

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 B-6055, *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 can

- increase the risk that pests will develop resistance to insecticides,
- reduce populations of beneficial insects that keep pests in check,
- result in secondary pest outbreaks, and
- can negatively impact human health and the environment when they are overused.

“Integrated 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 and lower risks

to the environment and to human health. 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 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 broad-spectrum 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, 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.

The frequent use of some insecticides can cause some insect pests to become resistant. Aphids are especially prone to developing resistance. 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. Soon, the insecticide is no longer effective.

Insecticides are classified according to their modes of action, or the ways they kill insect pests. The develop-

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ment of insecticide resistance can be managed by using insecticides only when necessary and rotating the use of insecticides with different modes of action, as indicated by the IRAC group number on the pesticide label. It is difficult for an insect to develop resistance to two insecticides that have different modes of action. Therefore, rotating insecticides with different modes of action is a good way to preserve the effectiveness of insecticides.

The mode of action of labeled pecan insecticides is identified by the IRAC mode of action number. To rotate insecticides, choose effective insecticides with different mode of action numbers. Rotating by brand name is often not 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 22 different brand names. Rotating among these 22 products is not an effective resistance management strategy as they are all group 4A 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. For example, 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 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 the suggested insecticide which provides the most effective, safe and economical control. All suggested materials should be considered poisonous, but proper handling reduces the hazards associated with their use. Comply with the manufacturer's label directions for handling all agricultural 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 use 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 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.



Phylloxera galls

Table 1. Suggested insecticides for controlling phylloxera. This information is provided for educational purposes. Read and follow label directions.

		Insecticide	
Active ingredient	IRAC group	Brand name	Remarks
Chlorpyrifos	1B	Govern® 4E, Hachet®, Lorsban® 4E, Lorsban® 50W, Lorsban® 75WG Nufos® 4E, Warhawk® Whirlwind®, Yuma 4E®	Do not graze livestock in treated orchards. Scout for aphids and other secondary pests which may increase to damaging levels when this and other broad spectrum insecticides are used.
Imidachloprid	4A	Provado® 1.6 F Malice® 75 WSP Montana® 2F Pasada® 1.6F Trimax Pro® AmTide Imidacloprid 2F AmTide Imidacloprid 4F Lada 2F Mallet 75 WSP Phoenix Hawk 2L Prey 1.6 Provado 1.6F Sherpa Wrangler	Do not graze livestock in treated orchards.
Malathion	1B	Malathion® 5EC Malathion® 8EC	Grazing allowed. Scout for aphids and other secondary pests which may increase to damaging levels when this and other broad spectrum insecticides are used.
Lambda-cyhalothrin	3A	Grizzly Z Karate w/ zeon tech Karate Kendo Lambda-CY EC LambdaStar LambdaStar 1CS Lambda-T, Lamcap Lambda-Cyhalothrin 1 EC Paradigm Province Silencer Warrior Warrior II	Grazing allowed. Scout for aphids and other secondary pests which may increase to damaging levels when this and other broad spectrum insecticides are used.

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.

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 development 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.

Sawfly

Sawfly larvae feed on the underside of pecan leaves in the spring. Sawfly larvae resemble caterpillars but they are actually larvae of a wasp. Sawfly larvae have 6 sets of abdominal prolegs, while larvae of moths and butterflies have 1 to 4 sets of abdominal prolegs. Two species are found on pecan. The larva of one species is shiny green and its feeding results in small holes cut in the leaf. The larva of the other species is yellowish brown to orange with black spots along the body, and these larvae generally consume the entire leaf. There is only one generation a year. There are no guidelines to assist producers in making treatment decisions.

June beetles

June beetles are brown to brownish-red, hard-bodied beetles about 1/2- to 3/4-inch long. June beetles feed on pecan leaves at night and large numbers of beetles can defoliate pecan trees almost overnight. Look for beetles feeding on leaves at night. It is often difficult to diagnose them as the cause of the leaf feeding in pecans because June beetles hide just below the soil surface during the day. Damage occurs in the spring when beetles emerge from the soil. Immature June beetles, called white grubs, feed on grass roots and are not a pest of pecans.

Table 2. Suggested insecticides for controlling sawfly. This information is provided for educational purposes. Read and follow label directions.

Insecticide			
Active ingredient	IRAC group	Brand name	Remarks
Chlorpyrifos	1B	Govern® 4E, Hachet®, Lorsban® 4E, Lorsban® 50W, Lorsban® 75WG Nufos® 4E, Warhawk® Whirlwind®, Yuma 4E®	Do not graze livestock in treated orchards. Scout for aphids and other secondary pests which may increase to damaging levels when this and other broad spectrum insecticides are used.
malathion	1B	Malathion® 5EC Malathion® 8EC	Grazing allowed. Scout for aphids and other secondary pests which may increase to damaging levels when this and other broad spectrum insecticides are used.

Table 3. Suggested insecticides for controlling June beetle adults. This information is provided for educational purposes. Read and follow label directions

Insecticide			
Active ingredient	IRAC group	Brand name	Remarks
Chlorpyrifos	1B	Govern® 4E, Hachet®, Lorsban® 4E, Lorsban® 50W, Lorsban® 75WG Nufos® 4E, Warhawk® Whirlwind®, Yuma 4E®	Do not graze livestock in treated orchards. Scout for aphids and other secondary pests which may increase to damaging levels when this and other broad spectrum insecticides are used.
malathion	1B	Malathion® 5EC Malathion® 8EC	Grazing allowed. Scout for aphids and other secondary pests which may increase to damaging levels when this and other broad spectrum insecticides are used.

PECAN NUT CASEBEARER

Damage

The pecan nut casebearer is found in all pecan-growing areas of Texas and can cause serious crop loss almost every year if left uncontrolled. Casebearer larvae or caterpillars feed inside



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

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 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 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 eggs for the second-generation 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 sufficiently 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 tiny, tough, 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.

Table 4. Suggested insecticides for controlling pecan nut casebearer, walnut caterpillar, and fall webworm. This information is provided for educational purposes. Read and follow label directions.

Insecticide			
Active ingredient	IRAC group	Brand name	Remarks
<i>Bacillus thuringiensis</i>	11A	Javelin-WG® Crymax® Deliver®	Bt insecticides have short residual activity, multiple applications may be needed for control
Methoxyfenozide	18	Intrepid® 2F	Grazing allowed
Spinetoram	5	Delegate®	Grazing allowed
Spinosad	5	Entrust*® SpinTor® 2SC, Success®	Grazing allowed
Tebufenizide	18	Confirm® 2F	Do not graze livestock in treated orchards
Chlorantraniliprole	28	Altacor	Grazing allowed
Methoxyfenozide + Spinetoram	5 18	Intrepid Edge	Grazing allowed
Flubendiamate	28	Belt SC	Grazing allowed

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

Note: Other insecticides, including chlorpyrifos, pyrethroid insecticides, combinations of these active ingredients, and malathion, are also labeled for PNC control in pecans. However, these broad spectrum insecticides can have a negative impact on beneficial insects and increase the risk of outbreaks of other pests. For this reason, only insecticides that target primarily pecan nut casebearer and other related caterpillar pests are included in this table. See Table 12 for list of all insecticides labeled

Control

Often a single, carefully timed insecticide application adequately controls above-threshold populations of first-generation casebearer. 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

The PNCforecast System is a web-based tool that pecan growers can use to determine when to scout for pecan nut casebearer (PNC) eggs in the spring and anticipate when an insecticide, if needed, should be applied. To use the PNCforecast System, you must monitor PNC moth flight in your orchard using PNC pheromone traps as described in the next section. The PNCforecast System uses PNC moth trap data to estimate egg-laying activity during the next 2 to 3 weeks and is therefore customized to the unique conditions of the orchard where the trap data were collected. The PNCforecast System is available on-line at <http://pecan.ipmpipe.org>.

The PNCforecast System calculates dates when first generation eggs are expected to be present in the orchard and the optimum dates to begin scouting the orchard for PNC eggs. Egg laying can vary by as much as 2 to 3 weeks, so knowing when to look for eggs can save time and help reduce the risk of missing egg laying activity. The PNCforecast System does not predict if you need to apply an insecticide—it estimates the optimum dates for scouting

the orchard for PNC eggs to determine if an insecticide treatment is justified.

To generate a PNCforecast, you need to know the date when PNC moths begin flying in your orchard. To be sure you capture the first PNC moths in the spring, you must place your traps in the orchard before the first moths fly. 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. Record the number of captured PNC moths every 1 to 2 days. If no PNC moths are present, enter a zero for that date. Once traps are in the orchard, there should be several inspection dates when no moths are captured to be sure the first moths that appear in your traps are indeed the first ones of the spring flight.

The date when you first capture PNC moths in your traps is very important in generating a reliable forecast. 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. Once you know the date of first moth capture, no additional trap data is needed to generate a PNCforecast. You can, however, continue to record trap captures to compare year to year PNC activity.

Examples

	May 1	May 2	May 3	May 6	May 8	May 9	“First” Month
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 know the date of the first moth capture, you are ready to generate a PNC forecast for your orchard. Log onto: <http://pecan.ipmpipe.org>. At the home page, select “Maps” and then under PNC Forecast Map click on “Forecast PNC risk.” After reading the “Warning” statement, close the text box using the X at the top right. At the top left, select “Choose Location” and use the arrows in the circle at the top left to find your orchard on the map. Use the magnifying glass to zoom in and out on the map. Once the map is fully magnified and the cursor is at your orchard location, right click. This will place a red pin at your orchard site. The PNCForecast will use the average temperature expected at this location during the next 2 to 3 weeks to predict PNC development. Next, at the top right of your screen, at “Set Biofix”, click on “Select Date” and use the calendar to enter the date on which

you captured the first PNC moths in traps at this orchard location. Once you enter this date, the site will generate a PNC forecast both as a graph and table. The PNCforecast table lists the dates when 10, 25, 50, 75 and 90 percent of all first generation PNC eggs are expected to be present in the orchard. An example is shown below.

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

Begin scouting for casebearer eggs on the dates of 25 to 50 percent egg-lay. In the example of a PNCforecast Output above, 25 percent of the total eggs of the first generation are expected to be present on May 10 and 50 percent are expected to be present on May 13. The first generation egg-laying period is expected to be nearly complete on May 19 when 90 percent of all expected eggs are predicted to be present.

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 PNCforecast System also provides information on casebearer egg-laying activity from selected sites in Texas and other states. These forecasts are based upon data collected by Extension agents, entomologists, Master Gardeners, and cooperating pecan growers. 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 onto <http://pecan.ipmpipe.org> and under the Maps option select PNC Risk Map.

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 (see discussion above on When to Scout for Eggs). If you are using the PNC Risk Map at <http://pecan.ipmpipe.org>, begin scouting on the Decision Window dates nearest 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 (see discussion above on When to Scout for 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 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. 6) 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

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*.

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



Black-margined aphid

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, both males and females occur, 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.

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 applications of pyrethroid insecticides Group 3A

(lambda-cyhalothrin, zeta-cypermethrin, etc.) and chlorpyrifos (Group 1B) may be followed by large increases in yellow aphids. If this occurs, rotate to an insecticide not in Group 3A or 1B. Also, frequent use of products containing imidacloprid (Group 4) may increase aphid resistance, leading to control failures. To reduce this risk, rotate with an insecticide not in the class 4 group (Table 5). For further information on managing insecticide resistance, see the discussion under Pest Management Principles.

Table 5. Suggested insecticide to control yellow pecan aphids (blackmargined and yellow pecan aphids) and black aphids. This information is provided for educational purposes only. Read and follow label directions.

Insecticide			
Active ingredient	IRAC group	Brand name	Remarks
Imidachloprid*	4A	Admire® Pro	Do not graze livestock
		Advise® 2 FL, Max	
		Alias 2F	
		AmTide Imidacloprid 2F	
		Amtide Imidacloprid 4F	
		Couraze® 1.6F	
		Couraze® 2F	
		Couraze 4F	
		Lada 2F	
		Imida® E-AG 1.6 F	
		Imida® E-AG 2F	
		Impulse® 1.6 F	
		Macho® 2.0 FL	
		Malice® 75WSP	
		Mana® Alias 4F	
		Merit® 2F, 75WSP	
		Montana® 2F	
		Nuprid® 1.6F	
		Nuprid® 2F	
		Nuprid® 4F	
Pasada® 1.6F			
Prey® 1.6			
Provado® 1.6F			
Sherpa®			
Trimax Pro®			
Widow®			
Wrangler			
Clothianidin	4A	Belay Arena	Do not graze
Flonicamid	9C	Beleaf 50SG, Carbine 50WG	Do not graze livestock, 40 day PHI
Pymetrozine	9B	Fulfill	Grazing allowed
Thiamethoxam	4A	Centric 40WG Flagship 25WG	Centric can be applied to bearing trees. Flagship can only be applied to nonbearing trees only.
Dimethoate	1B	Dimethoate® 4E Dimate® 4EC, 4E Dimethoate® 4EC Dimethoate® 5lb	Do not graze livestock in treated orchards. Marginal control of yellow aphids has been observed

Admire, Macho, and Widow labeled for only as a soil application though the irrigation system. See label.

* Repeated application of imidachloprid can select for insecticide resistance in aphids and lead to control failures.

Caution: In some locations in the state, yellow aphids resistant to Group 4A insecticides have been identified. In these orchards, the use of insecticides in this group may not be effective. Repeated use of any insecticide can select for insecticide resistance and control failure. To minimize development of insecticide resistant aphids, rotate insecticides between IRAC Groups.

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 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.



Hickory shuckworm damage

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.

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.

Table 6. Suggested insecticides for controlling hickory shuckworm. This information is provided for educational purposes. Always read and follow label directions.

Insecticide			
Active ingredient	IRAC group	Brand name	Remarks
Methoxyfenozide	18	Intrepid® 2F	Grazing allowed
Spinosad	5	Entrust® SpinTor® 2SC	Livestock grazing permitted
Tebufenizide	18	Confirm® 2F	Do not graze livestock in treated orchards
Methoxyfenozide + Spinetoram	5 18	Intrepid Edge	Grazing allowed
Chlorantraniliprole	28	Altacor	Grazing allowed
Flubendiamide	28	Belt SC	Grazing allowed

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

PECAN LEAF SCORCH 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.

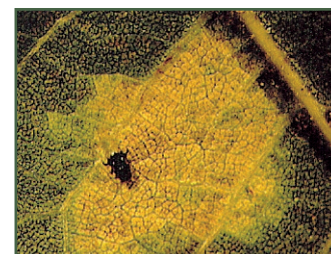
Control

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. An average of three black

pecan aphids per compound leaf can cause severe leaf damage and defoliation. Although they sometimes can be found on the upper side of the leaf, black pecan aphids feed primarily on the undersides of leaves and occur 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.

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 can increase rapidly. Note that yellow pecan aphids that are parasitized will turn black, and can be confused with black pecan aphids. Parasitized aphids are dead and stuck on the leaf surface and do not move while live black pecan aphids quickly fly when disturbed.

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

Table 7. Suggested insecticides to control pecan leaf scorch mite. This information is provided for educational purposes. Read and follow label directions.

Insecticide			
Active ingredient	IRAC group	Brand name	Remarks
Fenbutatin-oxide	12B	Vendex® 50 WP	Do not apply within 14 days of harvest.
Dicofol	unknown	Kelthane® MF	Do not apply within 7 days of harvest
Hexythiazox	10A	Onager® Savey® 50 DF Hexygon DF Hexy 2E	For non-bearing orchards only. Do not graze treated orchards.
Bifenazate	unknown	Acramite® 50 SC	Do not graze treated orchards.
Spirodiclofen	23	Envidor® 2 SC	Grazing allowed
Cyflumetofen	25	Nealta	Grazing allowed
Fenazaquin	21	Magus	Non-bearing trees only
Fenpyroximate	21A	Fujimite 5EC Portal XLO	Grazing allowed Grazing allowed

infestation often begins. In general, treat when black pecan aphids average three per compound leaf.

In most cases, black pecan aphids are easier to control with insecticides than yellow aphids. Insecticides for black pecan aphid are listed in Table 4. 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 leaf-footed 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 leaf-footed bugs have piercing-sucking mouthparts and penetrate the shuck to feed on the developing kernel. 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.



Stink bug

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.

Control

Brown stinkbugs are more difficult to kill with insecticides than are green stinkbugs and leaf-footed 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 leaf-footed 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 leaf-footed and stink bugs when the plants begin to bloom and set seed. Apply an insecticide to the trap crop to kill stink bugs and leaf-footed bugs once the crop stops blooming and is maturing seed. 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.

GRASSHOPPERS

Grasshoppers can move into pecan orchards from adjacent crops, pastures and weedy areas and feed on pecan leaves and developing nuts. Weed control in and around

Table 8. Suggested insecticides for control of stinkbugs and leaf-footed bugs. This information is provided for educational purposes. Read and follow label directions.

Insecticide			
Active ingredient	IRAC group	Brand name	Remarks
Bifenthrin	3A	Brigade® WSB Brigade 2EC Bifen 2 AG Gold Bifenture EC Bifenture 10F Fanfare ES Fanfare 2EC Sniper	Do not graze treated orchards.
Lambda-cyhalothrin and thiamethoxam	3A and 4A	Endigo® ZC	Do not graze treated orchards.
Zeta-cypermethrin and bifenthrin	3A and 3A	Hero®	Do not graze treated orchards.
Lambda-cyhalothrin	3A	Grizzly Z®, Kaiso 24® WG, Karate® w/ zeon® tech, Lambda-CY® EC, Province® Silencer®, Taiga Z® Warrior® Warrior II®	Grazing permitted
Zeta-cypermethrin	3A	Mustang Max®, Mustang Max EC, Respect® EC	Do not graze treated orchards

Table 9. Suggested insecticides for controlling grasshoppers. This information is provided for educational purposes. Read and follow label directions

Insecticide			
Active ingredient	IRAC group	Brand name	Remarks
carbaryl	1A	Carbaryl Prokoz Sevin SL Sevin 4F, 80WSP, 80S, XLR	Only treat orchard floor and surrounding areas to avoid killing beneficial insects in canopy.
chlorantraniliprole	28	Altacor	Grazing allowed
diflubenzuron	15	Dimilin 2L	Only effective on immature (without wings) stages
chlorpyrifos	1B	Govern® 4E, Hachet®, Lorsban® 4E, Lorsban® 50W, Lorsban® 75WG Nufos® 4E, Warhawk® Whirlwind®, Yuma 4E®	Do not graze livestock in treated orchards. Scout for aphids and other secondary pests which may increase when broad spectrum insecticides are used.

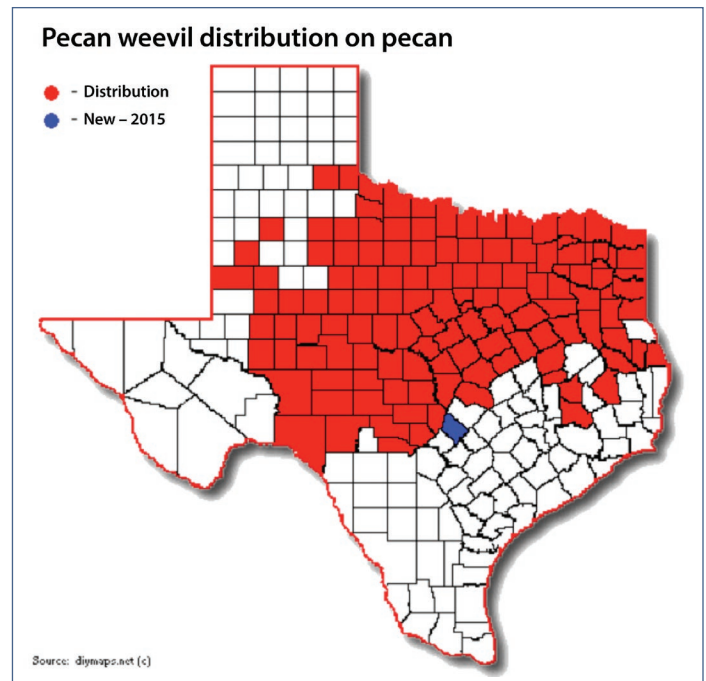
the orchard can deprive grasshoppers of food. Pyrethroid insecticides (lambda-cyhalothrin, zeta-cypermethrin, bifenthrin), chlorpyrifos and carbaryl labeled for use in pecans, kill grasshoppers. However, their residual control is limited and frequent reapplication may be required when grasshoppers continue to move into the orchard from adjacent areas. Treat the orchard floor, fence rows and areas surrounding the orchard to create a buffer zone.

PECAN WEEVIL

The pecan weevil is found throughout most of Texas (see map). Where present, 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.

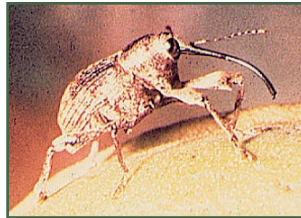


Records of pecan weevil presence in Texas counties, 2015

Table 10. Suggested insecticides for control of pecan weevil. This information is provided for educational purposes. Read and follow label directions.

Insecticide				
Active ingredient	IRAC group	Brand name	Pre-harvest interval	Remarks
Bifenthrin	3A	Brigade® WSB, Brigade 2EC, Bifen 2 AG Gold, Bifenture EC Bifenture 10F, Fanfare ES, Fanfare 2EC, Sniper	21 days	Do not graze treated orchards.
Carbaryl	1A	Sevin® 80WSP, Sevin®80S, Carbaryl® 4L, Prokoz Sevin® SL	14 days	Grazing allowed
Lambda-cyhalothrin	3A	Warrior®, Warrior II®, Grizzly Z® Kaiso 24® WG, Karate® w/ zeon® tech, Lambda-CY® EC, Province®	14 days "	Grazing allowed
Zeta-cypermethrin	3A	Mustang Max® EC, Mustang Max® Respect® EC	21 days	Do not graze treated orchards.
Zeta-cypermethrin and bifenthrin	3A and 3A	Hero®	21 days	Do not graze treated orchards.

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.



Pecan weevil

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 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, 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 “Teddies” traps. Pyramid traps are built of two triangular 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 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.

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 can be 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>.

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 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.

For more information on protecting pollinators, see <http://www.xerces.org>

Insecticides	Remarks
Group 1—Highly toxic	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.
Carbaryl	
Chlorpyrifos	
Cypermethrin	
Dimethoate	
Esfenvalerate	
Imidacloprid	
Imidan®	
Lambda-cyhalothrin	
Malathion	
Zeta-cypermethrin	
Group 2—Moderately toxic	Do not apply when bees are working in the field. Apply in late evening.
Malathion (EC)	
Spinosad (Entrust®, SpinTor®)	
Group 3—Relatively nontoxic	Apply in late evening or early morning when bees are not foraging
<i>Bacillus thuringiensis</i>	
Confirm® 2F	
Dimilin®	
Intrepid®	
Kelthane®	
Vendex®	

Table 11. Suggested insecticides for control of red imported fire ant. This information is provided for educational purposes. Read and follow label directions.

Insecticide			
Active ingredient	IRAC group	Brand name	Remarks
Bearing and nonbearing orchards			
Chlorpyrifos	1B	Lorsban® 50-W Whirlwind® Hatchet®	Do not graze livestock in treated orchards. Broadcast spray applied to the orchard floor.
Methoprene	7	Extinguish®	Livestock grazing permitted
Pyriproxyfen	7	Esteem®	See label
For Nonbearing Orchards Only			
Hydramethylnon		Amdro Pro®	Do not harvest food or feed from nonbearing orchards within one year of application. Do not graze.
Pyriproxyfen	7	Distance®	Do not harvest food or feed from nonbearing orchards within one year of application. Do not graze.

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>

PNCforecast System <http://pecan.ipmpipe.org>.

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

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

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

E-173, *Controlling the Pecan Nut Casebearer*

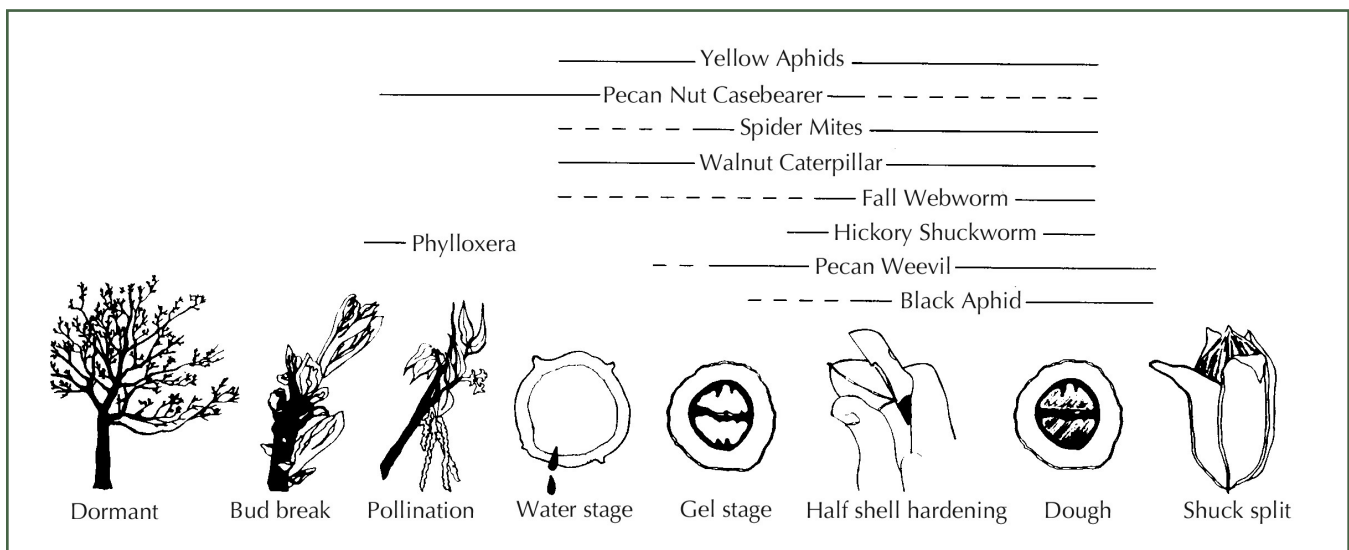
E-343, *Controlling the Pecan Weevil*

E-041: *Walnut Caterpillar*

E-042: *Fall Webworm*

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 the label directions.

Chemical name	Trade name	Company/ Manufacture	Percent Active Ingredient (AI)	Signal word	Restricted use pesticide	IRAC* Mode of action Main group	Class	Reentry	Grazing restrictions	PHI	OMRI Listed	
Single Active Ingredient Pesticides												
Abamectin	Abacus Abba Abba ultra Agri-Mek SC Agri-Mek 0.15EC Borrada Syngenta Epi-Mek 0.15 EC Reaper ClearForm, Advanced Zoro	Rotam North America, Inc MANA of North America MANA of North America Syngenta Syngenta Makhteshim of NA Syngenta Loveland Cheminova, Inc.	2 1.9 3.74 8 2 1.9 2 2 1.9	Warning Warning Warning Warning Warning Warning Warning Warning Warning	Yes Yes Yes Yes Yes Yes Yes Yes Yes	6 6 6 6 6 6 6 6 6	Nerve, muscle actions Nerve, muscle actions Nerve, muscle actions Nerve, muscle actions Nerve, muscle actions Nerve, muscle actions Nerve, muscle actions Nerve, muscle actions Nerve, muscle actions	12 hrs 12 hrs 12 hrs 12 hrs 12 hrs 12 hrs 12 hrs 12 hrs 12 hrs	No grazing No grazing No grazing No grazing No grazing No grazing No grazing No grazing No grazing	21 days 21 days 21 days 21 days 21 days 21 days 21 days 21 days 21 days	No No No No No No No No No	Mites Mites Mites Mites Mites Mites Mites Mites Mites
Acequinocyl	Kanemite 15 SC	Arysta LifeScience NA	15.8	Caution	No	20B		12 hrs	Grazing allowed	7 days	No	Mites
Acetamiprid	Assail 30 SG Assail 70WP TriStar 30 SG	United Phosphorus United Phosphorus Cleary	30.00 70.00 30.00	Caution Caution Caution	No No No	4A 4A 4A	Neonicotinoid Neonicotinoid Neonicotinoid	12 hrs 12 hrs 12 hrs	Grazing allowed Grazing allowed No	14 days 14 days 7 days	No No No	Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, glassy-winged sharpshooter Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, glassy-winged sharpshooter Non-bearing trees only - aphids, fall webworm, walnut caterpillar, caterpillars
Alpha-cypermethrin	Fastac	BASF	10.90	Danger	Yes	3A	Pyrethroid	12 hrs	Grazing allowed	7 days	No	Black pecan aphid, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, phylloxera, pecan weevil, stink bug, yellow pecan aphid
Azadirachtin	AZA-Direct Azatin XL Azatrol EC Ecozin 3% EC Ecozin Plus Molt-X Neemix 4.5	Gowan OHP, Inc. PBI Gordon Corp Amvac Chemical Corp. Amvac Chemical Corp. BioWorks, Inc. Cerris USA	1.20 3.00 1.20 3.00 1.20 3 4.50	Caution Caution Caution Warning Caution Caution Warning	No No No No No No No	Unknown Unknown Unknown Unknown Unknown Unknown Unknown	Growth regulator Growth regulator Growth regulator Growth regulator Botanically based Growth regulator	4 hrs 4 hrs 4 hrs 12 hrs 4 hrs 4 hrs 12 hrs	Grazing allowed Grazing allowed Grazing allowed Grazing allowed Grazing allowed Grazing allowed Grazing allowed	0 days 0 days 0 days 0 days 0 days 0 days 0 days	Yes No Yes Yes Yes Yes No	Aphids, true bugs, caterpillars, mites Aphids, sawflies, June beetles, leafminers, Aphids, mites, true bugs, leafrollers, beetles, weevils Spittle bugs, stink bugs, pecan nut casebearer, hickory shuckworm, serpentine leafminers Aphids, stink bugs, hickory shuckworm, Hickory shuckworm, twig girdler Black margined aphid, fall webworm, pecan nut casebearer, walnut caterpillar, hickory shuckworm, serpentine leafminer, spittle bug, leaf and stem phylloxera, grass hopper
Bifenazate	Acramite 45C-, 50WS Brigade W5B,	Chemtura Corp. FMC	43.20 10.00	Caution Warning	No Yes	Unknown 3A	Unknown Pyrethroid	12 hrs 12 hrs	Grazing allowed No Grazing	14 days 21 days	No No	Pecan leaf scorch mite Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, leaffooted bug, stink bug, pecan weevil
Bifenthrin	Brigade 2EC Bifen 2 AG Gold	FMC Direct Ag Source	25.10 25.10	Warning Warning	Yes Yes	3A 3A	Pyrethroid Pyrethroid	12 hrs 12 hrs	No grazing No grazing	21 days 21 days	No No	Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, leaffooted bug, stink bug, pecan weevil
Bifenture EC	Bifenture 10F	United Phosphorus, Inc. United Phosphorus, Inc.	25.1 10	Warning Caution	Yes Yes	3A 3A	Pyrethroid Pyrethroid	12 hrs 12 hrs	No grazing No grazing	21 days 21 days	No No	Black pecan aphid, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, phylloxera, stink bugs, yellow pecan aphids
Bisect Fanfare ES	Bisect Fanfare ES	Loveland Products, Inc. MANA of North America	79 22.6	Caution Warning	No Yes	3A 3A	Pyrethroid Pyrethroid	12 hrs 12 hrs	No grazing No grazing	21 days 21 days	No No	Black pecan aphid, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, phylloxera, stink bugs, yellow pecan aphids
Fanfare 2EC	Fanfare 2EC	MANA of North America	25.1	Warning	Yes	3A	Pyrethroid	12 hrs	No grazing	21 days	No	Black pecan aphid, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, phylloxera, stink bugs, yellow pecan aphids
Sniper	Sniper	Loveland Products, Inc.	25	Warning	Yes	3A	Pyrethroid	12 hrs	No grazing	21 days	No	Black pecan aphid, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, phylloxera, stink bugs, yellow pecan aphids
Beauveria bassiana	BotaniGard ES Mycotrio	Laverlam International Laverlam International	1130.00% 109	Caution Caution	No No		Biological Biological	4 hrs 4 hrs	Grazing allowed Grazing allowed	0 days 0 days	No Yes	Grasshoppers, pecan weevil

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

Chemical name	Trade name	Company/ Manufacture	Percent Active Ingredient (AI)	Signal word	Restricted use pesticide	IRAC* Mode of action Main group	Class	Reentry	Grazing restrictions	PHI	OMRI Listed	
Single Active Ingredient Pesticides												
Bt - kurstaki	Biobit HP Crymax Deliver Dipel DF Javelin-WG	Valent USA Certs Certs USA Valent USA Certs	58.20 40.00 85.00 54.00 85.00 40.00	Caution Caution Caution Caution Warning	No No No No No	11A 11A 11A 11A 11A	Bacillus thuringiensis Bacillus thuringiensis Bacillus thuringiensis Bacillus thuringiensis Bacillus thuringiensis	4 hrs 4 hrs 4 hrs 4 hrs 12 hrs	Grazing allowed Grazing allowed Grazing allowed Grazing allowed Grazing allowed	0 days 0 days 0 days 0 days	No * No Yes Yes Yes	
Bt - aizawai	Agree WG Jackpot WP XenTari DF	Certs USA Certs USA Valent USA	50.00 50.00 54.00	Caution Caution Caution	No No No	11A 11A 11A	Bacillus thuringiensis Bacillus thuringiensis Bacillus thuringiensis	4 hrs 4 hrs 4 hrs	Grazing allowed Grazing allowed Grazing allowed	0 days 0 days 0 days	Yes No No No * No	
Buprofezin	Centaur WDG	Nichino	70.00	Caution	No	16	Insect growth regulator	12 hrs	Grazing allowed	60 days	No	
Capsicum oleoresin extract	Captiva	Gowan	7.60	Caution	No		Insect repellent	4 hrs	Grazing allowed		No	
Carbaryl	Carbaryl	Drexel Chemical Company	43.40	Caution	No	1A	Carbamate	12 hrs	Grazing allowed	14 days	No	
	ProkozSevin 5L	PROKOZ	43.00	Caution	No	1A	Carbamate	12 hrs	Grazing allowed	14 days	No	
	Sevin 4F-80WSP, 80S, XLR	Loveland, Bayer, Wilbur Ellis	Several	Warning	No	1A	Carbamate	12 hrs	Grazing allowed	14 days	No	
Chenopodium ambrosioides	Requiem	Bayer	16.75	Caution	No			4 hrs			No	
Chlorantraniliprole	Altacor	DuPont	35.00	No signal word	No	28	Diamides	4 hrs	Grazing allowed	10 days	No	
Chlorpyrifos	Chlorpyrifos 4E AG Govern 4E Hatchet Lorsban 4E, 50W Lorsban 75WG Lorsban Advanced	MANA TENKOZ, Inc. Dow AgroSciences Dow AgroSciences Gowan Dow AgroSciences	42.50 44.90 44.90 44.90 75.00 40.20	Warning Warning Warning Warning Warning Warning	Yes Yes Yes Yes Yes Yes	1B 1B 1B 1B 1B 1B	Organophosphate Organophosphate Organophosphate Organophosphate Organophosphate Organophosphate	24 hrs 24 hrs 24 hrs 24 hrs 24 hrs 24 hrs	No grazing No grazing No grazing No grazing No grazing No grazing	28 days 28 days 28 days 28 days 28 days 28 days	No No No No No No	
	Nufos 4E	Cheminova	44.90	Warning	Yes	1B	Organophosphate	24 hrs	No grazing	28 days	No	
	Vulcan	MANA	39.5	Warning	Yes	1B	Organophosphate	12 hrs	No grazing	28 days	No	
	Warhawk	Loveland Products	44.90	Warning	Yes	1B	Organophosphate	24 hrs	No grazing	28 days	No	
	Whirlwind	Helena	44.90	Warning	Yes	1B	Organophosphate	24 hrs	No grazing	28 days	No	
	Yuma	Winfield Solutions	44.90	Warning	Yes	1B	Organophosphate	24 hrs	No grazing	28 days	No	
Clothianidin	Arena 50WDG Belay	Valent USA Valent USA	50.00 23.60	Caution Caution	No No	4A 4A	Neonicotinoid Neonicotinoid	12 hrs	Nonbearing trees No grazing	21 days	No No	

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

Chemical name	Trade name	Company/ Manufacture	Percent Active Ingredient (AI)	Signal word	Restricted use pesticide	IRAC* Mode of action Main group	Class	Reentry	Grazing restrictions	PHI	OMRI Listed	
Single Active Ingredient Pesticides												
Chromobacterium subtugae	Grandevo	Marrone	30.00	Caution	No		Biological	4 hrs	Grazing allowed	0 days	Yes	Fall webworm, hickory shuckworm, pecan nut casebearer, aphids, mites, pecan weevil
Cyrantranilprole	Exirel Mainspring	DuPont Sygenta	10.20 18.66	Caution None listed	No No	28 28		12 hrs 4 hrs	Grazing allowed Grazing allowed	5 days Non bearing trees	No No	Hickory shuckworm, pecan nut casebearer Aphids
cyflumetofen	Nealta	BASF	18.70	Caution	No	25		12 hrs			No	Mites
Cyfluthrin	Baythroid XL	Bayer CropScience	12.70	Warning	Yes	3A	Pyrethroid	12 hrs	Grazing allowed	14 days	No	Leaffooted bug, pecan nut casebearer, pecan weevil, hickory shuckworm, spittle bug
	Renounce 20WP	Bayer CropScience	20.00	Caution	Yes	3A	Pyrethroid	12 hrs	Grazing allowed	14 days	No	Leaffooted bug, pecan nut casebearer, pecan weevil, hickory shuckworm, spittle bug, stink bugs
	Tombstone	Loveland Products	25.00	Danger	Yes	3A	Pyrethroid	12 hrs	Grazing allowed	14 days	No	Leaffooted bug, pecan nut casebearer, pecan weevil, stink bug, hickory shuckworm
Cypermethrin	Ammo 2.5 EC	Helena	30.00	Caution	Yes	3A	Pyrethroid	12 hrs	No grazing	21 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan weevil
	Battery 2.5 EC	Winfield Solutions	0.30	Caution	Yes	3A	Pyrethroid	12 hrs	No grazing	21 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan weevil
	Cypermethrin	TENKOZ, Inc.	30.60	Caution	Yes	3A	Pyrethroid	12 hrs	No grazing	21 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan weevil
	Holster	Loveland Products, Inc.	30.00	Caution	Yes	3A	Pyrethroid	12 hrs	No grazing	21 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan weevil
	UP-Cyde 2.5 EC	United Phosphorus, Inc.	30.60	Caution	Yes	3A	Pyrethroid	12 hrs	No grazing	21 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan weevil
Deltamethrin	Battalion 0.2 EC	Winfield Solutions	2.86	Danger	Yes	3A	Pyrethroid	12 hrs	No grazing	21 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, stink bugs
	Delta Gold	Winfield Solutions	16.60	Danger	Yes	3A	Pyrethroid	12 hrs	No grazing	21 days	No	Hickory shuckworm, pecan nut casebearer, pecan weevil, stink bug
Dicofol	Dicofol 4E	MANA	42.00	Caution	No	Unknown	Chlorinated hydrocarbon	49 days	No grazing	7 days	No	Mites
	kelthane MF	Dow AgroSciences	42.00	Caution	No	Unknown	Chlorinated hydrocarbon	48 hrs	No grazing	7 days	No	Mites
Diflubenzuron	Dimilin 2L	Chemtura Corp.	22.00	Caution	Yes	15	Growth regulation	12 hrs	Grazing allowed	28 days	No	Hickory shuckworm, pecan nut casebearer, fall webworm, walnut caterpillar, pecan weevil – suppression
Dimethoate	Dimethoate 4E	Chemnova, Inc.	43.50	Warning	No	1B	Organophosphate	48 hrs	No grazing	21 days	No	Aphids, mites, leafhoppers
	Dimate 4EC, 4E	Winfield Solutions	44.74	Warning	No	1B	Organophosphate	48 hrs	No grazing	21 days	No	Aphids, mites, leafhoppers
	Dimethoate 4EC	Drexel Chemical Company	44.80	Danger	No	1B	Organophosphate	48 hrs	No grazing	21 days	No	Aphids, mites, leafhoppers
	Dimethoate 4-E	Chemnova, Inc.	43.50	Warning	No	1B	Organophosphate	48 hrs	No grazing	21 days	No	Aphids, mites, leafhoppers
	Dimethoate 5lb	Chemnova, Inc.	57.00	Danger	No	1B	Organophosphate	48 hrs	No grazing	21 days	No	Aphids, mites, leafhoppers
	Dimethoate 400	Helena Loveland	43.50	Warning	No	1B	Organophosphate	48 hrs	No grazing	21 days	No	Aphids, mites, leafhoppers
Dormant oil	Damoil	Drexel Chemical Company	98	Caution	No			4 hrs	Grazing allowed		Yes	Obscure scale
Esfenvalorate	Asana XL	DuPont Crop Protection	8.40	Warning	Yes	3A	Pyrethroid	12 hrs	No grazing	21 days	No	Aphids, hickory shuckworm, pecan nut casebearer, spittlebug, pecan weevil
	S-Fenvalostat	LG Life Sciences	8.40	Warning	Yes	3A	Pyrethroid	12 hrs	No grazing	21 days	No	Aphids, hickory shuckworm, pecan nut casebearer, leaf phylloxera, stemphylloxera, spittle bug, pecan weevil
	Zyrate	Rotam NA	8.40	Warning	Yes	3A	Pyrethroid	12 hrs	No grazing	21 days	No	Hickory shuckworm, aphids, pecan nut casebearer, leaf phylloxera, spittlebug, stem phylloxera, pecan weevil
Etoxazole	TetraSan 5 WDG	Valent	5.00	Caution	No	??	??	12 hrs	Grazing allowed	XXX		Mites – non bearing trees only
Emamectin benzoate	Proclaim	Syngenta	5.00	Caution	Yes	6		12 hrs	No grazing	14 days	No	Fall webworm, hickory shuckworm, pecan bud moth, pecan nut casebearer, pecan leaf casebearer, pecan serpentine leafminer, walnut caterpillar
	Enfold	Syngenta	5.00	Caution	Yes	6		12 hrs	No grazing		No	Fall webworm, hickory shuckworm, pecan bud moth, pecan nut casebearer, pecan leaf casebearer, pecan bud moth, pecan serpentine leafminer, walnut caterpillar
Etoxazole	Zeal miticide	Valent USA	72.00	Caution	No	10B	Mite growth inhibitor	12 hrs	Grazing allowed		No	Mites – non bearing trees only
Fats and Glyceric oils	DeBug	Valent USA	65.80	Caution	No		Antifeedant, repellent	4 hrs			Yes	Aphids, casebearers, mites, phylloxera, weevils

Table 12. Insecticides labeled for use on pecans. Read and follow the label directions (continued).

Chemical name	Trade name	Company/ Manufacture	Percent Active Ingredient (AI)	Signal word	Restricted use pesticide group	IRAC* Mode of action Main group	Class	Reentry	Grazing restrictions	PHI	OMRI Listed	
fenazaquin	Magus	Gowan	18.79	Warning	No	21		12 hrs	Non-bearing	No	Mites	
Fenbutatin-oxide	Vendex 50WP	United Phosphorus	50.00	Danger	Yes	12B	Organotin miticides	48 hrs	No grazing	14 days	No	
Fenoxycarb	Award	Syngenta	1.00	Caution	No	7	Hormone-mimics	12 hrs	Non-bearing trees only	No	Red imported fire ant Red imported fire ant	
Fenpropathin	Danitol	Valent USA	30.9	Warning	Yes	3	Pyrethroid	24 hrs	No grazing	3 days	No	Pecan nut casebearer, hickory shuckworm, green stink bug, southern green stink bug
Fenpyroximate	Fujimite 5EC	Nichino America, Inc.	5.00	Warning	No	21	Energy metabolism inhibitors	12 hrs	No grazing	14 days	No	Mites
	Portal	Nichino America, Inc.	5.00	Warning	No	21	Energy metabolism inhibitors	12 hrs	No grazing	14 days	No	Pecan leaf scorch mite, 2-spotted spider mite, non-bearing trees only
Flubendiamide	Belt 5C	Bayer CropScience	39.00	Caution	No	28	Diamides	12 hrs	Grazing allowed	14 days	No	Fall webworm, hickory shuckworm, pecan nut casebearer, walnut caterpillar
Fonicamid	Beleaf 505G Carbine 50WG	FMC	50.00	Caution	No	9C		12 hrs	No grazing	40	No	Aphids, plant bugs
Gamma-cyhalothrin	Declare	Chemnova, Inc.	14.4	Caution	Yes	3A	Pyrethroid	24 hrs	No grazing	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Proaxis	Loveland products	5.9	Caution	Yes	3A	Pyrethroid	24 hrs	No grazing	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug
Garlic Juice Extract	Allityn	Helena Chemical Company	50.00	Caution	No		Repellent	4 hrs	No grazing	Non bearing	No	Repellent for: aphids, beetles, hickory shuckworm, pecan nut casebearer, hickory shuckworm
Hexythiazox	Hexygon DF Hexygon DF Hexy 2E Onager Savay 50WP	Gowan Sharda Sharda Gowan Gowan	50.00 24.20 11.80 50.00	Caution Caution Caution Caution	No No No No	10A 10A 10A 10A	Mite growth inhibitor Mite growth inhibitor Mite growth inhibitor Mite growth inhibitor	12 hrs 12 hrs 12 hrs 12 hrs	No grazing No grazing No grazing No grazing	7 days 28 days 28 days 28 days	No No No No	Mites - non bearing trees only Mites Pecan leaf scorch mite, 2-spotted spider mite Pecan leaf scorch mite
Imidacloprid	Admire Pro Advise 2 FL Max Alias 2F MANA AmTide imidacloprid 2F AmTide imidacloprid 4F Couraze 1.6F Couraze 2F	Bayer CropScience Winfield Solutions MANA MANA AmTide AmTide Chemnova Chemnova	42.80 21.40 21.40 22.6 40.6 17.40 21.40	Caution Caution Caution Caution Caution Caution Caution	No No No No No No No	4A 4A 4A 4A 4A 4A 4A	Neonicotinoid Neonicotinoid Neonicotinoid Neonicotinoid Neonicotinoid Neonicotinoid Neonicotinoid	12 hrs 12 hrs 12 hrs 12 hrs 12 hrs 12 hrs 12 hrs	No grazing No grazing No grazing No grazing No grazing No grazing No grazing	7 days 7 days None stated 7 days 7 days 7 days 7 days	No No No No No No No	Aphids, sharpshooters, spittlebugs Aphids, spittlebug Aphids, 2 lined-spittlebug Aphids, phylloxera, spittle bugs Aphids, phylloxera, Black pecan aphid, yellow pecan aphid, sharpshooters, spittle bugs Black pecan aphid, yellow pecan aphid, sharpshooters, spittle bugs Aphids, leafhoppers, spittle bug Blackmargined aphid, yellow pecan aphid, pecan stem phylloxera, pecan spittle bug, pecan leaf phylloxera Aphids, spittle bug Aphids, spittle bug Aphids, spittle bug Black margined aphid, yellow pecan aphid, leaf phylloxera, stem sphyllxear, spittle bug Yellow pecan aphid, blackmargined aphid, phylloxera, spittle bug Yellow pecan aphid, blackmargined aphid, phylloxera, spittle bug
	Couraze 4F Lada 2F	Chemnova Rotam North America	42.30 21.40	Caution Caution	No No	4A 4A	Neonicotinoid Neonicotinoid	12 hrs 12 hrs	No grazing No grazing	7 days 7 days	No No	Aphids, leafhoppers, spittle bug Blackmargined aphid, yellow pecan aphid, pecan stem phylloxera, pecan spittle bug, pecan leaf phylloxera
	Machos 2.0 FL Machos 4.0 Malice 2F Malice 75WSB	Albaugh, Inc. Albaugh, Inc. Loveland Products Loveland Products	21.40 40.70 21.40 21.40	Caution Caution Caution Caution	No No No No	4A 4A 4A 4A	Neonicotinoid Neonicotinoid Neonicotinoid Neonicotinoid	12 hrs 12 hrs 12 hrs 12 hrs	No grazing No grazing No grazing No grazing	Soil applied 7 days 7 days None stated	No No No No	Aphids applied Aphids, spittle bug Aphids, spittle bug Black margined aphid, yellow pecan aphid, leaf phylloxera, stem phylloxera, spittle bug Soil applied - aphids, sharpshooters, spittle bugs Green house and nursery trees only Black margined aphid, yellow pecan aphid, leaf phylloxera, stem sphyllxear, spittle bug Aphids Aphids
	Mallet 75 WSP	Nufarm	75	Caution	No	4A	Neonicitinoid	12 hrs	No grazing	None stated	No	Black pecan aphid, blackmargined aphid, yellow pecan aphid, phylloxera, spittle bug
	Mana Alias 4F Marathon 60W Merit 2F 75WSP	MANA OHP, Inc. Bayer CropScience	42.30 60.00 21.40	Caution Caution Caution	No No No	4A 4A 4A	Neonicotinoid Neonicotinoid Neonicotinoid	12 hrs 12 hrs 12 hrs	No grazing No grazing No grazing	7 days 7 days	No No No	Soil applied - aphids, sharpshooters, spittle bugs Green house and nursery trees only Black margined aphid, yellow pecan aphid, leaf phylloxera, stem sphyllxear, spittle bug Aphids Aphids
	Midash 25C Midash Forte Montana 2F	Sharda USA Rotam North America	21.40 40.70 21.40	Caution Caution Caution	No No No	4A 4A 4A	Neonicotinoid Neonicotinoid Neonicotinoid	12 hrs 12 hrs 12 hrs	No grazing No grazing No grazing	Soil applied 7 days 7 days	No No No	Black pecan aphid, blackmargined aphid, yellow pecan aphid, phylloxera, spittle bug Aphids, phylloxera, spittle bugs Black pecan aphid, blackmargined aphid, yellow pecan aphid, spittle bug, sharpshooters
	Montana 4F Nuprid 1.6F	Rotam North America Nufarm	40.60 17.40	Caution Caution	No No	4A 4A	Neonicotinoid Neonicotinoid	12 hrs 12 hrs	No grazing No grazing	7 days 7 days	No No	Black pecan aphid, blackmargined aphid, yellow pecan aphid, phylloxera, spittle bug, sharpshooters
	Nuprid 2F	Nufarm	21.40	Caution	No	4A	Neonicotinoid	12 hrs	No grazing	7 days	No	Black pecan aphid, blackmargined aphid, yellow pecan aphid, spittle bug, sharpshooters, termites

Table 12. Insecticides labeled for use on pecans. Read and follow the label directions (continued).

Chemical name	Trade name	Company/ Manufacture	Percent Active Ingredient (AI)	Signal word	Restricted use pesticide	IRAC* Mode of action Main group	Class	Reentry	Grazing restrictions	PHI	OMRI Listed	
Single Active Ingredient Pesticides												
Imidacloprid (continued)	Nuprid 4F	Nufarm	40.00	Caution	No	4A	Neonicotinoid	12 hrs	No grazing	7 Days	No	Black pecan aphid, blackmargined aphid, yellow pecan aphid, spittle bug, sharpshooters
	Pasada 1.6F	MANA	17.40	Caution	No	4A	Neonicotinoid	12 hrs	No grazing	7 Days	No	Black pecan aphid, blackmargined aphid, yellow pecan aphid, leaf and stem phylloxera, spittle bug
	Phoenix Hawk	United Phosphorus	21.40	Caution	No	4A	Neonicotinoid	12 hrs	No grazing		No	Yellow pecan aphid, blackmargined pecan aphid, spittle bug, phylloxera
	Prey 1.6	Loveland Products	17.40	Caution	No	4A	Neonicotinoid	12 hrs	No grazing	7 Days	No	Aphids, phylloxera, spittle bug
	Provado 1.6F	Bayer CropScience	17.40	Caution	No	4A	Neonicotinoid	12 hrs	No grazing	7 Days	No	Black peach aphid, blackmargined aphid, yellow pecan aphid, sharpshooters, leaf phylloxera, spittle bug
	Sherpa	Loveland Products	17.40	Caution	No	4A	Neonicotinoid	12 hrs	No grazing	7 Days	No	Aphids, leaf phylloxera, sharpshooters, spittle bug
	Trimax Pro	Bayer CropScience	40.70	Caution	No	4A	Neonicotinoid	12 hrs	No grazing	7 Days	No	Aphids, phylloxera, spittle bug
	Widow	Loveland Products	21.40	Caution	No	4A	Neonicotinoid	12 hrs	No grazing	Soil applied	No	Aphids, spittle bug
	Wrangler	Loveland Products	40.7	Caution	No	4A	Neonicotinoid	12 hrs	No grazing	Foliar or soil applied	No	Aphids, phylloxera, spittle bugs
iron phosphate	Bug-N-Sluggo	Certis	0.97	Caution	No			4 hrs			Yes	Aphids, mites, leafminers and in soil beetle grubs on non-bearing trees
Isaria fumosorosea	PFR-97 20WDG	Certis	20	Caution	No			4 hrs			Yes	
Gamma-cyhalothrin	Proaxis	Loveland, Cheminova & TENIKOZ	5.90	Caution	Yes	3	Pyrethroid	12 hrs	No grazing	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, spittle bug, phylloxera, stink bug
Lambda-cyhalothrin	Grizzly Z	Winfield Solutions	11.40	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, spittle bug, stink bug, phylloxera
	Karate w/ zeon tech	Syngenta	22.80	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, spittle bug, stink bug, phylloxera
	Karate	Syngenta	13.10	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Kendo	Helix Agro	13.10	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Lambda-CY EC	United Phosphorus	11.40	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, spittle bug, stink bug, phylloxera
	LambdaStar	LG international	13.10	Danger	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, pecan weevil, spittle bug, phylloxera, stink bug
	LambdaStar TCS	LG international	12.00	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Lambda-T	Helena	11.40	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Lamcap	Syngenta	11.4	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Hickory shuckworm, aphids, Pecan nut casebearer, phylloxera, spittle bug, Pecan weevil, stink bugs
	Lambda-Cyhalothrin 1 EC	Nufarm	13	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, phylloxera, spittle bug, pecan weevil stink bug
	Paradigm	MANA	12.7	Caution	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, phylloxera, spittle bug, pecan weevil stink bug
	Province	TENIKOZ	11.40	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Silencer	MANA	12.7	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, spittle bug, stink bug, phylloxera
	Taiga Z	MANA	11.4	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, spittle bug, stink bug, phylloxera
	Warrior	Syngenta	11.4	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Warrior II	Syngenta	22.8	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Willowood Lambda-CY	Willowood	13.10	Warning	Yes	3A	Pyrethroid	24 hrs	Grazing allowed	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug
Kaolin	Surround –WP	Tessenderlo Kerley	95	No	No			0 hrs	Grazing allowed	0 days	Yes	Reduces heat stress

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

Chemical name	Trade name	Company/ Manufacture	Percent Active Ingredient (AI)	Signal word	Restricted use pesticide	IRAC* Mode of action Main group	Class	Reentry	Grazing restrictions	PHI	OMRI Listed	
Single Active Ingredient Pesticides												
Malathion	Malathion 57%	Loveland Products	0.57	Warning	No	1B	Organophosphate	24 hrs	Grazing allowed	7 days	No	Pecan bud moth, aphids, pecan leaf casebearer, pecan phylloxera, pecan nut casebearer
	Cheminova malathion	Cheminova	56.00	Warning	No	1B	Organophosphate	24 hrs	Grazing allowed	7 days	No	Pecan bud moth, aphids, pecan leaf casebearer, pecan phylloxera, pecan nut casebearer
	Fyfanon	Helena	56.44	Warning	No	1B	Organophosphate	12 hrs	No grazing	3 days	No	Mites, aphids, pecan nut casebearer, pecan phylloxera, pecan bud moth
	Malathion 5	Winfield Solutions	56.80	Warning	No	1B	Organophosphate	12 hrs	Grazing allowed	0	No	Aphids, mites, phylloxera, pecan budmoth, pecan leaf casebearer, pecan nut casebearer
	Malathion 8EC	Gowan	80.75	Warning	No	1B	Organophosphate	12 hrs	Grazing allowed	0	No	Aphids, mites, phylloxera, pecan budmoth, pecan leaf casebearer, pecan nut casebearer
Methoprene	Extinguish	Weilmark International	0.50	Caution	No	7	Growth regulation	4 hrs	Grazing allowed	not listed	No	Red imported fire ant
Metaflumizone	Altrevin	BASF	0.063	Caution	No	22B				5 days	No	Red imported fire ant
Methoxyfenozide	Intrepid 2F	Dow AgroSciences	22.60	Caution	No	18	Growth regulator	4 hrs	Grazing allowed	14 days	No	Pecan nut casebearer, hickory shuckworm, fall webworm, walnut caterpillar
Myrothecium verrucaria	Difera DF	Valent USA	90.00	Caution	No		Biological nematocide	4 hrs	Grazing allowed	XXXX	No	Root nematodes
Oil - horticulture	BioCover UL, MLT, 5S Citri oil	Loveland	98.00	Caution	No		Oil, paraffinic	4 hrs	Grazing allowed	0 days	No	Scale, aphid eggs, mite eggs
	Dormant oil-435	Winfield Solutions	99.00	Caution	No		Oil, paraffinic	12 hrs	Grazing allowed	0 days	No	Scale
	JMS Stylet Oil	JMS Flower Farm	98.80	Caution	No		Oil, paraffinic	12 hrs	Grazing allowed	0 days	No	Scale
	Organic JMS stylet oil	JMS Flower Farm	97.10	Caution	No		Oil, paraffinic	4 hrs	Grazing allowed	0 days	No	Obscure scale
	Mite-E- Oil	Helena	97.10	Caution	No		Oil, paraffinic	4 hrs	Grazing allowed	0 days	Yes	Obscure scale
	Purespray green	Petro-Canada	98.00	Caution	No		Oil, petroleum	4 hrs	Grazing allowed	0 days	No	Obscure scale
	Superior	Loveland	80.00	Caution	No		Oil, petroleum	4 hrs	Grazing allowed	0 days	Yes	Scale
Oil - mineral	TriTek	Brandt	80.00	Caution	No		Oil - mineral	4 hrs	Grazing allowed	0 days	Yes	Aphids, scales
	Suffoli-X	BioWorks	80.00	Caution	No		Oil - mineral	4 hrs	Grazing allowed	0 days	Yes	Aphids, mites, scales
Oil - soybean	Golden Pest Spray Oil	Stoller	93.00	Caution	No		Oil	4 hrs	Grazing allowed	0	No	Obscure scale
Paeclomyces lilacinus	MeloCon WG	Prophyta	6.00	Caution	No	Fungal spores	Fungal spores	4 hrs	Grazing allowed	0 days	Yes	Nematodes
Phosmet	Imidan 70W	Gowan	70.00	Warning	No	1	Organophosphate	3 days	No grazing	14 days	No	Black pecan aphid, fall webworm, hickory shuckworm, pecan nut casebearer, pecan weevil, spittle bug, southern green stink bug
Potassium Salts	Des-X M-Pede	Certis Gowan	47.00 49.00	Warning Warning	No No		Insecticidal soap Insecticidal soap	12 hrs 12 hrs	grazing allowed grazing allowed	12 hrs 12 hrs	Yes Yes	Aphids, mites, scale Aphids, mites
Propargite	Omite 30WS	Chemtura Corp.	32.00	Danger	No	12	Energy metabolism inhibitors	7 days	No grazing		No	2-spotted spider mites - non bearing trees only
Pymetrozine	Fulfil	Syngenta	50.00	Caution	No	9	Feeding blocker	12 hrs	Grazing allowed	14 days	No	Black pecan aphid, yellow pecan aphid, black margined aphid
Pyrethrins	Pyganic EC 1.4	MGK Company	5.00	Warning	No	3A	Pyrethroid	12 hrs	Grazing allowed	0 days	Yes	Aphids, fall webworm, red imported fire ant, stink bugs, caterpillars
	Tersus	MGK	5.00	Caution	No	3A	Pyrethroid	12 hrs	Grazing allowed	0 days	No	Aphids, caterpillars, webworms, stink bugs
Pyridaben	Nexter miticide/ insecticide	Gowan	75.00	Warning	No	21	Energy metabolism inhibitors	12 hrs	Grazing allowed	7 days	No	Black margined aphid, yellow pecan aphid
Pyriproxyfen	Distance Distance Fireant Bait Esteem Ant Bait	Valent USA Valent USA Valent USA	11.23 0.50 0.50	Caution Caution Caution	No No No	7 7 7	Hormone mimics Hormone mimics Hormone mimics	12 hrs 12 hrs 12 hrs	Nonbearing trees only		No No No	Red imported fire ant Red imported fire ant
	Esteem 35WP; 0.86 EC Pitch	Valent Mana	35; 11.23 11.23	Caution Caution	No No	7 7C	Hormone mimics Hormone mimics	12 hrs 12 hrs		1 day 21 days	No No	Red imported fire ant No pecan pests on label Scale
Sesame oil	Sesamin EC	Brandt Consolidated	70.00	none listed	No		Sesame oil	0 hrs	Grazing allowed	None stated	No	Parasitic nematodes
Spinetoram	Delegate WG	Dow AgroSciences	0.25	Caution	No	5	Spinosyns	12 hrs	Grazing allowed	14 days	No	Pecan nut casebearer, walnut caterpillar, fall webworm, hickory shuckworm

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

Chemical name	Trade name	Company/ Manufacture	Percent Active Ingredient (AI)	Signal word	Restricted use pesticide	IRAC* Mode of action Main group	Class	Reentry restrictions	PHI	OMRI Listed	
Single Active Ingredient Pesticides											
Spinosad	Entrust, Entrust SC Seduce SpinTor 25C	Dow AgroSciences Dow AgroSciences Certis USA Dow AgroSciences	80.00 22.50 0.07 22.80	Caution Caution Caution Caution	No No No No	5 5 5 5	Spinosyns Spinosyns Spinosyns Spinosyns	4 hrs 4 hrs 4 hrs 4 hrs	Grazing allowed Grazing allowed Grazing allowed Grazing allowed	1 day 1 day 14 days 14 days	Yes Yes Yes No
spiroticlofen	Envidor 2 SC	Bayer CropScience	22.30	Caution	No	23	Growth regulator	12 hrs	Grazing allowed	7 days	No
Spiromesifen	Judo	OHP, Inc.	45.2	Caution	No	23		12 hrs	No grazing	Non bearing trees only	No
Spirotetramat	Kontos Movento	OHP, Inc. Bayer CropScience	22.4 22.40	Caution Caution	No No	23 23	Growth regulator	24 hrs 24 hrs	Grazing allowed	Non bearing trees only 7 Days	No
Sulfur	THAT Flowable Sulfur Suffa Sulfur 6L, DF Thiolux	Stoller Enterprises Drexel Arysta & Wilbur-Ellis Loveland	52.00 52.00 80.00	Caution Caution Caution	No No No	M2 fungicide Elemental sulfur M2 fungicide Fungicide- miticide M2 fungicide		24 hrs 24 hrs 24 hrs 24 hrs	Grazing allowed Grazing allowed Grazing allowed Grazing allowed	No * No No No	
Tebufenozide	Confirm 2F	Gowan	23.00	Caution	No	18	Growth regulator	4 hrs	No grazing	14 days	No
Thiamethoxam	Centric 40WG Flagship 25WG	Syngenta Syngenta	40.00 25	Caution Caution	No No	4 4A	Neonicotinoid Neonicotinoid	12 hrs 12 hrs	No grazing No grazing	14 days Non bearing trees	No No
Toflenpyrad	Apta	Nichino	15.00	Warning	No	21A		12 hrs	Grazing allowed	14 days	No
zeta-cypermethrin	Mustang Mustang Max	FMC FMC	9.60	Warning	Yes	3 3	Pyrethroid Pyrethroid	12 hrs	No grazing	14 days	No
	Mustang Maxx	FMC	9.15	Warning	Yes	3	Pyrethroid	12 hrs	No grazing	7 days	No
	Respect EC	BASF	9.60	Caution	Yes	3	Pyrethroid	12 hrs	No grazing	7 days	No
Combination Products											
Chlorpyrifos + Gamma-cyhalothrin	Cobalt	Dow AgroSciences	30.00 0.54	Danger	Yes	1 and 3	Organophosphate Pyrethroid	24 hr	No grazing	28 days	No
Chlorpyrifos + Lambda-cyhalothrin	Cobalt Advanced	Dow AgroSciences	28.12 1.44	Warning	Yes	1 and 3	Organophosphate Pyrethroid	24 hrs	No grazing	28 days	No
Peppermint oil + Rosemary oil	Ectro EC		2.00 10.00	Caution	No		Oil	0 hrs	Grazing allowed	0 days	Yes
Lambda-cyhalothrin + Thiamethoxam	Endigo ZC	Syngenta	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	MGK Company	6.00 60.00	Caution	No	3	Pyrethroid	12 hrs	Grazing allowed	0 days	No
zeta-cypermethrin + Bifenthrin	Hero	FMC	3.75 11.25	Caution	Yes	3 and 3	Pyrethroid Pyrethroid	12 hrs	No grazing	21 days	No

Table 12. Insecticides labeled for use on pecans. Read and follow the label directions (continued).

Chemical name	Trade name	Company/ Manufacture	Percent Active Ingredient (AI)	Signal word	Restricted use pesticide	IRAC* Mode of action Main group	Class	Reentry	Grazing restrictions	PHI	OMRI Listed	
Combination Products												
zeta-cypermethrin + Bifenthrin	Hero EW	FMC	3.24 9.72	Warning	Yes	3A 3A	Pyrethroid Pyrethroid	12 hrs	No grazing	21 days	No	Black pecan aphid, hickory shuckworm, leaffooted bug, pecan weevil, pecan leaf casebearer, pecan nut casebearer, phylloxera, stink bug, yellow pecan aphid
imidacloprid + cyfluthrin	Leverage 2.7	Bayer Crop Science	17.00 12.00	Warning	Yes	3 and 4	Neonicotinoid Pyrethroid	12 hrs	No grazing	14 days	No	Black pecan aphid, black margined aphid, yellow pecan aphid, hickory shuckworm, leaffooted bug, sharpshooters, pecan nut casebearer, pecan weevil, stink bugs, phylloxera, spittle bug
imidacloprid + beta-cyfluthrin	Leverage 360	Bayer Crop Science	21.00 10.50	Caution	Yes	4A 3	Neonicotinoid Pyrethroid	12 hrs	No grazing	14 days	No	Aphids, hickory shuckworm, leaffooted bug, leafhoppers/sharpshooters, pecan nut casebearer, pecan weevil, phylloxera, spittle bugs, stink bugs: black pecan aphid – suppression only
Bifenthrin + Avermectin B1	Athena	FMC	8.84 1.33	Caution	Yes	3A 6	Pyrethroid Avermectin	12 hrs	No grazing	21 days	No	Aphids, fall webworm, hickory shuckworm, leaffooted bug, pecan nut casebearer, pecan leaf casebearer
Azadirachtin + pyrethrins	Azera	MgK Company	1.2 1.4	Caution	No	Unknown 3A	Unknown Pyrethrin	12 hrs	Grazing allowed	None listed	Yes	Aphids, fall webworm, hickory shuckworm, pecan nut casebearer, walnut caterpillar, pecan weevils, twig girdlers, serpentine leafminer, leaffooted bug
Chlorpyrifos + gamma-cyhalothrin	Cobalt Advanced	Dow AgroSciences	28.12 1.44	Warning	Yes	1B 3A	Organophosphate Pyrethroid	No grazing	No grazing	28 days	No	Black margined aphid, fall webworm, pecan nut casebearer, yellow pecan aphid, black pecan aphid, hickory shuckworm, phylloxera, pecan leaf scorch mite, spittle bugs, stink bugs
Chlorpyrifos + lambda-cyhalothrin	Gladiator	FMC	2.01 0.91	Caution	Yes	3A 6	Pyrethroid Avermectin	12 hrs	No grazing	28 days	No	Aphids, fall webworm, pecan nut casebearer, hickory shuckworm, spittle bugs, phylloxera, stink bug, ants
zeta-cypermethrin + Avermectin B1	Stallion	FMC	3.08 30.8	Warning	Yes	3A 1B	Pyrethroid Organophosphate	24 hrs	No grazing	21 days	No	Aphids, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, stink bugs
zeta-cypermethrin + Chlorpyrifos	Steed	FMC	8.2 9.8	Warning	Yes	3A 3A	Pyrethroid Pyrethroid	12 hrs	No grazing	28 days	No	Black pecan aphid, hickory shuckworm, leaffooted bugs, pecan leaf casebearer, pecan nut casebearer, phylloxera, stink bugs, yellow pecan aphid
zeta-cypermethrin + bifenthrin	Steed	FMC	8.2 9.8	Warning	Yes	3A 3A	Pyrethroid Pyrethroid	12 hrs	No grazing	21 days	No	Black pecan aphid, hickory shuckworm, leaffooted bugs, pecan weevil, pecan leaf casebearer, pecan nut casebearer, phylloxera, stink bugs, yellow pecan aphids
Bifenthrin + imidacloprid	Brigadier	FMC	11.3 11.3	Warning	Yes	3A 4A	Pyrethroid Neonicotinoid	12 hrs	No grazing	21 days	No	Aphids, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, pecan phylloxera, stink bug
bifenthrin + imidacloprid	Swagger	Loveland Products, Inc.	5.7 5.7	Danger	Yes	3A 4A	Pyrethroid neonicotinoid	12 hrs	No grazing	21 days	No	Aphids, leafhoppers/sharpshooters, phylloxera species, stink bugs
Lambda-cyhalothrin + Chlorantraniliprole	Voliarm Xpress	Syngenta	4.63 9.26	Warning	Yes	3A 28	Pyrethroid Diamides	24 hrs	No grazing	14 days	No	Hickory shuckworm, pecan aphids, pecan nut casebearer, pecan leaf casebearer, pecan phylloxera, pecan spittle bug, pecan weevil, stink bugs
methoxyfenozide + spinetoram	Intrepid Edge	Dow AgroSciences	28.3 5.66	Caution	No	5 18	Spinosyns Diacetylhydrazines	4 hrs	Grazing allowed	14 days	No	Pecan nut casebearer, hickory shuckworm, fall webworm, walnut caterpillar
imidacloprid + lambda-cyhalothrin	Killer	Nufarm Agricultural products	14.49 10.86	Danger	Yes	4A 3	Neonicotinoid Pyrethroid	24 hrs	No grazing	14 days	No	Aphids, hickory shuckworm, leaffooted bug, pecan nut casebearer, pecan leaf casebearer, phylloxera, pecan spittle bug, pecan weevil, stink bug
Flubendiamide + Buprofezin	Tourismo	Nichino	12.5 25	Caution	No	28 16	Diamides Buprofezin	12 hrs	Grazing allowed	60 days	No	Fall webworm
Bifenthrin + Imidacloprid	Tempest	Helena	11.3 11.3	Warning	Yes	3A 4A	Pyrethroid Neonicotinoid	12 hrs	No grazing	21 days	No	Aphids, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, phylloxera, stink bug

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

Chemical name	Trade name	Company/ Manufacture	Percent Active Ingredient (AI)	Signal word	Restricted use pesticide	IRAC* Mode of action Main group	Class	Reentry	Grazing restrictions	PHI	OMRI Listed
Bifenthrin + imidacloprid	Skyraider	Mana	21.65 10.8	Warning	Yes	3A 4A	Pyrethroid Neonicotinoid	12 hrs	No grazing	21 days	No
Iron phosphate + spinosad	Bug-N-Sluggo	Certis	0.97 0.07	Caution	No			4 hrs			Yes

Combination Products

1A	Carbamate										
1B	Organophosphate										
2B	Phenylpyrazoles										
3A	Pyrethroid										
4A	Neonicotinoid										
4C	Sulfoxalor										
6	Avermectin										
7A	Juvenile hormone mimic										
7B	Fenoxycarb										
9	feeding blocker										
10B	mite growth inhibitor										
11A	Bacillus thuringiensis										
12	Energy metabolism inhibitors										
15	Growth regulation										
18	Growth regulator										
20B	Energy metabolism inhibitors										
21	Energy metabolism inhibitors										
23	Growth regulation										
28	Diamides										
	Unknown										

IRAC - Insecticide Resistance Action Committee <http://www.iraac-online.org/>

The IRAC Mode of Action (MoA) classification provides producers with a guide to the selection of insecticides and acaricides for use in an effective and sustainable insecticide or acaricide resistance management strategy.

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