
	Tombstone	25.00	Danger	Yes	3	Pyrethroid	12 hrs	allowed	14 days	No

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Table 12. Insecticides labeled for use on pecans (continued).

Chemical name	Trade name	Percent active ingredient (AI)	Signal word	Restricted use pesticide	Mode of action	Class	Re-entry	Grazing restrictions	PHI	OMRI Listed
Cypermethrin	Ammo 2.5 EC	30.00	Caution	Yes	3	Pyrethroid	12 hrs	no grazing	21 days	No
	Battery 2.5 EC	30.60	Caution	Yes	3	Pyrethroid	12 hrs	no grazing	21 days	No
	Cypermethrin	30.60	Caution	Yes	3	Pyrethroid	12 hrs	no grazing	21 days	No
	Holster	30.00	Caution	Yes	3	Pyrethroid	12 hrs	no grazing	21 days	No
	UP-Cyde 2.5 EC	30.60	Caution	Yes	3	Pyrethroid	12 hrs	no grazing	21 days	No
Deltamethrin	Battalion 0.2 EC	2.86	Danger	Yes	3	Pyrethroid	12 hrs	no grazing	21 days	No
	Delta Gold	16.60	Danger	Yes	3	Pyrethroid	12 hrs	no grazing	21 days	No
Dicofol	Dicofol 4E	42.00	Caution	No	unknown	Chlorinated hydrocarbon	12 hrs	no grazing	7 days	No
	Kelthane MF	42.00	Caution	No	unknown	Chlorinated hydrocarbon	48 hrs	no grazing	7 days	No
Diflubenzuron	Dimilin 2L	22.00	Caution	Yes	15	Growth regulation	12 hrs	allowed	28 days	No
Dimethoate	Dimethoate 4E	43.50	Warning	No	1	Organophosphate	48 hrs	no grazing	21 days	No
	Dimate 4EC, 4E	44.74	Warning	No	1	Organophosphate	48 hrs	no grazing	21 days	No
	Dimethoate 4EC	44.80	Danger	No	1	Organophosphate	48 hrs	no grazing	21 days	No
	Dimethoate 4-E	43.50	Warning	No	1	Organophosphate	48 hrs	no grazing	21 days	No
	Dimethoate 5lb	57.00	Danger	No	1	Organophosphate	48 hrs	no grazing	21 days	No
Esfenvalorate	Adjourn	8.40	Warning	Yes	3	Pyrethroid	12 hrs	no grazing	21 days	No
	Asana XL	8.40	Warning	Yes	3	Pyrethroid	12 hrs	no grazing	21 days	No
	S-Fenvalostar	8.40	Warning	Yes	3	Pyrethroid	12 hrs	no grazing	21 days	No
Etoxazole	Zeal miticide	72.00	Caution	No	10	Mite growth inhibitor	12 hrs	allowed		No
Fenbutatin-oxide	Vendex 50WP	50.00	Danger	Yes	12	Organotin miticides	48 hrs	no grazing	14 days	No
Fenoxycarb	Award	1.00	Caution	No	7	Hormone mimics	12 hrs	nonbearing trees only		No
Fenpyroximate	Fujimite 5EC	5.00	Warning	No	21	Metabolism inhibitors	12 hrs	no grazing	14 days	No
	Portal	5.00	Warning	No	21	Metabolism inhibitors	12 hrs	no grazing	14 days	No
Flubendiamide	Belt SC	39.00	Caution	No	28	Diamides	12 hrs	allowed	14 days	No
Garlic juice extract	Allityn	50.00	Caution	No		Repellent	4 hrs	no grazing		No
Hexythiazox	Hexygon DF	50.00	Caution	No	10	Mite growth inhibitor	12 hrs	no grazing		No
	Onager	11.80	Caution	No	10	Mite growth inhibitor	12 hrs	no grazing	28 days	No
	Savey 50WP	50.00	Caution	No	10	Mite growth inhibitor	12 hrs	no grazing	28 days	No

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Table 12. Insecticides labeled for use on pecans (continued).

Chemical name	Trade name	Percent active ingredient (AI)	Signal word	Restricted use pesticide	Mode of action	Class	Re-entry	Grazing restrictions	PHI	OMRI Listed
Imidacloprid	Admire Pro	42.80	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Advise 2 FL, Max	21.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing		No
	Alias 2F	21.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing		No
	Couraze 1.6F	17.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Couraze 2F	21.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing		No
	Imida E-AG 1.6 F	17.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Imida E-AG 2F	21.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Impulse 1.6 F	17.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Macho 2.0 FL	21.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	soil applied	No
	Malice 75WSB	21.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing		No
	Mana Alias 4F	42.30	Caution	No	4	Neonicotinoid	12 hrs	no grazing		No
	Marathon 60W	60.00	Caution	No	4	Neonicotinoid	12 hrs	no grazing		No
	Merit 2F, 75WSP	21.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing		No
	Montana 2F	21.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Nuprid 1.6F	17.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Nuprid 2F	21.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Nuprid 4F	40.00	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Pasada 1.6F	17.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Prey 1.6	17.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Provado 1.6F	17.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Sherpa	17.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Torrent 1.6 F	17.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Torrent 2F	21.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	soil applied	No
	Trimax Pro	40.70	Caution	No	4	Neonicotinoid	12 hrs	no grazing	7 days	No
	Widow	21.40	Caution	No	4	Neonicotinoid	12 hrs	no grazing	soil applied	No
Gamma-cyhalothrin	Proaxis	5.90	Caution	Yes	3	Pyrethroid	12 hrs	no grazing	14 days	No
Lambda-cyhalothrin	Grizzly Z	11.40	Warning	Yes	3	Pyrethroid	24 hrs	allowed	14 days	No
	Kaiso 24 WG	24.00	Warning	Yes	3	Pyrethroid	24 hrs	allowed	14 days	No
	Karate w/ zeon tech	22.80	Warning	Yes	3	Pyrethroid	24 hrs	allowed	14 days	No
	Lambda-CY EC	11.40	Warning	Yes	3	Pyrethroid	24 hrs	allowed	14 days	No
	Province	11.40	Warning	Yes	3	Pyrethroid	24 hrs	allowed	14 days	No
	Silencer	12.7	Warning	Yes	3	Pyrethroid	24 hrs	allowed	14 days	No
	Taiga Z	11.4	Warning	Yes	3	Pyrethroid	24 hrs	allowed	14 days	No
	Warrior	11.4	Warning	yes	3	Pyrethroid	24 hrs	allowed	14 days	No
	Warrior II	22.8	Warning	yes	3	Pyrethroid	24 hrs	allowed	14 days	No
Malathion	Fyfanon	56.44	Warning	No	1	Organophosphate	12 hrs	no grazing	3 days	No
	Malathion 5	56.80	Warning	No	1	Organophosphate	12 hrs	allowed	0	No
	Malathion 8EC	80.75	Warning	No	1	Organophosphate	12 hrs	allowed	0	No

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Table 12. Insecticides labeled for use on pecans (continued).

Chemical name	Trade name	Percent active ingredient (AI)	Signal word	Restricted use pesticide	Mode of action	Class	Re-entry	Grazing restrictions	PHI	OMRI Listed
Methoprene	Extinguish	0.50	Caution	No	7	Growth regulator	4 hrs	allowed	not listed	No
Methoxyfenozide	Intrepid 2F	22.60	Caution	No	18	Growth regulator	4 hrs	allowed	14 days	No
Oil - horticulture	BioCover UL	98.00	Caution	No		Oil, paraffinic	4 hrs	allowed	0 days	No
	Citrus oil	99.00	Caution	No		Oil, paraffinic	12 hrs	allowed	0 days	No
	Dormant oil - 435	98.80	Caution	No		Oil, paraffinic	12 hrs	allowed	0 days	No
	JMS Stylet Oil	97.10	Caution	No		Oil, paraffinic	4 hrs	allowed	0 days	No
	Mite-E -Oil	97.10	Caution	No		Oil, paraffinic	4 hrs	allowed	0 days	No
	Purespray green	98.00	Caution	No		Oil, petroleum	4 hrs	allowed	0 days	Yes
	Superior	80.00	Caution	No		Oil, petroleum	4 hrs	allowed	0 days	No
Phosmet	Imidan 70W	70.00	Warning	No	1	Organophosphate	3 days	no grazing	14 days	No
Propargite	Omite 30WS	32.00	Danger	No	12	Metabolism inhibitors	7 days	no grazing		No
Pymetrozine	Fulfill	50.00	Caution	No	9	Feeding blocker	12 hrs	allowed	14 days	No
Pyrethrins	Pyganic EC 1.4	5.00	Warning	No	3	Pyrethroid	12 hrs	allowed	0 days	Yes
Pyridaben	Nexter miticide/ insecticide	75.00	Warning	No	21	Metabolism inhibitors	12 hrs		7 days	No
Pyriproxyfen	Distance	11.23	Caution	No	7	Hormone mimics	12 hrs	nonbearing	1 day	No
	Distance Fire Ant Bait	0.50	Caution	No	7	Hormone mimics	12 hrs	trees only		No
	Esteem Ant Bait	0.50	Caution	No	7	Hormone mimics	12 hrs			No
Spinotram	Delegate WG	0.25	Caution	No	5	Spinosyns	12 hrs	allowed	14 days	No
Spinosad	Entrust	80.00	Caution	No	5	Spinosyns	4 hrs	allowed	14 days	Yes
	SpinTor 2SC	22.80	Caution	No	5	Spinosyns	4 hrs	allowed	14 days	No
Spirodiclofen	Envidor 2 SC	22.30	Caution	No	23	Growth regulator	12 hrs	allowed	7 days	No
Spirotetramat	Movento	22.40	Caution	No	23	Growth regulator	24 hrs	allowed	7 days	No
Sulfur	That Flowable Sulfur		Caution	No	M2	Fungicide	24 hrs	allowed		No
	Sulfur, 6L, DF	52.00	Caution	No	M2	Fungicide	24 hrs	allowed		No
	Pronatural sulfur		Caution	No	M2	Fungicide	24 hrs	allowed		No
Tebufenizide	Confirm 2F	23.00	Caution	No	18	Growth regulator	4 hrs	no grazing	14 days	No
Thiamethoxam	Centric 40WG	40.00	Caution	No	4	Neonicotinoid	12 hrs	no grazing	14 days	No
zeta-cypermethrin	Mustang Max EC	9.60	Caution	Yes	3	Pyrethroid	12 hrs	no grazing		No
	Mustang Max	9.60	Warning	Yes	3	Pyrethroid	12 hrs	no grazing	14 days	No
	Respect EC	9.60	Caution	Yes	3	Pyrethroid	12 hrs	no grazing	7 days	No

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Table 12. Insecticides labeled for use on pecans (continued).

Chemical name	Trade name	Percent active ingredient (AI)	Signal word	Restricted use pesticide	Mode of action	Class	Re-entry	Grazing restrictions	PHI	OMRI Listed
Combination products										
Chlorpyrifos + Gamma-cyhalothrin	Cobalt	30.00 0.54	Danger	yes	1 and 3	Organophosphate Pyrethroid	24 hr	no grazing	28 days	No
Peppermint oil + Rosemary oil	Ectrol EC	2.00 10.00	Caution	No		Oil	0 hrs	allowed	0 days	Yes
Lambda-cyhalothrin Thiamethoxam	Endigo ZC	9.48 12.60	Warning	Yes	3 and 4	Pyrethroid Neonicotinoid	24 hrs	no grazing	14 days	No
Pyrethrins + Piperonyl butoxide	Evergreen EC 60-6	6.00 60.00	Caution	No	3	Pyrethroid	12 hrs	allowed	0 days	No
Zeta-cypermethrin + Bifenthrin	Hero	3.75 11.25	Caution	yes	3 and 3	Pyrethroid Pyrethroid	12 hrs	no grazing	21 days	No
Imidacloprid + Cyfluthrin	Leverage 2.7	17.00 12.00	Warning	Yes	3 and 4	Neonicotinoid Pyrethroid	12 hours	no grazing	14 days	No

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