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Managing Insect and Mite Pests of Commercial Pecans in Texas

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Many insects feed on the leaves, nuts, branches, and buds of the pecan tree, reducing the tree's nut 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 ENTO-083, *Pecan Pests in the Home Orchard* (available from your local Texas A&M AgriLife Extension office and online at http://agrilifebookstore.org) describes how to control pests attacking pecans in home landscapes and in other noncommercial orchards.

Pest Management Principles

For many years, growers minimized pest damage to pecans by spraying pesticides on a regular schedule based on crop development. This effective, relatively inexpensive approach paired well with a preventive fungicide and zinc spray program. However, applying pesticides according to a schedule can:

- Increase the risk that pests will develop resistance to pesticides;
- Reduce populations of beneficial insects that keep pests in check;
- Result in secondary pest outbreaks; and
- Overuse of insecticides can negatively impact human health and the environment.

"Integrated Pest Management," or IPM, is a philosophy used to design pest control programs. It uses the most compatible and ecologically sound combination of pest suppression techniques available to sustain profitability. These management techniques include:

- **Cultural control**—such as destroying crop residues where some pests overwinter;
- **Host plant resistance**—selecting pecan varieties that are well adapted and, when available, have genetic resistance to pests;
- **Chemical control**—using insecticides only when pest densities exceed economically damaging levels and, when available, selecting effective insecticides that have the least impact on natural enemies and non-target organisms; and
- **Biological control**—recognizing and protecting, when possible, natural enemies that suppress pest populations.

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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 systematically conducted 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 application rates carefully according to their effectiveness, the hazard they pose to the applicator, and their impact on beneficial insects.

Application of insecticides classified as pyrethroids, carbamates, and organophosphates (Table 10) may be followed by outbreaks of aphids, other insects, or spider mites. Outbreaks may result from the destruction of natural enemies that were holding these secondary pests in check. If these products are used, limit their use to control late-season pests. Pyrethroids used in orchards where mite or aphid outbreaks have occurred following their use may exacerbate problems with those same pests.

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

Insecticides are classified according to their modes of action, or the ways they kill insect pests. The development of insecticide resistance can be managed by using them only when necessary and rotating their use with other pesticides with different modes of action. 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 resistance management tactic. The mode of action of labeled pecan insecticides is identified by its IRAC number or group number as listed on the label (see Table 10). To rotate insecticides, choose effective insecticides with different mode of action numbers. Rotating by brand name may not be effective because the same active ingredient (and the same mode of action) is often sold under different brand names. For example, the active ingredient imidacloprid is sold under more than 30 different brand names. Rotating among these 30 products would not be effective as they are all group 4A insecticides, as shown in Table 10. These imidacloprid products should be rotated with any other effective insecticide that is not a Group 4 insecticide.

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 that are the least toxic to the natural enemy. As examples, Confirm®, Intrepid®, Spinosad, and *B.t.* formulations are less toxic to most beneficial insects and other non-target species than carbamate, pyrethroid, and organophosphate insecticides. Ground covers such as legumes can provide food and shelter for natural enemies. 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 of gallons of water applied. To determine the number of gallons applied per acre, divide the amount of water applied by the

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

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

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

Chemical Use Precautions

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

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

Caution: All pesticides are potentially hazardous to humans, animals, and non-target crops; use them with caution. Store all pesticides out of the reach of children, irresponsible people, livestock, and household pets. Properly dispose of leftover spray materials and containers. Provide proper training to any orchard worker who is engaged in mixing, spraying, or entering orchards after they have been sprayed. Use appropriate signage in orchards when trees have been sprayed to communicate proper reentry times to all persons coming and going through the orchard.

Pesticide drift: Do not let the 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 user 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 A&M AgriLife Extension Service assumes no responsibility for risks, and 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.

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 the instructions on the container label carefully.

Pecan Insect Pests

Phylloxera

Damage

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

Pecan leaf phylloxera form galls on leaf tissue only; extensive infestations may cause some defoliation. The pecan phylloxera is the most

Phylloxera galls

Phylloxera galls

damaging species because it attacks shoots and nuts. Widespread 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 adult female leaf phylloxera 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

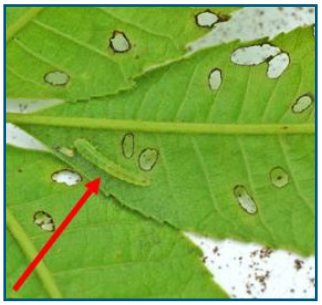
Native trees and improved varieties vary in susceptibility to phylloxera. Because phylloxera cannot fly long distances, infestations move slowly from tree to tree. You can often control them by treating only those trees with phylloxera galls. Survey the orchard in May and mark trees with galls to treat the next spring.

Insecticides for phylloxera (Table 1) must be applied after the eggs hatch in the spring but before nymphs are protected inside galls. Treat after bud break when growth is 1 to 2 inches long.

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

Active Ingredient	IRAC Group	Insecticide 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 livestock in treated orchards.
Chlorpyrifos	1B	Govern® 4E, Hatchet®, 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 using this and other broad-spectrum insecticides.
Gamma-cyhalothrin	3A	Declare, Proaxis	
Imidacloprid	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	
Malathion	1B	Malathion® 5EC, Malathion® 8EC	Scout for aphids and other secondary pests which may increase to damaging levels when using this and other broad-spectrum insecticides.
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	Scout for aphids and other secondary pests which may increase to damaging levels when using this and other broad-spectrum insecticides.
Zeta-cypermethrin	3A	Mustang Max®, Mustang Max EC, Respect® EC	Scout for aphids and other secondary pests which may increase to damaging levels when using this and other broad-spectrum insecticides.

Sawfly


Sawfly larva

Sawfly larvae feed on the underside of pecan leaves in the spring. Sawfly larvae resemble caterpillars, but they are actually wasp larvae. Sawfly larvae have six sets of prolegs, while larvae of moths and butterflies have anywhere from one to four sets of prolegs. Two species are often found on pecans. The larva of one species is shiny green and its feeding results in small, neat holes cut in the leaf. Full-grown larvae are about ½ inch long. The larva of the other species ranges from yellowish-brown to orange with black spots along the body and generally consume the entire leaf. These larvae only produce one generation a year. There are no guidelines for making insecticide treatments. However, leaf damage is usually minor, and insecticidal control is rarely needed. Very few insecticides list sawfly on the label. However, if an insecticide is needed to prevent excessive defoliation during outbreaks, malathion, or chlorpyrifos labeled for pecans can be effective (Table 10). Scout for aphids and other secondary pests which may increase to damaging levels when using these and other broad-spectrum insecticides.

June Beetles

June beetles are brown to brownish-red, hard-bodied beetles about ½ to ¾ 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 during the night. As the beetles hide just below the soil surface during the day, it is often difficult to identify them as the cause of the leaf-feeding in pecans. 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. Very few insecticides list adult June beetle on the label. However, if an insecticide is needed to prevent excessive defoliation, malathion, or chlorpyrifos labeled for pecans can be effective (Table 10). Scout for aphids and other secondary pests which may increase to damaging levels when using these and other broad-spectrum insecticides.

Pecan Nut Casebearer

Damage

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

Biology

The adult casebearer is a gray moth about ⅓-inch long with a ridge of dark scales across the forewings. The moths are active only at night when they mate and lay eggs on pecan nuts. Most eggs are found on the nutlet tips. Each female can lay 50 to 150 eggs during her 5- to 8-day life. The greenish-white to white eggs change color to pink or red before hatching.


Pecan nut casebearer eggs

Casebearer eggs hatch in 4 to 5 days; young larvae crawl to nearby buds below the nuts to begin feeding. The empty white eggshell remains on the nut. After feeding for 2 to 3 days 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 usually 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.


Nutlets in a nut cluster damaged by internal feeding of a pecan nut casebearer larva


Frass and silk produced by larva of first generation pecan nut casebearer

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

Third-generation eggs are deposited on nuts from late July to early September. These larvae feed only in the shucks if the pecan shells have hardened to prevent penetration into the kernel. Many third- and later-generation larvae do not feed, but crawl to the base of a dormant bud and build tough, tiny, silken cocoons where they spend the winter. In spring, these immature larvae leave the cocoon, called a hibernaculum. They feed on buds and tunnel in developing shoots until they are full-grown. Larvae then pupate in shoot tunnels or bark crevices. Casebearer moths soon emerge to lay first-generation eggs on nutlets.

Control

Often a single, carefully timed insecticide application adequately controls the first-generation casebearer. A second insecticide application may be required if unhatched eggs are found 7 to 10 days after the first application, depending on product and rate. Time insecticide applications accurately to control newly hatched casebearer larvae before they enter the nuts. Once inside nuts, larvae are protected from insecticides. See Table 2 for insecticides.

To determine whether treatment is needed and when to apply insecticide, examine nuts carefully in the spring for casebearer eggs. Infested clusters can be flagged to monitor egg hatch. Once they emerge from the egg, the tiny larvae feed for 2 to 3 days on a secondary bud just below the nut cluster and then tunnel into a nutlet. Delaying treatment until observing the first nut entry 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 mid to 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 PNC egg-laying activity during the next 2 to 3 weeks. Therefore, it is customized to the unique conditions of the orchard where the trap data are collected. The PNCforecast System is available online at https://pecan.ipmpipe.org/Maps/pncForecastMap.

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 activity can vary by as much as 2 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 but 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 1-2 days. If no PNC moths are present, enter a zero for that date. Once traps are set, there should be several inspection dates when no moths are captured; this is to ensure that the first moths that appear in your traps are indeed the first ones of the spring flight. Sometimes one or two moths are captured, and other times none are captured. 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 are needed to generate a PNCforecast, but you can continue to record trap captures to compare year to year PNC activity. Following are examples of calculating the date of first moth capture.

Examples

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

Once you know the date of first moth capture in your traps, you are ready to generate a PNCforecast for your orchard. Log onto: https://pecan.ipmpipe.org/Maps/pncForecastMap and enter the date PNC moths were first captured in your orchard. Then expand the map and move the marker to the orchard location. The PNCforecast will use the average temperature expected at this location during the next 2 to 3 weeks to predict PNC development. The site will then list the dates when 10, 25, 50, 75, and 90 percent of all first-generation PNC eggs are expected to be present in your orchard. An example is shown below.

Example

PNCforecast System Output	
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

Example: PNCforecast System Output

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 often determines that the infestation is above the treatment threshold. (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) 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.

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. 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, the 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.

Begin searching for eggs on the dates of predicted 25 to 50 percent egg-lay as generated by the PNCforecast model; see discussion above on When to Scout for Eggs. If a PNCforecast is not available, begin

scouting 7 to 10 days after capturing the first moths in pheromone traps. Also, monitor egg hatch 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 single 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, as 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 during this period.

Monitoring Pecan Nut Casebearer Moth Activity with Pheromone Traps

Insect traps baited with PNC pheromone are used to determine when PNC moths are active in the orchard. Knowing when PNC moths first become active in the spring 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 casebearers.

Pheromone lures and traps are commonly sold together as kits. Kits sold for pecan nut casebearers use the Trece Pherocon 3 Delta trap or the Trece Pherocon VI trap. The Pherocon VI trap has a removable liner that makes it easy to see captured moths and will last several years if stored inside during the offseason. For a list of suppliers selling traps and lures, see http://pecankernel.tamu.edu. 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 at 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. When placing traps throughout the orchards, be sure to place them in areas where temperature conditions vary, such as between river bottom sites and upland sites. Traps should be placed 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 sometimes captured in pheromone traps. The PNC moth dark gray with a wing length of 0.3 inch. A distinctive ridge of dark scales is present across the forewings.


Pecan nut casebearer moths


Pecan bud moth

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 often 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, and 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 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 caterpillars have occasionally occurred in Texas.

Table 2. Suggested insecticides for controlling pecan nut casebearers, walnut caterpillars, and fall webworms. The information provided is for educational purposes. Read and follow label directions.

Active Ingredient	IRAC Group	Insecticide Brand Name	Remarks
Bacillus thuringiensis	11A	Javelin-WG® Crymax® Deliver®	Bt insecticides have short residual activity; multiple applications may be needed for control.
Methoxyfenozide	18	Intrepid® 2F Inspirato 2F Invertid 2F TurnStyle Troubadour 2F	
Spinetoram	5	Delegate®	
Spinosad	5	Entrust*® SpinTor® 2SC, Success®	
Tebufenozide	18	Confirm® 2F	Do not graze livestock in treated orchards.
Chlorantraniliprole	28	Altacor	Grazing allowed
Methoxyfenozide + Spinetoram	5 18	Intrepid Edge	
Flubendiamate	28	Belt SC	

*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 harm beneficial insects and increase the risk of outbreaks of other pests. For this reason, only insecticides that primarily target pecan nut casebearer and other related caterpillar pests are included in this table. See Table 10 for a list of all insecticides labeled.

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.

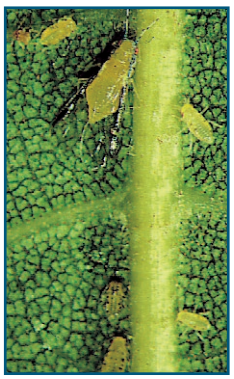
Larvae congregate in large masses on the trunk and scaffold branches to shed their skins before crawling back to complete feeding on leaves. These final-stage larvae consume most of the foliage, and defoliation can occur very quickly. Mature larvae crawl to the soil to pupate. A generation is completed 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 severe damage. Insecticide treatment may be necessary if large infestations threaten to defoliate trees. Insecticides are listed in Table 2.

Yellow Aphids


Yellow aphid

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

The black margined 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.

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

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

Damage

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

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

Biology

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

Control

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

Inspect leaves frequently to monitor yellow aphid densities. Treatment of either species of yellow aphid may be justified on "Cheyenne" when aphid densities are high and persist for several weeks. "Pawnee" is the least susceptible cultivar to yellow aphids, and insecticide treatment for yellow aphids is not normally needed on this variety.

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

Insecticides do not consistently control either species of yellow aphid. Aphids may become resistant to an insecticide used frequently in an orchard. An insecticide that is effective in one orchard may be ineffective in a nearby orchard. Studies have shown that in some cases, applications of pyrethroid insecticides 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 another active ingredient in a different group. Also, frequent use of products containing imidacloprid (Group 4A) may increase aphid resistance, leading to control failures. To reduce this risk, rotate with an insecticide not in the Class 4 Group, such as flonicamid, pymetrozine, or dimethoate (Table 3). For further information on managing insecticide resistance, see the discussion under Pest Management Principles.

Hickory Shuckworm

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

Damage

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

Table 3. Suggested insecticide to control yellow pecan aphids (black margined and yellow pecan aphids) and black aphids. The information provided is for educational purposes only. Read and follow label directions.

Active Ingredient	IRAC Group	Insecticide Brand Name	Remarks
Imidacloprid*	4A	Admire® Pro, 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	Caution. In some locations in the state, yellow aphids resistant to Group 4a insecticides have been identified in these orchards. Therefore, the us of Group 4a insecticides may not be effective. Repeated use of any insecticide can select for insecticide and control failure. To minimize the development of insecticide-resistant aphids, rotate insecticides between IRAC Groups.
Clothianidin	4A	Belay, Arena	Do not graze.
Flonicamid	9C	Beleaf 50SG, Carbine	40-day PHI
Pymetrozine	9B	Fulfill	
Sulfoxaflor	4C	Closer SC	Do not apply within 7 days of harvest.
Thiamethoxam	4A	Centric 40WG, Flagship 25WG	Flagship cannot be applied to bearing trees.
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 through the irrigation system. See label.

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

Biology


Hickory shuckworm damage

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 pecans 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 (see the chart of Development Stages, page 19). A second application 10 to 14 days later may be needed. See Table 4 for a list of insecticides.

Early maturing varieties such as "Pawnee" must be treated earlier for hickory shuckworm, since the half-shell hardening stage will occur sooner. 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

Table 4. Suggested insecticides for controlling hickory shuckworms. The information provided is for educational purposes. Always read and follow label directions.

Active Ingredient	IRAC Group	Insecticide Brand Name	Remarks
Methoxyfenozide	18	Intrepid® 2F Inspirato 2F Invertid 2F TurnStyle Troubadour 2F	
Spinosad	5	Entrust®* SpinTor® 2SC	
Tebufenozide	18	Confirm® 2F	Do not graze livestock in treated orchards.
Methoxyfenozide + Spinetoram	5 18	Intrepid Edge	
Chlorantraniliprole	28	Altacor	Grazing is allowed.
Flubendiamide	28	Belt SC	

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

potential defoliation appears unacceptable, spot spraying of infested trees may be practical. The insecticide spray must penetrate the web to be effective. Insecticides are listed in Table 2.

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. Miticides are listed in Table 5.

Black Pecan Aphid

Black aphid

The black pecan aphid is much more destructive than the two species of yellow aphid. Three black pecan aphids per compound leaf can cause severe leaf damage and defoliation. 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.

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

Table 5. Suggested miticides to control pecan leaf scorch mites. The information provided is for educational purposes. Read and follow label directions.

Active Ingredient	IRAC Group	Insecticide 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	20D	Acramite® 50 SC	
Spirodiclofen	23	Envidor® 2 SC	
Cyflumetofen	25	Nealta	
Fenazaquin	21	Magus	Non-bearing trees only.
Fenpyroximate	21A	Fujimite 5EC Portal XLO	

females that reproduce without mating. Male and female forms appear in fall and females lay eggs that overwinter on branches. Densities often are very low until August or September, when infestations often increase rapidly. Note that parasitized yellow pecan aphids 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 infestation often begins. In general, treat when black pecan aphids average three per compound leaf. Black pecan aphids are easier to control with insecticides than yellow aphids. Insecticides for black pecan aphid are listed in Table 3. Natural enemies are important in keeping the number of black pecan aphids low.

Stink Bugs And Leaf-footed Bugs

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

Damage


Stink bug

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. The affected areas taste bitter.

Biology

These bugs overwinter as adults under fallen leaves and in other sheltered places on the ground. Populations increase in summer when adults lay eggs on many crops and weeds. Fields of soybeans, other legumes, and sorghum may be sources of adults that fly to pecans. Infestations are usually largest from September through shuck split, but low numbers not necessarily requiring treatment may occur throughout the growing season in pecan orchards.

Control

Look for stinkbugs feeding on pecans during kernel development. Guidelines for determining when an insecticide is needed to prevent stinkbug damage have not been developed. Brown stinkbugs are

Table 6. Suggested insecticides for control of stinkbugs and leaf-footed bugs. The information provided is for educational purposes. Read and follow label directions.

Active Ingredient	IRAC Group	Insecticide 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	
Lambda-cyhalothrin	3A	Grizzly Z®, Kaiso 24® WG, Karate® w/ zeon® tech, Lambda-CY® EC, Province® Silencer®, Taiga Z® Warrior® Warrior II®	
Zeta-cypermethrin	3A	Mustang Max®, Mustang Max EC, Respect® EC	

more difficult to kill with insecticides than are green stinkbugs and leaf-footed bugs. Field studies indicate bifenthrin is more effective on brown stinkbugs than other pyrethroids (Table 6).

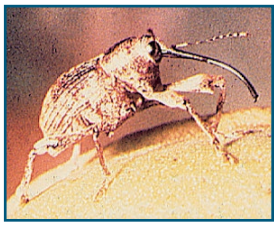
Weed control in and near the orchard helps suppress stink bugs and lower the possibility of their moving into pecans. Some growers also have planted "trap crops" to lure adult stinkbugs and leaf-footed bugs away from pecans. Black eye, purple hull, crowder peas, or millet planted in plots or a single 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 pods. Apply an insecticide to the trap crop to kill stink bugs and leaf-footed bugs once the crop stops blooming and setting pods. This treatment is necessary to kill the bugs before they leave and fly into the pecans. Before planting a trap crop, make sure you have enough available water to obtain a stand and are planting a variety of pea suited to the soil type and soil pH of the orchard. You will also need to control weeds and prevent livestock and wildlife from grazing plots.

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 the orchard can deprive grasshoppers of food. Pyrethroid insecticides (lambda-cyhalothrin, zeta-cypermethrin, bifenthrin), chlorpyrifos, and carbaryl labeled for use in pecans kill grasshoppers (Table 7). However, their residual control is limited, and frequent re-application 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

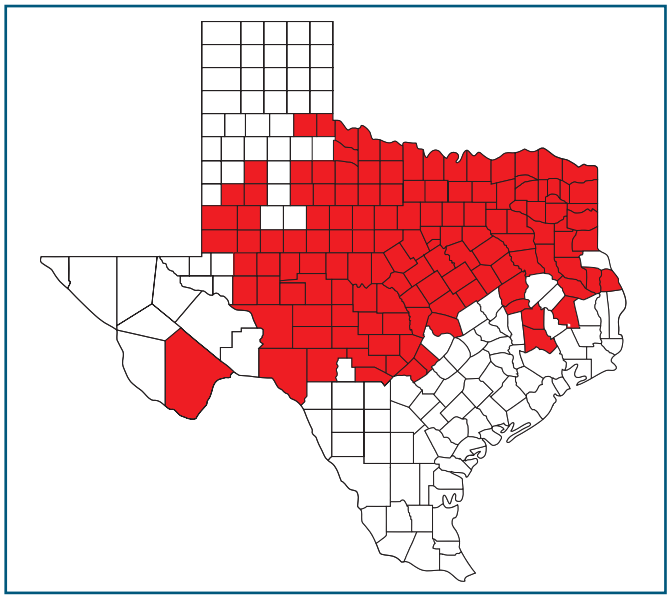
The pecan weevil is found throughout most of Texas (see map). Where present, the pecan weevil is the most damaging late-season pecan pest. Infestations are often localized and vary greatly within orchards.



Pecan weevil

Damage

In August, adult weevils begin to emerge from the soil and feed on nuts in the water stage, causing them to drop. After the kernel has entered the gel stage, the nut is susceptible to egg-laying and attack by pecan



Records of Pecan Weevil presence in Texas counties, 2019

Table 7. Suggested insecticides for controlling grasshoppers. The information provided is for educational purposes. Read and follow label directions.

Active Ingredient	IRAC Group	Insecticide Brand Name	Remarks
Carbaryl	1A	Carbaryl 4L, Sevin 4F, Sevin SL, Sevin XLR	Only treat orchard floor and surrounding areas to avoid killing beneficial insects in canopy.
Chlorpyrifos	1B	Govern® 4E, Hatchet®, 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 using this and other broad-spectrum insecticides.

weevil larvae. Infested nuts remain on the tree while the developing larvae consume the kernels. Full-grown larvae emerge from nuts in late fall or early winter through a round hole chewed through the shell.

Biology

The life cycle of the pecan weevil from egg, larva, pupa and to 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. The 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://factsheets.okstate.edu/documents/epp-7190-monitoring-adult-weevil-populations-in-pecan-and-fruit-trees-in-oklahoma/. Begin monitoring traps about 1 to 2 weeks before the first pecans enter the gel stage. In Central Texas, begin trapping about the first week of August and continue through shuck split.

Wire cone traps. Wire cone traps are built from ⅛-inch mesh hardware cloth. Place traps on the soil beneath "scout" trees known to have a history of high weevil numbers. Weevils emerging from the soil beneath the trap crawl up the sides of the trap and are captured inside the jar at the top.

Inspect traps every 2 to 3 days, record the captured weevils and remove them from the traps. The number of traps you will need depends on the orchard size and weevil density. Ten to 15 traps per orchard are often enough to monitor weevil activity.

Pyramid or "Tedders" traps. Pyramid traps are built of two triangular pieces of ½-inch hardboard that interlock to form a 4-foot tall pyramid. The trap is painted a dark color and fitted with a container at the top for capturing weevils.

When placed in the orchard, pyramid traps 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. 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 require removal 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 indicates the presence and relative abundance of adult pecan weevils. The pattern of trap catches, as described above, helps determine 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 (see insecticides in Table 8). Once nuts reach the gel stage, apply insecticide if adult weevils are present. A second application 7 to 10 days later is usually necessary unless drought has delayed weevil emergence from the soil. 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' stings can be a serious problem for orchard workers and interfere with pecan operations such as grafting, mowing, and harvesting. They may also damage equipment such as electrical motors and irrigation systems. Some formulations of chlorpyrifos are labeled for application as a broadcast spray to the orchard floor and temporarily reduce fire ants. Methoprene (Extinguish®), pyriproxyfen (Esteem®, Distance®), and hydramethylnon (AmdroPro®) are baits that are broadcast across the orchard (Table 9). 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, download the publication E-628, *Broadcast Baits for Fire Ant Control* from the Texas A&M AgriLife Bookstore (www.agrilifebookstore.org).

Table 8. Suggested insecticides for control of pecan weevils. The information provided is for educational purposes. Read and follow label directions.

Active Ingredient	IRAC Group	Insecticide 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	Carbaryl 4L, Sevin 4F, Sevin SL, and Sevin XLR	14 days	
Lambda-cyhalothrin	3A	Warrior®, Warrior II®, Grizzly Z® Kaiso 24® WG, Karate® w/ zeon® tech, Lambda-CY® EC, Province®	14 days	
Zeta-cypermethrin	3A	Mustang Max® EC, Mustang Max® Respect® EC	21 days	
Zeta-cypermethrin and bifenthrin	3A and 3A	Hero®	21 days	Do not graze treated orchards.

Table 9. Suggested insecticides for control of red imported fire ants. The information provided is for educational purposes. Read and follow label directions.

Active Ingredient	IRAC Group	Insecticide Brand Name	Remarks
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 is permitted.
Pyriproxyfen	7	Esteem®	See label for instructions.
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.

Protecting Bees and Other Pollinators from Insecticides

Pecans are wind pollinated and therefore do not rely on insects for pollination. Pecan flowers do not produce nectar, and the pollen grains are very small and of poor nutritional content; therefore, they are not collected by honeybees. Honeybees sometimes collect aphid honeydew, a source of sugar, from pecan leaves. Bees may be killed if cover crops such as clovers, alfalfa, or vetch are flowering in the orchard during insecticide application. Insecticide applicators and beekeepers should cooperate closely to minimize bee losses.

Table 10. Insecticides grouped according to their relative hazards to honey bees.

Insecticides	Remarks
Group 1–Highly toxic Carbaryl Chlorpyrifos Cypermethrin Dimethoate Esfenvalerate Imidacloprid Imidan® Lambda-cyhalothrin Malathion Zeta-cypermethrin	This group includes materials that kill bees on contact or several days afterward. Remove bees from the area if these insecticides are used on plants visited by bees. Malathion occasionally causes heavy bee losses, particularly during periods of extremely high temperatures. Make applications in the evening after all bees have completed foraging. Avoid ultra-low-volume malathion sprays after blooms appear.
Group 2–Moderately toxic Malathion (EC) Spinosad (Entrust®, SpinTor®)	Do not apply when bees are working in the field. Apply in the late evening.
Group 3–Relatively nontoxic Bacillus thuringiensis Confirm® 2F Dimilin® Intrepid® Kelthane® Vendex®	Apply in the late evening or early morning when bees are not foraging

To prevent bee losses, do not spray colonies or allow insecticide to drift onto colonies. Bees cluster on the fronts of their hives on hot evenings and can be exposed to pesticide drift or direct spray. Read the "Directions for Use" section of the pesticide label for directions and restrictions on protecting honeybees and pollinators. New labels include this information in a bee advisory box highlighted by the bee icon.

Additional Resources

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

Texas A&M University Entomology Department
httpsw://entomology.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

The publications below can be downloaded or ordered from http://agrilifebookstore.org:

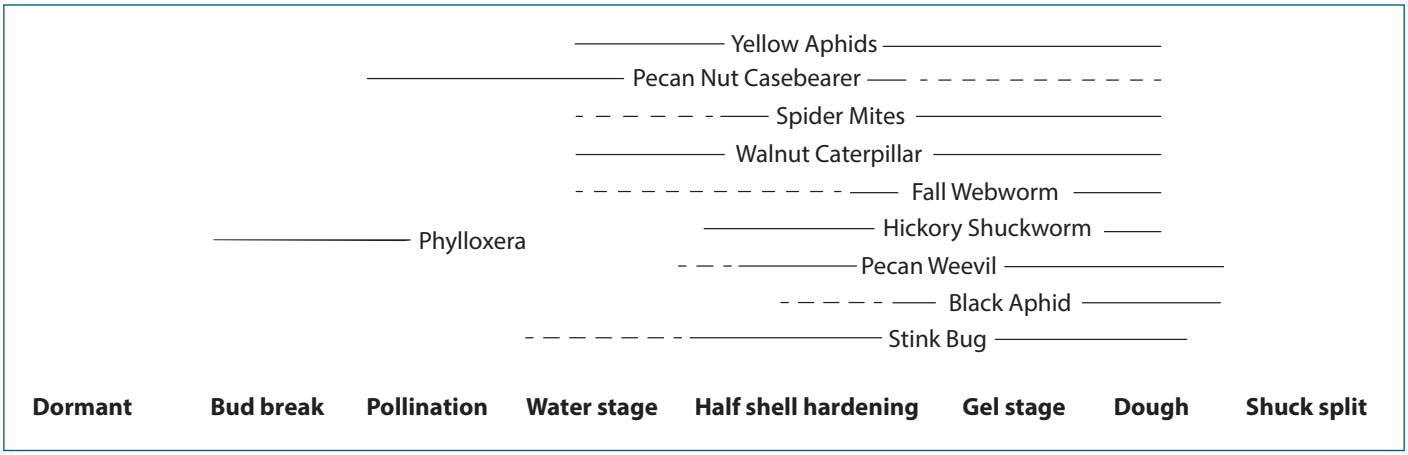
ENTO-083, *Pecan Pests in the Home Orchard*

E-173, *Controlling the Pecan Nut Casebearer*

ENTO-089, *Controlling the Pecan Weevil*

Seasonal Pecan Pest Profile

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



Developmental Stages of the Pecan

Dormant: Period from leaf drop to bud break.

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

Pollination: Catkins are shedding pollen and stigmas are receptive.

Water stage: The nut interior is filled with water.

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

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

Dough: The gel of the kernel begins to solidify.

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

Table 10. Insecticides labeled for use on pecans. Read and follow 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	Labeled pests
Abamectin	Abacus, Abacus V, Abamex	Rotam North America, Inc	2.00	Warning	Yes	6	Nerve, muscle actions	12 hr.	No grazing	21 days	No	Mites
	Abba 0.15, Abba 0.15EC	ADAMA	1.90	Warning	Yes	6	Nerve, muscle actions	12 hr.	No grazing	21 days	No	Mites
	Abba ultra	Amvac, ADAMA	3.70	Warning	Yes	6	Nerve, muscle actions	12 hr.	No grazing	21 days	No	Mites
	Agri-Mek SC	Syngenta	8.00	Warning	Yes	6	Nerve, muscle actions	12 hr.	No grazing	21 days	No	Mites
	Borrada	Adda	1.90	Warning	Yes	6	Nerve, muscle actions	12 hr.	No grazing	21 days	No	Mites
	Epi-Mek 0.15 EC	Syngenta	2.00	Warning	Yes	6	Nerve, muscle actions	12 hr.	No grazing	21 days	No	Mites
	Nufarm Abamectin 0.15 EC	Nufarm	2.00	Warning	Yes	6	Nerve, muscle actions	12 hr.	No grazing	21 days	No	Mites
	Reaper 0.15 EC, Advance	Loveland	2.00	Warning	Yes	6	Nerve, muscle actions	4 days	No grazing	21 days	No	Mites
	Reaper ClearForm, Advanced	Loveland	2.00	Warning	Yes	6	Nerve, muscle actions	12 hr.	No grazing	21 days	No	Mites
	Willowood Abamectin 0.15EC	Willowood	2.00	Warning	Yes	6	Nerve, muscle actions	12 hr.	No grazing	21 days	No	Mites
	Willowood Abemectin 0.7SC	Willowood	8.00	Warning	Yes	6	Nerve, muscle actions	12 hr.	No grazing	21 days	No	Mites
	Zoro	Cheminova, Inc.	1.90	Warning	Yes	6	Nerve, muscle actions	12 hr.	No grazing	21 days	No	Mites
Acequinocyl	Kanemite 15 SC	Arysta LifeScience NA	15.80	Caution	No	20B	Unknown	12 hr.	—	7 days	No	Mites
Acetamiprid	Anarch 30 SG	Loveland Products	30.00	Caution	No	4A	Neonicotinoid	12 hr.	—	14 days	No	Aphids, pecan nut casebearer, hickory shuckworm, pecan weevil, glassywinged sharpshooter
	Anarchy 70 WP	Loveland Products	70.00	Caution	No	4A	Neonicotinoid	12 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, glassy-winged sharpshooter
	Arvida 30SG	Atticus Agricultural Products	30.00	Caution	No	4A	Neonicotinoid	12 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, glassy-winged sharpshooter
	ArVida 70 WP	Atticus Agricultural Products	70.00	Caution	No	4A	Neonicotinoid	12 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, glassy-winged sharpshooter
	Assail 30 SG	United Phosphorus	30.00	Caution	No	4A	Neonicotinoid	12 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, glassy-winged sharpshooter

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Table 10 *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	Labeled pests
Acetamiprid *continued*	Assail 70WP	United Phosphorus	70.00	Caution	No	4A	Neonicotinoid	12 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, glassy-winged sharpshooter
	Azomar	AgBiome	30.00	Caution	No	4A	Neonicotinoid	12 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, glassy-winged sharpshooter
	Intruder Max 70WP	United Phosphorus	70.00	Caution	No	4A	Neonicotinoid	12 hr.	—	14 days	No	Aphids, leafhoppers, sharpshooters, pecan nut casebearer, hickory shuckworm, pecan weevil
Allyl isothiocyanate	Domunus	Isogo	96.30	Danger	—	Unknown	Soil fumigant		—	—	No	Nematodes, white grubs
Alphacypermethrin	Fastac	BASF	10.90	Danger	Yes	3A	Pyrethroid	12 hr.	—	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	Gowan	1.20	Caution	No	Unknown	Growth regulator	4 hr.	—	0 days	Yes	Aphids, true bugs, caterpillars, mites
	Azaguard	BioSafe	3.00	Caution	No	Unknown	Botanically based	4 hr.	—	0 days	No	Aphids, stink bugs, sawflies, hickory shuckworm, mites
	Azatin O	OHP, Inc.	4.00	Caution	No	Unknown	Growth regulator	4 hr.	—	0 days	No	Aphids, sawflies, June beetles, leafminers,
	Azatrol EC, Azatrol Hydro	PBI Gordon Corp	1.20	Caution	No	Unknown	Growth regulator	4 hr.	—	0 days	Yes	Aphids, mites, true bugs, leafrollers, beetles, weevils
	Ecozin Plus 1.2 ME	Amvac Chemical Corp.	1.20	Caution	No	Unknown	Growth regulator	4 hr.	—	0 days	Yes	Aphids, mites, true bugs, leafrollers, beetles
	Molt-X	BioWorks, Inc.	3.00	Caution	No	Unknown	Botanically based	4 hr.	—	0 days	No	Hickory shuckworm, twig girdler
	Neemix 4.5	Certis USA	4.50	Warning	No	Unknown	Growth regulator	12 hr.	—	0 days	Yes	Black margined aphid, fall webworm, pecan nut casebearer, walnut caterpillar, hickory shuckworm, serpentine leafminer, spittle bug, leaf and stem phylloxera, grasshopper
Bifenazate	Acramite 4SC, 50WS	Arysta	43.20	Caution	No	Unknown	Unknown	12 hr.	—	14 days	No	Pecan leaf scorch mite
	Banter SC	United Phosphorus	43.20	Caution	No	Unknown	Unknown	12 hr.	—	14 days	No	Pecan leaf scorch mite
	Banter WDG	United Phosphorus	50.00	Caution	No	Unknown	Unknown	12 hr.	—	14 days	No	Pecan leaf scorch mite
	Bifenamite 4SC	Albaugh, LLC	43.20	Caution	No	20D	Unknown	12 hr.	—	14 days	No	Pecan leaf scorch mite
	Bifenamite 50WDG	Albaugh, LLC	50.00	Caution	No	20D	Unknown		—			
	Bizate	Loveland	43.20	Caution	No	20D	Unknown	12 hr.	—	14 days	No	Pecan leaf scorch mite
	Enervate 4 SC	Atticus	43.20	Caution	No	20D	Unknown	12 hr.	—	14 days	No	Mites

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Table 10 *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	Labeled pests
Bifenazate *continued*	Enervate 50 WSB	Atticus	50.00	Caution	No	20D	Unknown	12 hr.	—	14 days	No	Mites
	Willowood 50WDG	Willowood	50.00	Caution	No	20D	Unknown	12 hr.	—	14 days	No	Mites
	Vigilant 4SC	Macdermid Ag Solutions	43.20	Caution	No	20D	Unknown	12 hr.	—	14 days	No	Pecan leaf scorch mite
Bifenthrin	Brigade WSB	FMC	10.00	Warning	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm pecan nut casebearer, pecan leaf casebearer, leaffooted bug, stink bug, pecan weevil, phylloxera
	Brigade 2EC	FMC	25.10	Warning	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm pecan nut casebearer, pecan leaf casebearer, leaffooted bug, stink bug, pecan weevil, phylloxera
	Bi-Dash 2E	Sharda	25.00	Warning	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	black pecan aphid, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, phylloxera, stink bugs, yellow pecan aphid
	Bifen 2 AG Gold	Direct Ag Source	25.10	Warning	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer. Pecan phylloxera, stink bug, leaffooted bug
	Bifen 25%EC	Tacoma Ag	25.00	Warning	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer. pecan phylloxera, stink bug, leaffooted bug
	Bifenthrin 2EC	Aceto Ag Chemicals	25.10	Warning	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer. pecan phylloxera, stink bug, leaffooted bug
	Bifenture EC	United Phosphorus, Inc.	25.10	Warning	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	Black pecan aphid, hickory shuckworm, leaffooted bugs, pecan leaf casebearer, pecan nut casebearer, pecan phylloxera, stink bugs, yellow pecan aphids
	Bifenture 10F	United Phosphorus, Inc.	10.00	Caution	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	Black pecan aphid, hickory shuckworm, leaffooted bugs, pecan leaf casebearer, pecan nut casebearer, pecan phylloxera, stink bug, yellow pecan aphids

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Table 10 *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	Labeled pests
Bifenthrin *continued*	Fanfare EC	ADAMA	24.00	Warning	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	Black pecan aphid, hickory shuckworm, leaffooted bug, pecan nut casebearer, phylloxera, stink bug, yellow pecan aphid
	Fanfare ES	MANA of North America	22.60	Warning	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	Black pecan aphid, hickory shuckworm, leaffooted bugs, pecan leaf casebearer, pecan nut casebearer, phylloxera, stink bugs, yellow pecan aphids
	Fanfare 2EC	MANA of North America	25.10	Warning	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	Black pecan aphid, hickory shuckworm, leaffooted bugs, pecan leaf casebearer, pecan nut casebearer, phylloxera, stink bugs, yellow pecan aphids
	Sniper, Helios, LFR	Loveland Products, Inc.	25.00	Warning	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	Black pecan aphid, hickory shuckworm, leaffooted bugs, pecan leaf casebearer, pecan nut casebearer, phylloxera, stink bugs, yellow pecan aphids
	Skyraider	ADAMA	21.65	Warning	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	Black pecan aphid, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, phylloxera, stink bugs, yellow pecan aphid
Beauveria bassiana	BioCeres WP	BioSafe	20.00	Caution	No	Unknown	Biological	4 hr.	—	0 days	No	Aphids
	BotaniGard ES	Laverlam International	11.30	Caution	No	Unknown	Biological	4 hr.	—	0 days	No	Grasshoppers, pecan weevil
	Mycotrol WPO, ESO	BioWorks	11.30	Caution	No	Unknown	Biological	4 hr.	—	0 days	Yes	Grasshoppers, pecan weevil, stink bugs
Bt. – Kurstaki	Biobit HP	Valent USA	58.20	Caution	No	11A	Bacillus thuringiensis	4 hr.	—	0 days		Fall webworm, walnut caterpillar
	Crymax	Certis	40.00	Caution	No	11A	Bacillus thuringiensis	4 hr.	—	0 days	No	Pecan nut casebearer, hickory shuckworm
	Deliver	Certis USA	85.00	Caution	No	11A	Bacillus thuringiensis	4 hr.	—	0 days	Yes	Pecan nut casebearer, fall webworm
	Dipel DF	Valent USA	54.00	Caution	No	11A	Bacillus thuringiensis	4 hr.	—	0 days	Yes	Walnut caterpillar
	Javelin-WG	Certis	85.00	Caution	No	11A	Bacillus thuringiensis	4 hr.	—	0 days	Yes	Pecan nut casebearer, fall webworm
Bt. – Aizawai	Agree WG	Certis USA	50.00	Caution	No	11A	Bacillus thuringiensis	4 hr.	—	0 days	Yes	No pecan insects listed
	Jackpot WP	Certis USA	50.00	Caution	No	11A	Bacillus thuringiensis	4 hr.	—	0 days	No	No pecan insects listed
	XenTari DF	Valent USA	54.00	Caution	No	11A	Bacillus thuringiensis	4 hr.	—	0 days	No	No pecan insects listed
Buprofezin	Centaur WDG	Nichino	70.00	Caution	No	16	Insect growth regulator	12 hr.	—	60 days	No	Meally bugs, scales
Burkholderia spp.	Venerate	Marrone	94.46	Caution	No	Unknown	Biological	4 hr.	—	0 days	Yes	Aphids, mites, pecan weevil, fall webworm, hickory shuckworm, pecan nut casebearer

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Table 10 *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	Labeled pests
Capsicum oleoresin extract	Captiva	Gowan	7.60	Caution	No	Unknown	Insect repellent	4 hr.	—	—	No	(Insect repellent) mites, lepidoptera larvae
Carbaryl	Carbaryl 4L	Drexel Chemical Company	42.6	Caution	No	1A	Carbamate	12 hr.	—	14 days	No	Black margined aphid, fall webworm, hickory shuckworm, phylloxera, pecan nut casebearer, spittle bug, pecan weevil, twig girdler, walnut caterpillar
	Sevin 4F	NovaSource	43.0	Caution	No	1A	Carbamate	12 hr.	—	14 days	No	Black margined aphid, fall webworm, hickory shuckworm, phylloxera, pecan nut casebearer, spittle bug, pecan weevil, twig girdler, walnut caterpillar
	Sevin SL	Bayer	44.0	Caution	No	1A	Carbamate	12 hr.	—	14 days	No	Black margined aphid, fall webworm, hickory shuckworm, phylloxera, pecan nut casebearer, spittle bug, pecan weevil, twig girdler, walnut caterpillar
	Sevin XLR	NovaSource	44.1	Caution	No	1A	Carbamate	12 hr.	—	14 days	No	Black margined aphid, fall webworm, hickory shuckworm, phylloxera, pecan nut casebearer, spittle bug, pecan weevil, twig girdler, walnut caterpillar
Calcium Polysulfide	Brandt Lime Sulfur	Brandt	29.00	Danger	No	Unknown	Unknown	48 hr.	—	—	No	Yellow aphids and mites
	Lime Sulfur Ultra	OR-CAL	27.00	Danger	No	Unknown	Unknown	48 hr.	—	—	No	Yellow aphids and mites
	Lime-Sulphur Solution	Novasource	29.00	Danger	No	Unknown	Unknown	48 hr.	—	—	No	Yellow aphids and mites
	Miller Lime-Sulfur Solution	Miller Chemical & Fertilizer	29.00	Danger	No	Unknown	Unknown	48 hr.	—	—	No	Yellow aphids and mites
	Rex Lime Sulfur Solution	OR-CAL	28.00	Danger	No	Unknown	Unknown	48 hr.	—	—	No	Yellow aphids and mites
Cedar oil	Cedar Gard	Natural Resources Group	16.00	—	No	Unknown	Unknown	—	—	—	Yes	—
Chenopodium ambrosioides	Requiem	Bayer	16.75	Caution	No	Unknown	Unknown	4 hr.	—	—	No	Mites
Chlorantraniliprole	Altacor	DuPont	35.00	No signal word	No	28	Diamides	4 hr.	Grazing allowed	10 days	No	Hickory shuckworm, pecan nut casebearer
Chlorpyrifos	Chlorpyrifos 4E AG	ADMA	42.50	Warning	Yes	1B	Organophosphate	24 hr.	No grazing	28 days	No	Black pecan aphid, yellow pecan aphid, pecan nut casebearer, fall webworm, hickory shuckworm, spittle bugs, pecan leaf scorch mite

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Table 10 ***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	Labeled pests
Chlorpyrifos *continued*	Govern 4E	TENKOZ, Inc.	44.90	Warning	Yes	1B	Organophosphate	24 hr.	No grazing	28 days	No	Black pecan aphid, yellow pecan aphid, blackmargined aphid, spittle bug, fall webworm, pecan nut casebearer, hickory shuckworm phylloxera
	Hatchet	Dow AgroSciences	44.90	Warning	Yes	1B	Organophosphate	24 hr.	No grazing	28 days	No	Black pecan aphid, black margined aphid, spittle bug, yellow pecan aphid, fall webworm, pecan nut casebearer, hickory shuckworm phylloxera
	Lorsban 4E	Dow AgroSciences	44.90	Warning	Yes	1B	Organophosphate	24 hr.	No grazing	28 days	No	Aphids (mixed with pyrethroid), hickory shuckworm, fall webworm, pecan nut casebearer, phylloxera
	Lorsban 75WG	Gowan	75.00	Warning	Yes	1B	Organophosphate	24 hr.	No grazing	28 days	No	Aphids (mixed with pyrethroid), hickory shuckworm, fall webworm, pecan nut casebearer, phylloxera
	Lorsban Advanced	Dow AgroSciences	40.20	Warning	Yes	1B	Organophosphate	24 hr.	No grazing	28 days	No	Blackmargined aphid, yellow pecan aphid, spittle bug, fall webworm, pecan nut casebearer, black pecan aphid, phylloxera, hickory shuckworm, brown marmorated stink bug,
	Vulcan	ADAMA	39.50	Warning	Yes	1B	Organophosphate	12 hr.	No grazing	28 days	No	Pecan nut casebearer, fall webworm, phylloxera, black pecan aphid, hickory shuckworm, pecan leaf scorch mite, yellow pecan aphid, blackmargined pecan aphid spittle bugs
	Warhawk, Warhawk Clearform	Loveland Products	44.90	Warning	Yes	1B	Organophosphate	24 hr.	No grazing	28 days	No	Black pecan aphid, blackmargined aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, spittle bug, phylloxera
	Whirlwind	Helena	44.90	Warning	Yes	1B	Organophosphate	24 hr.	No grazing	28 days	No	Black pecan aphid, blackmargined aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, fall webworm, phylloxera, spittle bug

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Table 10 *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	Labeled pests
Chlorpyrifos *continued*	Yuma	Winfield Solutions	44.90	Warning	Yes	1B	Organophosphate	24 hr.	No grazing	28 days	No	Black pecan aphid, blackmargined aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, fall webworm, phylloxera, spittle bug
Clothianidin	Belay	Valent USA	23.60	Caution	No	4A	Neonicotinoid	12 hr.	No grazing	21 days	No	Aphids, pecan nut casebearer, pecan weevil, hickory shuckworm, stink bugs
Chromobacterium subtsugae	Grandevo, Grandevo CG, WDG	Marrone	30.00	Caution	No	Unknown	Biological	4 hr.	—	0 days	Yes	Fall webworm, hickory shuckworm, pecan nut casebearer, aphids, mites, pecan weevil
Cinnamon oil	Cinnerate	Seipasa	60.00	Caution	No	Unknown	Unknown	—	—	0 days	No	Aphids, caterpillars, scale
Cyantraniliprole	Exirel	DuPont	10.20	Caution	No	28	Unknown	12 hr.	—	5 days	No	Hickory shuckworm, pecan nut casebearer
	Mainspring GNL	Sygenta	18.66	None listed	No	28	Unknown	4 hr.	—	Non bearing trees	No	Aphids
Cyflumetofen	Nealta	BASF	18.70	Caution	No	25	Unknown	12 hr.	—	—	No	Mites
Cyfluthrin (Beta)	Baythroid XL	Bayer CropScience	12.70	Warning	Yes	3A	Pyrethroid	12 hr.	—	14 days	No	Leaffooted bug, pecan nut casebearer, pecan weevil, hickory shuckworm, spittle bug
	Tombstone	Loveland Products	24.74	Danger	Yes	3A	Pyrethroid	12 hr.	—	14 days	No	Leaffooted bug, pecan nut casebearer, pecan weevil, hickory shuckworm
	Tombstone Helios	Loveland Products	25.00	Warning	Yes	3A	Pyrethroid	12 hr.	—	14 days	No	Leaffooted bug, pecan nut casebearer, pecan weevil, stink bug, hickory shuckworm
Cypermethrin	Holster	Loveland Products, Inc.	30.00	Caution	Yes	3A	Pyrethroid	12 hr.	—	21 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan weevil
	UP-Cyde 2.5 EC	United Phosphorous, Inc.	30.60	Caution	Yes	3A	Pyrethroid	12 hr.	—	21 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan weevil
Cypermethrin (Alpha)	Fastac EC	BASF	10.90	Danger	Yes	3A	Pyrethroid	12 hr.	—	7 days	No	Aphids, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, phylloxera, pecan weevil, stink bug
	Fastac CS	BASF	9.88	Caution	Yes	3A	Pyrethroid	12 hr.	—	7 days	No	Aphids, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, phylloxera, pecan weevil, stink bug

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Table 10 *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	Labeled pests
Deltamethrin	Delta Gold	Winfield Solutions	16.60	Danger	Yes	3A	Pyrethroid	12 hr.	—	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	—	7 days	No	Mites
Diflubenzuron	Dimilin 2L	Chemtura Corp.	22.00	Caution	Yes	15	Growth regulation	12 hr.	—	28 days	No	Hickory shuckworm, pecan nut casebearer, fall webworm, walnut caterpillar, pecan weevil (suppression)
	Durant 2L	Tacoma Ag	22.00	Caution	Yes	15	Growth regulation	12 hr.	—	28 days	No	Hickory shuckworm, pecan nut casebearer, fall webworm, pecan weevil (suppression)
	Micromite 2L	Arysta LifeSciences	22.00	Caution	Yes	15	Growth regulation	12 hr.	—	28 days	No	Hickory shuckworm, pecan nut casebearer, fall webworm, pecan weevil (suppression), walnut caterpillar
	Unforgiven	Loveland	22.00	Caution	Yes	15	Growth regulation	12 hr.	—	28 days	No	Hickory shuckworm, pecan nut casebearer, fall webworm, pecan weevil (suppression)
Dimethoate	Dimethoate 4E	Cheminova, Inc.	43.50	Warning	No	1B	Organophosphate	48 hr.	No grazing	21 days	No	Aphids, mites, leafhoppers
	Dimate 4EC, 4E	Winfield Solutions	44.74	Warning	No	1B	Organophosphate	48 hr.	No grazing	21 days	No	Aphids, mites, leafhoppers
	Dimethoate 4EC	Drexel Chemical Company	44.80	Danger	No	1B	Organophosphate	48 hr.	No grazing	21 days	No	Aphids, mites, leafhoppers
	Dimethoate 4-E	Cheminova, Inc.	43.50	Warning	No	1B	Organophosphate	48 hr.	No grazing	21 days	No	Aphids, mites, leafhoppers
	Dimethoate 400	Loveland	43.50	Warning	No	1B	Organophosphate	48 hr.	No grazing	21 days	No	Aphids, mites, leafhoppers
	Dimethoate LV-4	Drexel Chemical Company	41.70	Caution	No	1B	Organophosphate	48 hr.	No grazing	21 days	No	Aphids, mites, leafhoppers
	Dimethoate 2.67	Drexel Chemical Company	30.50	Warning	No	1B	Organophosphate	48 hr.	No grazing	21 days	No	Aphids, mites, leafhoppers
Dormant oil	Damoil	Drexel Chemical Company	98.00	Caution	No	Unknown	Unknown	4 hr.	—	—	Yes	Obscure scale
Esfenvalorate	Asana XL	Valent	8.40	Warning	Yes	3A	Pyrethroid	12 hr.	—	21 days	No	Aphids, hickory shuckworm, pecan nut casebearer, spittlebug, pecan weevil
	S-Fenvalostar	LG Life Sciences	8.40	Warning	Yes	3A	Pyrethroid	12 hr.	—	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 hr.	—	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	10B	Unknown	12 hr.	—	—	No	Mites (non bearing trees only)
	Zeal	Valent	72.00	Caution	No	10B	Unknown	12 hr	—	28 days	No	Mites
	Zara WSB	Atticus	72.00	Caution	No	10B	Unknown	12 hr.	—	28 days	No	Mites

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Table 10 *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	Labeled pests
Emamectin benzoate	Proclaim	Syngenta	5.00	Caution	Yes	6	Unknown	12 hr.	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	Unknown	12 hr.	No grazing	—	No	Fall webworm, hickory shuckworm, pecan bud moth, pecan nut casebearer, pecan leaf casebearer, pecan bud moth, pecan serpentine leafminer, walnut caterpillar
Fats and glyceridic oils	DeBug ON	Agro	70.00	Caution	No	Unknown	Antifeedant, repellent	4 hr.	—	—	Yes	Aphids, casebearer, mites, phylloxera, weevils
	DeBug Optimo	Agro	15.04	Caution	No	Unknown	Antifeedant, repellent	4 hr.	—	—	Yes	Aphids, casebearer, mites, phylloxera, weevils
	DeBug Tres	Agro	4.00	Caution	No	Unknown	Antifeedant, repellent	4 hr.	—	—	Yes	Aphids, casebearer, mites, phylloxera, weevils
	DeBug Turbo	Agro	68.00	Caution	No	Unknown	Antifeedant, repellent	4 hr.	—	—	Yes	Aphids, casebearer, mites, phylloxera, weevils
Fenazaquin	Magister SC	Gowan	18.79	Warning	No	21	Unknown	12 hr.	—	7 days	No	Mites
	Magister	Gowan	18.79	Warning	No	21	Unknown	12 hr.	—	7 days	No	Mites (non bearing trees only)
	Magus	Gowan	18.79	Warning	No	21	Unknown	12 hr.	—	Non-bearing	No	Mites
Fenbutatin-oxide	Vendex 50WP	United Phosphorus	50.00	Danger	Yes	12B	Organotin miticides	48 hr.	—	14 days	No	Mites
Fenpropathin	Danitol 2.4 EC	Valent USA	30.90	Warning	Yes	3	Pyrethroid	24 hr.	—	3 days	No	Pecan nut casebearer, hickory shuckworm, green stink bug, southern green stink bug
Fenpyroximate	FujiMite SC	Nichino America, Inc.	5.00	Warning	No	21A	Entergy metabolism inhibitors	12 hr.	—	14 days	No	Mites
	FujiMite XLO	Nichino America, Inc.	5.00	Warning	No	21 A	Entergy metabolism inhibitors	12 hr.	—	14 days	No	Mites
	Portal	Nichino America, Inc.	5.00	Warning	No	21	Entergy metabolism inhibitors	12 hr.	—	14 days	No	Pecan leaf scorch mite, 2-spotted spider mite (nonbearing trees only)
Flubendiamide	Belt SC	Bayer CropScience	39.00	Caution	No	28	Diamides	12 hr.	—	14 days	No	Fall webworm, hickory shuckworm, pecan nut casebearer, walnut caterpillar
Flonicamid	Beleaf 50SG	FMC	50.00	Caution	No	29	Unknown	12 hr.	—	40 days	No	Aphids, plant bugs
	Carbine 50 WG	FMC	50.00	Warning	No	9C	Unknown	12 hr.	—	40 days	No	
Flupyradifurone	Altus	Bayer CropScience	17.09	Caution	No	4D	Butenolides	4 hr.	—	7 days	No	Aphids (landscape/ornamental)
	Sivanto 200 SL	Bayer CropScience	17.09	Caution	No	4D	Butenolides	4 hr.	—	7 days	No	Aphids
	Sivanto Prime	Bayer CropScience	17.09	Caution	No	4D	Butenoides	4 hr.	—	7 days	No	Aphids

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Table 10 *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	Labeled pests
Gamma-cyhalothrin	Declare	FMC	14.40	Caution	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Proaxis	FMC	5.90	Caution	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug
Garlic juice	Envirepel 50	Cal Crop USA	50.00	Caution	No	Unknown	Garlic	12 hr.	—	—	No	Aphids, casebearer, catacolas, borers, mites, leafminers, phylloxera, sawflies, shuckworm, spittle bugs, twig girdlers, webworms, walnut caterpillar, weevils
Hexythiazox	Clever 50 DF	Atticus Ag Products	50.00	Caution	No	10A	Mite growth inhibitor	12 hr.	No grazing	28 days	No	Mites (nonbearing trees only)
	Hexamite	Albaugh	11.80	Caution	No	10A	Mite growth inhibitor	12 hr.	No grazing	—	No	Mites (nonbearing trees only)
	Hexygon IQ Miticide	Gowan	11.93	Caution	No	10A	Mite growth inhibitor	12 hr.	No grazing	7 days	No	Mites (nonbearing trees only)
	Hexygon Miticide	Gowan	50.00	Caution	No	10A	Mite growth inhibitor	12 hr.	No grazing	28 days	No	Mites (nonbearing trees only)
	Hexy 1E	Sharda	11.70	Caution	No	10A	Mite growth inhibitor	12 hr.	No grazing	—	—	—
	Hexy 2E	Sharda	24.20	Caution	No	10A	Mite growth inhibitor	12 hr.	No grazing	7 days	No	Mites
	Onager Optek	Gowan	11.93	Caution	No	10A	Mite growth inhibitor	12 hr.	No grazing	28 days	No	Pecan leaf scorch mite, 2-spotted spider mite
	Onager Miticide	Gowan	11.80	Caution	No	10A	Mite growth inhibitor	12 hr.	No grazing	—	No	
	Ruger 1 EC	Atticus Ag Products	11.80	Caution	No	10A	Mite growth inhibitor	12 hr.	No grazing	7 days	No	Mites
	Savey 50WP	Gowan	50.00	Caution	No	10A	Mite growth inhibitor	12 hr.	No grazing	28 days	No	Pecan leaf scorch mite
Hydramethylon	Amdro Pro	BASF	0.73	Caution	No	20A	Unknown		No grazing	—	No	Fire ants
Imidacloprid	Admire Pro	Bayer CropScience	42.80	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids, sharpshooters, spittlebugs
	Advise 2 FL, Max, Advise Four	Winfield Solutions	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids, spittlebug
	Alias 2F. 4F	ADAMA	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids, two-lined spittlebug
	Hawk-I 2L	United Phosphorus	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	—	No	Yellow pecan aphid, blackmargined aphid, stem phylloxera, leaf phylloxera

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Table 10 *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	Labeled pests
Imidacloprid *continued*	Hawk-I 75WSP	United Phosphorus	75.00	Caution	No	4A	Neonicotinoid	12 hr.	—	—	No	Yellow pecan aphid, blackmargined aphid, stem phylloxera, leaf phylloxera
	Imidashot DF	Sulphur Mills	70.00	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids, leafhoppers/ sharpshooters, spittle bugs
	Lada 2F	Rotam North America	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Blackmargined aphid, yellow pecan aphid, pecan stem phylloxera, pecan spittle bug, pecan leaf phylloxera
	Macho 2.0 FL	Albaugh, Inc.	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	Soil applied	No	Aphids, spittle bug
	Macho 4.0	Albaugh, Inc.	40.70	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids, spittle bug
	Malice 2F	Loveland Products	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids, spittle bug
	Malice 75WSP	Loveland Products	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	None stated	No	Black margined aphid, yellow pecan aphid, leaf phylloxera, stem phylloxera, spittle bug
	Mallet 2F T&O	Nufarm	21.40	Caution	No	4A	Neonicotinoid	—	—	7 days	No	Yellow aphid, blackmargined aphid, leaf phylloxera, stem phylloxera, spittle bug
	Mallet 75 WSP	Nufarm	75.00	Caution	No	4A	Neonicotinoid	12 hr.	—	None stated	No	Yellow pecan aphid, blackmargined aphid, phylloxera, spittle bug
	Marath 1% Granular	OHP, Inc.	1.00	Caution	No	4A	Neonicotinoid	—	—	—	No	Aphids, sharpshooters
	Marathon 60W	OHP, Inc.	60.00	Caution	No	4A	Neonicotinoid	12 hr.	—	—	No	Aphids and other pests (Greenhouse and nursery trees only)
	Merit 2F, 75WSP	Bayer CropScience	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	—	No	Black margined aphid, yellow pecan aphid, leaf phylloxera, stem sphyylxear, spittle bug
	Midash 2SC	Sharda USA	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	Soil applied	No	Aphids
	Midash Forte	Sharda USA	40.70	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids
	Montana 2F	Rotam North America	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Black pecan aphid, blackmargined aphid, yellow pecan aphid, phylloxera, spittle bug
	Montana 4F	Rotam North America	40.60	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids, phylloxera, spittle bugs
	Nuprid 2SC	Nufarm	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids, spittle bugs, leafhoppers
	Nuprid 2F	Nufarm	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Black pecan aphid, black margined aphid, yellow pecan aphid, spittle bug, sharpshooters, termites

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Table 10 *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	Labeled pests
Imidacloprid *continued*	Nuprid 4F Max	Nufarm	40.40	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Black pecan aphid, blackmargined aphid, yellow pecan aphid, spittle bug, sharpshooters
	Nuprid 4.6F Pro	Nufarm	45.20	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Black pecan aphid, blackmargined aphid, yellow pecan aphid, spittle bug, sharpshooters
	Pasada 1.6F	ADAMA	17.40	Caution	No	4A	Neonicotinoid	12 hr.	—	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 hr.	—	—	No	Yellow pecan aphid, blackmargined pecan aphid, spittle bug, phylloxera
	Prey 1.6	Loveland Products	17.40	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids, phylloxera, spittle bug
	PROKoZ Zenith 75 WSP	Bayer Environmental Science	75.00	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Yellow pecan aphid, blackmargined aphid, pecan stem phylloxera, pecan leaf phylloxera, spittle bug
	Provoke	Innvictis Crop Care	40.00	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids, sharpshooters, spittlebugs
	Sherpa	Loveland Products	17.40	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids, leaf phylloxera, sharpshooters, spittle bug
	Widow	Loveland Products	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	Soil applied	No	Aphids, spittle bug
	Willowood Imidacloprid 2SC	Willowood	21.40	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids, sharpshooters, spittlebugs
	Willowood Imidacloprid 4SC	Willowood	40.70	Caution	No	4A	Neonicotinoid	12 hr.	—	7 days	No	Aphids, sharpshooters, spittle bugs
	Wrangler	Loveland Products	40.70	Caution	No	4A	Neonicotinoid	12 hr.	—	Foliar or soil applied	No	Aphids, phylloxera, spittle bugs
Iron phosphate	Ferroxx AQ Slug and Snail Bait	Neudorff	3.00	Caution	No	Unknown	Unknown	4 hr.	—	0 days	No	Slugs and snails
	Ferroxx Slug and Snail Bait	Neudorff	5.00	Caution	No	Unknown	Unknown	0 hr.	—	0 days	No	Slugs and snails
	Leaf Life Sluggo Snail/ Slug Bait	Loveland	1.00	Caution	No	Unknown	Unknown	0 hr.	—	—	No	Slugs and snails (container plants only)
	Sluggo Slug and Snail Bait	Certis	1.00	Caution	No	Unknown	Unknown	0 hr.	—	0 days	Yes	Slugs and snails
Isaria fumosorosea	PFR-97 20WDG	Certis	20.00	Caution	No	Unknown	Unknown	4 hr.	—	—	Yes	Aphids, mites, leafminers and in soil beetle grubs on nonbearing trees

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Table 10 *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	Labeled pests
Kaolin clay	Surround CF	Tessenderlo Kerley	95.00	Caution	No	Unknown	Unknown	4 hr.	—	—	No	Mite suppression
	Surround WP	Tessenderlo Kerley	95.00	Caution	No			4 hr.	—	—	No	Mite suppression
Lambda-cyhalothrin	Cavalry II	Grownmark	22.80	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, phylloxera, spittle bug, pecan weevil stink bug
	Firestone	Altitude Crop Innovations	13.10	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Grizzly Too	Winfield Solutions	22.80	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, phylloxera, spittle bug, pecan weevil stink bug
	Grizzly Z	Winfield Solutions	11.40	Warning	Yes	3A	Pyrethroid	24 hr.	—	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 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan weevil, spittle bug, stink bug, phylloxera
	Kendo 22.8 CS	Helm Agro	13.10	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Kendo Insecticide	Helm Agro	13.10	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf phylloxera, phylloxera, spittle bug, pecan weevil, stink bug
	Lambda-Cy EC	United Phosphorus	11.40	Warning	Yes	3A	Pyrethroid	24 hr.	—	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 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, pecan weevil, spittle bug, phylloxera, stink bug
	Lamdec	Syngenta	13.10	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug

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Table 10 *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	Labeled pests
Lambda-cyhalothrin *continued*	Lambdastar Plus	LG international	23.28	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil stink bug
	LambdaStar 1CS	LG international	12.00	Warning	Yes	3A	Pyrethroid	24 hr.	—	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 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Lambda-Cy AG	WinField United	11.40	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Lamcap	Syngenta	11.40	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, phylloxera, spittle bug, pecan weevil, stink bugs
	Lamcap II	Syngenta	22.80	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, phylloxera, spittle bug, pecan weevil, stink bugs
	Lambda-Cyhalothrin 1 EC	Nufarm	13.00	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, phylloxera, spittle bug, pecan weevil stink bug
	L - C Insecticide	Drexel	12.60	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, phylloxera, spittle bug, pecan weevil, stink bugs
	Paradigm	ADAMA	12.70	Caution	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, phylloxera, spittle bug, pecan weevil stink bug
	Paradigm VC	WinField	12.70	Caution	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Hickory shuckworm, aphids, pecan nut casebearer, phylloxera, spittle bug, pecan weevil, stink bugs
	Province	TENKOZ	11.40	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, phylloxera, spittle bug, pecan weevil, stink bug

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Table 10 *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	Labeled pests
Lambda-cyhalothrin *continued*	Province II	TENKOZ	22.80	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Ravage	Invictis	13.10	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, phylloxera, spittle bug, pecan weevil, stink bug
	Silencer, VXN	MANA	12.70	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, spittle bug, stink bug, phylloxera
	Taiga Z		11.40	Warning	Yes	3A	Pyrethroid	24 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, spittle bug, stink bug, phylloxera
	Warrior II	Syngenta	22.80	Warning	Yes	3A	Pyrethroid	24 hr.	—	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 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan nut casebearer, pecan leaf casebearer, phylloxera, spittle bug, pecan weevil, stink bug
Malathion	Malathion 57%	Loveland Products	0.57	Warning	No	1B	Organophosphate	24 hr.	—	7days	No	Pecan bud moth, aphids, pecan leaf casebearer, pecan phylloxera, pecan nut casebearer
	Fyfanon	Helena	56.44	Warning	No	1B	Organophosphate	12 hr.	—	3 days	No	Mites, aphids, pecan nut casebearer, pecan phylloxera, pecan bud moth
	Fyfanon 57 % EC	Helena	57.00	Warning	No	1B	Organophosphate	12 hr.	—	7 days	No	Pecan nut casebearer, pecan phylloxera (Shade trees only)
	Fyfanon 8 lb Emulsion	Helena	81.80	Warning	No	1B	Organophosphate	24 hr.	—	7 days	No	Mites, aphids, pecan nut casebearer, pecan phylloxera, pecan bud moth
	Malathion 5	Winfield Solutions	56.80	Warning	No	1B	Organophosphate	12 hr.	—	0 days	No	Aphids, mites, phylloxera, pecan budmoth, pecan leaf casebearer, pecan nut casebearer
	Malathion 8 Flowable	Gowan	79.50	Caution	No	1B	Organophosphate	12 hr.	—	0 days	No	Aphids, mites, phylloxera, pecan budmoth, pecan leaf casebearer, pecan nut casebearer
Metaflumizone	Altrevin Fire Ant Bait	BASF	0.06	Caution	No	Unknown	Unknown	12 hr.	—	5 days	No	Fire ants
Methomyl	Lannate LV	DuPont	29.00	Danger	Yes	1A	Acetylcholinesterase (ache) inhibitors	48 hr.	—	30 days	No	Aphids
	Lannate SP	DuPont	90.00	Danger	Yes	1A	Acetylcholinesterase (ache) inhibitors	48 hr.	—	30 days	No	Aphids

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Table 10 *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	Labeled pests
Methomyl *continued*	Nudrin LV	Rotam	29.00	Danger	Yes	1A	Acetylcholinesterase (ache) inhibitors	48 hr.	—	30 days	No	Aphids (Southeast only)
	Nudrin SP	Rotam	90.00	Danger	Yes	1A	Acetylcholinesterase (ache) inhibitors	48 hr.	—	30 days	No	Aphids (Southeast only)
Methoprene	Extinguish	Wellmark International	0.50	Caution	No	7	Growth regulation	4 hr.	Grazing allowed	Not listed	No	Red imported fire ant
Metaflumizone	Altrevin	BASF	0.063	Caution	No	22B	Voltage-dependent sodium channel blockers	12 hr.	—	5 days	No	Red imported fire ant
	Siesta	BASF	0.063	Caution	No	22B	Voltage-dependent sodium channel blockers	12 hr.	—	—	No	Red imported fire ant
Methidathion	Supracide	Gowan	25.00	Warning	Yes	1B	Unknown	3 days	—	60 days	No	Yellow pecan aphid, hickory shuckworm, serpentine leaf minor (Southern US only)
Methoxyfenozide	Inspirato 2F	Atticus Ag Products	22.60	Caution	No	18	Growth regulator	4 hr.	—	7 days	No	Pecan nut casebearer, hickory shuckworm, fall webworm, walnut caterpillar
	Intrepid 2F	Dow AgroSciences	22.60	Caution	No	18	Growth regulator	4 hr.	—	14 days	No	Pecan nut casebearer, hickory shuckworm, fall webworm, walnut caterpillar
	Invertid 2F	Loveland	22.60	Caution	No	18	Growth regulator	4 hr.	—	14 days	No	Pecan nut casebearer, hickory shuckworm, fall webworm, walnut caterpillar
	TurnStyle	United Phosphorus	22.00	Caution	No	18	Growth regulator	4 hr.	—	14 days	No	Pecan nut casebearer, hickory shuckworm, fall webworm, walnut caterpillar
	Troubadour 2F	Helena	22.60	Caution	No	18	Growth regulator	4 hr.	—	14 days	No	Pecan nut casebearer, hickory shuckworm, fall webworm, walnut caterpillar
Myrothecium verrucaria	DiTera DF	Valent USA	90.00	Caution	No	Unknown	Biological nematacide	4 hr.	—	—	No	Root nematodes
Oil – Horticulture	BioCover UL, MLT, SS	Loveland	98.00	Caution	No	Unknown	Oil, paraffinic	4 hr.	—	0 days	No	Scale, aphid eggs, mite eggs
	Citri oil	Wilbur-Ellis	99.00	Caution	No	Unknown	Oil, paraffinic	12 hr.	—	0 days	No	Scale
	Dormant oil - 435	Winfield Solutions	98.80	Caution	No	Unknown	Oil, paraffinic	12 hr.	—	0 days	No	Scale
	JMS Stylet Oil	JMS Flower Farm	97.10	Caution	No	Unknown	Oil, paraffinic	4 hr.	—	0 days	No	Obscure scale
	Organic JMS stylet oil	JMS Flower Farm	97.10	Caution	No	Unknown	Oil, paraffinic	4 hr.	—	0 days	Yes	Obscure scale
	Mite-E -Oil	Helena	97.10	Caution	No	Unknown	Oil, paraffinic	4 hr.	—	0 days	No	Obscure scale
	Spray oil 470	Loveland	98.00	Caution	No	Unknown	Oil, paraffinic	4 hr.	—	0 days	No	Scale, aphid eggs, mite eggs
	Purespray green	Petro-Canada	98.00	Caution	No	Unknown	Oil, petroleum	4 hr.	—	0 days	Yes	Scale
	Superior	Loveland	80.00	Caution	No	Unknown	Oil, petroleum	4 hr.	—	0 days	No	Obscure scale
Oil – Mineral	415 Superior Spray Oil	Wilbur-Ellis	99.00	Caution	No	Unknown	Oil – mineral	12 hr.	—	0 days	No	Aphid (eggs), mite (eggs), scale
	435 Oil 98.8	Drexel	98.80	Caution	No	Unknown	Oil – mineral	4 hr.	—	0 days	No	Scale
	440 Superior Spray oil	Wilbur-Ellis	99.00	Caution	No	Unknown	Oil – mineral	12 hr.	—	0 days	Yes	Aphid (eggs), mite (eggs), scale
	455 Oil 98.8	Drexel	98.80	Caution	No	Unknown	Oil – mineral	4 hr.	—	0 days	No	Obscure scale

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Table 10 *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	Labeled pests
Oil – Mineral *continued*	470 Supreme Spray Oil	Wilbur-Ellis	99.00	Caution	No	Unknown	Oil – mineral	4 hr.	—	0 days	No	Aphid (eggs), mite (eggs), scale
	Damoil	Drexel	98.00	Caution	No	Unknown	Oil – mineral	4 hr.	—	0 days	No	Scale
	Glacial Spray Fluid	Loveland	98.40	Caution	No	Unknown	Oil – mineral	4 hr.	—	0 days	No	Aphid (eggs), mite (eggs), scale
	PHT 440 Supreme Spray Oil	JR Simplot	99.00	Caution	No	Unknown	Oil – mineral	12 hr.	—	0 days	Yes	Aphid (eggs), mite (eggs), scale
	Ultra Pure oil	BASF	98.00	Caution	No	Unknown	Oil – mineral	4 hr.	—	0 days	No	Scale
	TriTek	Brandt	80.00	Caution	No	Unknown	Oil – mineral	4 hr.	—	0 days	Yes	Aphids, scales
	SufOil	Bioworks	80.00	Caution	No	Unknown	Oil – mineral	4 hr.	—	0 days	Yes	Aphids, mites, scales
	VistaSpray 415 Spray Oil	Mar Vista	98.50	Caution	No	Unknown	Oil – mineral	4 hr.	—	0 days	Yes	Scale, mites
Oil – Neem	Debug ON	Agro Logistics Systems	70.00	Caution	No	Unknown	Oil – neem	4 hr.	—	0 days	No	Numerous
	Trilogy	Certis	70.00	Caution	No	Unknown	Oil – neem	4 hr.	—	0 days	Yes	Mites
Oil – Soybean	Golden Pest Spray Oil	Stoller	93.00	Caution	No	Unknown	Oil	4 hr.	—	0 days	No	Obscure scale
Oil – Thyme	Huma Gro Proud 3	Huma Gro	5.60	Caution	No	Unknown	Oil		—	0 days	Yes	Aphids, mites
Paecilomyces lilacinus	MeloCon WG	Prophyta	6.00	Caution	No	Fungal spores	Fungal spores	4 hr.	—	0 days	Yes	Nematodes
Paecilomyces fumosoroseus Apopka Strain 97	PFR-97 20% WDG	Certis	20.00	Caution	No	Fungal spores	Fungal spores	4 hr.	—	0 days	Yes	Aphids, mites
Phosmet	Imidan 70W	Gowan	70.00	Warning	No	1	Organophosphate	3 days	—	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	Certis	47.00	Warning	No	Unknown	Insecticidal soap	12 hr.	—	12 hr.	Yes	Aphids, mites, scale
	M-Pede	Gowan	49.00	Warning	No	Unknown	Insecticidal soap	12 hr.	—	12 hr.	Yes	Aphids, mites
Propargite	Omite 30WS	Chemtura Corp	32.00	Danger	No	12	Energy metabolism inhibitors	22days	—	—	No	2-spotted spider mites (nonbearing trees only)
	Omite 6E	Arysta	69.20	Danger	Yes	12C	Unknown	22 days	—	—	No	Mites (nonbearing trees only)
	Endomite	Atticus	69.60	Danger	Yes	12C	Unknown		—	—	No	Mites (nonbearing trees only)
Pymetrozine	Fulfill Insecticide	ADAMA	50.00	Caution	No	9B	Feeding blocker	12 hr.	—	14 days		Black pecan aphid, yellow pecan aphid, blackmargined aphid
	Fulfill	Syngenta	50.00	Caution	No	9B	Feeding blocker	12 hr.	—	14 days	No	Black pecan aphid, yellow pecan aphid, blackmargined aphid
Pyrethrins	Pyganic EC 1.4	MGK Company	5.00	Warning	No	3A	Pyrethrin	12 hr.	—	0 days	Yes	Aphids, fall webworm, red imported fire ant, stink bugs, caterpillars
	Pyganic EC 5.0	Valent	5.00	Caution	No	3A	Pyrethrin	12 hr.	—	0 days	Yes	Aphids, caterpillars, webworms, stink bugs, ants
	Tersus	MGK	5.00	Caution	No	3A	Pyrethrin	12 hr.	—	0 days	No	Aphids, caterpillars, webworms, stink bugs
Pyridaben	Nexter miticide/ insecticide	Gowan	75.00	Warning	No	21	Energy metabolism inhibitors	12 hr.	—	7 days	No	Black margined aphid, yellow pecan aphid
Pyrifluquinazon	PQZ	Nichino America	20.20	Caution	No	9B		12 hr.	—	7 days	No	Aphids

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Table 10 *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	Labeled pests
Pyriproxyfen	Braize 35 WSB	Atticus	35.00	Caution	No	7C	Hormone mimics	12 hr.	—	21 days	No	Scale
	Distance Fireant Bait	Valent, USA	0.50	Caution	No	7	Hormone mimics	12 hr.	No grazing	—	No	Red imported fire ant
	Esteem Ant Bait	Valent USA	0.50	Caution	No	7	Hormone mimics	12 hr.	—	1 day	No	Red imported fire ant
	Esteem 35WP; 0.86 EC	Valent	35.00; 11.23	Caution	No	7	Hormone mimics	12 hr.	—			No pecan pests on label
	Pitch 35 WP	ADAMA	35.00	Caution	No	7	Unknown		—	21 days	No	Scale
	Reemit 0.86	Atticus Ag Products	11.23	Caution	No	7C	Unknown	12 hr.	—	21 days	No	Scale
	Reemit 35 WSB	Atticus Ag Products	35.00	Caution	No	7c	Unknown	12 hr.	—	21 days	No	Scale
	Reemit 0.5 G Fire Ant Bait	Atticus Ag Products	0.50	Caution	No	7C	Unknown	12 hr.	—	21 days	No	Ants
	Pitch 0.86	ADAMA	11.23	Caution	No	7C	Hormone mimics	12 hr.	—	21 days	No	Scale
	Seize 35 WO	Valent	35.00	Caution	No	7C	Unknown	12 hr.	—	21 days	No	Scale
	Terva 35 WP	ADAMA	35.00	Caution	No	7C	Hormone mimics	12 hr.	—	21 days	No	Scale
Sesame oil	Sesamin EC	Brandt Consolidated	70.00	none listed	No	Unknown	Sesame oil	0 hr.	—	None stated	No	Plant feeding nematodes
Sodium Ferric EDTA	Iron Fist Slug and Snail Bait	Engage Agro USA	2.00	Caution	No	Unknown	Unknown	0 hr.	—	—	No	Slugs and snails in outdoor container trees
Sodium tetraborohydrate decahydrate	Prev-am Ultra	ORO Agri Inc	0.99		No	Unknown	Unknown	—	—	—	No	Aphids, mites
Spinetoram	Delegate WG	Dow AgroSciences	0.25	Caution	No	5	Spinosyns	12 hr.	—	14 days	No	Pecan nut casebearer, walnut caterpillar, fall webworm, hickory shuckworm
Spinosad	Entrust,	Dow AgroSciences	80.00	Caution	No	5	Spinosyns	4 hr.	—	1 day	Yes	Hickory shuckworm, pecan nut casebearer, fall webworm
	Entrust SC	Dow AgroSciences	22.50	Caution	No	5	Spinosyns	4 hr.	—	1 day	Yes	Hickory shuckworm, pecan nut casebearer, fall webworm
	Seduce	Certis USA	0.07	Caution	No	5	Spinosyns	4 hr.	—	14 days	Yes	Ants
	SpinTor 2SC	Dow AgroSciences	22.80	Caution	No	5	Spinosyns	4 hr.	—	14 days	No	Fall webworm, hickory shuckworm, pecan nut casebearer, walnut caterpillar
	Success Naturalyte Insect Control	Dow AgroSciences	22.80	None listed	No	5	Spinosyns	4 hr.	—	14 days	No	Fall webworm, hickory shuckworm, pecan nut casebearer, walnut caterpillar
Spirodiclofen	Envidor 2 SC	Bayer CropScience	22.30	Caution	No	23	Growth regulation	12 hr.	—	7 days	No	Mites
	Envidor CA	Bayer CropScience	22.30	Caution	No	23	Growth regulation	12 hr.	—	7 days	No	Mites
Spirotetramat	Kontos	OHP, Inc.	22.40	Caution	No	23	Unknown	24 hr.	—	Non bearing only	No	(For container drench only of nursery trees) aphids, scale crawlers, spittlebugs
	Movento	Bayer CropScience	22.40	Caution	No	23	Growth regulation	24 hr.	—	7 days	No	Aphids, phylloxera
Sulfur	Cosavet DF	Sulphur Mills	80.00	Caution	No	Fungicide/ miticide	Unknown	24 hr.	—	—	Yes	—
	Golden micronized sulfur	Wilbur-Ellis	92.00	Caution	No	fungicide/ miticide	Sulfur	24 hr.	—	—	Yes	Mites, powdery mildew, sooty mold

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Table 10 *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	Labeled pests
Sulfur *continued*	Kumulus	Wilbur-ellis	80.00	Caution	No	Fungicide/ miticide	Unknown	24 hr.	—	—	No	Mites
	Micro Sulf	NufARM	80.00	Caution	No	Fungicide/ miticide	Sulfur	24 hr.	—	—	No	Mites, powdery mildew, sooty mold
	Mirofine Sulfur	Loveland	90.00	Caution	No	Fungicide/ miticide	Sulfur	24 hr.	—	—	Yes	Mites, powdery mildew, sooty mold
	Microthiol Disperss	United Phosphorus	80.00	Caution	No	Fungicide/ miticide	Sulfur	24 hr.	—	—	Yes	Mites, powdery mildew, sooty mold
	Suffa	Drexel	52.00	Caution	No	Unknown	Elemental sulfur	24 hr.	—	—	No	Mites
	Sulfur, 6L, DF	Arysta & Wilbur-Ellis	52.00	Caution	No	M2 fungicide	Unknown	24 hr.	—	—	No	Mites
	Sulfur 80 WDG	Drexel Chemical Company	80.00	Caution	No	—	—	24 hr.	—	—	Yes	Mites
	Sulfur 90 W	Drexel Chemical Company	90.00	Caution	No	Unknown	Unknown	24 hr.	—	—	Yes	Mites
	Thiolux	Loveland	80.00		No	Fungicide-miticide	Sulfur	24 hr.	—	—	No	Mites
	Pronatural sulfur			Caution	No	M2 fungicide	Unknown	24 hr.	—	—	No	Red spider mite, 2-spotted spider mite
Sulfoxaflor	Closer SC	Corteva Agrisience	21.80	Caution	No	4C	Unknown	12 hr.	—	7 days	No	Aphids,
	Sequoia	Corteva Agrisience	21.80	Caution	No	4C	Unknown	12 hr.	—	7 days	No	Aphids
Tebufenozide	Confirm 2F	Gowan	23.00	Caution	No	18	Growth regulator	4 hr.	No grazing	14 days	No	Pecan nut casebearer, hickory shuckworm, fall webworm, walnut caterpillar
Thiamethoxam	Centric 40WG	Syngenta	40.00	Caution	No	4A	Neonicotinoid	12 hr.	—	14 days	No	Black pecan aphid, yellow pecan aphid, phylloxera
	Flagship 0.22 G	Syngenta	0.22	Caution	No	4A	Neonicotinoid	12 hr.	—	Non bearing trees	No	Aphids
	Flagship 25WG	Syngenta	25.00	Caution	No	4A	Neonicotinoid	12 hr.	—	Non bearing trees	No	Aphids, leafminers
Tolfenpyrad	Apta	Nichino	15.00	Warning	No	21A	Unknown	12 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan weevil, stink bugs (suppression)
	Bexar	Nichino	15.00	Warning	No	21A	Unknown	12 hr.	—	14 days	No	Aphids, hickory shuckworm, pecan weevil, stink bugs (suppression)
Zeta-cypermethrin	Mustang	FMC	17.10	Warning	Yes	3	Pyrethroid	12 hr.	—	7 days	No	Black pecan aphid, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, phylloxera, pecan weevil, stink bug, yellow pecan aphids

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Table 10 *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	Labeled pests
Zeta-cypermethrin *continued*	Mustang Maxx	FMC	9.15	Warning	Yes	3	Pyrethroid	12 hr.	—	7 days	No	Black pecan aphid, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, phylloxera, pecan weevil, stink bug, yellow pecan aphids
	Respect EC	BASF	9.60	Caution	Yes	3	Pyrethroid	12 hr.	—	7 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan weevil
Combination products												
Chlorpyrifos + Gamma-cyhalothrin	Cobalt	Dow AgroSciences	30.00 0.54	Danger	Yes	1B 3A	Organophosphate Pyrethroid	24 hr	No grazing	28 days	No	Black pecan aphid, yellow pecan aphid, ants, phylloxera, hickory shuckworm, pecan nut casebearer, stink bug, fall webworm, stink bug
Chlorpyrifos + Lambda-cyhalothrin	Cobalt Advanced	Dow AgroSciences	28.12 1.44	Warning	Yes	1B 3A	Organophosphate Pyrethroid	24 hr.	No grazing	28 days	No	Blackmargined aphid. Pecan nut casebearer, fall webworm, yellow pecan aphid, black pecan aphid, phylloxera, hickory shuckworm, spittle bug, stink bug, ants
Lambda-cyhalothrin + Thiamethoxam	Endigo ZC	Syngenta	9.48 12.60	Warning	Yes	3 4	Pyrethroid Neonicotinoid	24 hr.	—	14 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, phylloxera, spittle bugs, pecan weevil, stink bug
Pyrethrins + Piperonyl butoxide	Evergreen EC 60-6	MGK Company	6.00 60.00	Caution	No	3	Pyrethroid	12 hr.	—	0 days	No	Aphids, fall webworm, stink bugs
Zeta-cypermethrin + Bifenthrin	Hero	FMC	3.75 11.25	Caution	Yes	3 3	Pyrethroid Pyrethroid	12 hr.	No grazing	21 days	No	Black pecan aphid, yellow pecan aphid, hickory shuckworm, pecan nut casebearer, pecan weevil
	Hero EW	FMC	3.24 9.72	Warning	Yes	3A 3A	Pyrethroid Pyrethroid	12 hr.	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 + Beta-cyfluthrin	Leverage 360	Bayer Crop Science	21.00 10.50	Caution	Yes	4A 3	Neonicotinoid Pyrethroid	12 hr.	—	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)

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Table 10 *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	Labeled pests
Bifenthrin + Avermectin B1	Athena	FMC	8.84 1.33	Caution	Yes	3A 6	Pyrethroid Avemectin	12 hr.	No grazing	21 days	No	Aphids, fall webworm, hickory shuckworm, leaffooted bug, pecan nut casebearer, pecan leaf casebearer pecan phylloxera, stink bug
Azadirachtin + Pyrethrins	Azera	Valent	1.20 1.40	Caution	No	Unknown 3A	Unknown Pyrethrin	12 hr.	—	None listed	Yes	Aphids, fall webworm, hickory shuckworm, pecan nut casebearer, walnut caterpillar, pecan weevils, twig girdlers, serpentine leafminer, leaffooted bug
Chlorpyrifos + Gamma cyhalothrin	Bolton	FMC	30.00 0.99	Warning	Yes	1B 3A	Organophosphate Pyrethroid	24 hr.	No grazing	28 days	No	Blackmargined 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	Cobalt Advanced	Dow AgroSciences	28.12 1.44	Warning	Yes	1B 3A	Organophosphate Pyrethroid	—	No grazing	28 days	No	Aphids, fall webworm, pecan nut casebearer, hickory shuckworm, spittle bugs, phylloxera, stink bug, ants
Zeta-cypermethrin + Avermectin B1	Gladiator	FMC	2.01 0.91	Caution	Yes	3A 6	Pyrethroid Avemectin	12 hr.	No grazing	21 days	No	Aphids, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, stink bugs
Zeta-cypermethrin + Chlorpyrifos	Stallion	FMC	3.08 30.8	Warning	Yes	3A 1B	Pyrethroid Organophosphate	24 hr.	No grazing	28 days	No	Black pecan aphid, hickory shuckworm, leaffooted bugs, pecan leaf casebearer, pecan nut casebearer, phylloxera, pecan weevil, stink bugs, yellow pecan aphid
Zeta-cypermethrin + Bifenthrin	Steed	FMC	8.20 9.80	Warning	Yes	3A 3A	Pyrethroid Pyrethroid	12 hr.	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
Lambda-cyhalothrin + Chlorantraniliprole	Voliam Xpress	Syngenta	4.63 9.26	Warning	Yes	3A 28	Pyrethroid Diamides	24 hr.	—	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	28.30 5.66	Caution	No	5 18	Spinosyns Diacylhydrazines	4 hr.	—	14 days	No	Pecan nut casebearer, hickory shuckworm, fall webworm, walnut caterpillar

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Table 10 *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	Labeled pests
Imidacloprid + Lambda-cyhalothrin	Kilter	Nufarm Agricultural products	14.49 10.86	Danger	Yes	4A 3	Neonicotinoid Pyrethroid	24 hr.	—	14 days	No	Aphids, hickory shuckworm, leaffooted bug, pecan nut casebearer, pecan leaf casebearer, phylloxera, pecan spittle bug, pecan weevil, stink bug
Bifenthrin + Imidacloprid	Tempest	Helena	11.30 11.30	Warning	Yes	3A 4A	Pyrethroid Neonicitinoid	12 hr.	No grazing	21 days	No	Aphids, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer phylloxera, stink bug
	Skyraider	Adama	21.65 10.80	Warning	Yes	3A 4A	Pyrethroid Neonicotinoid	12 hr.	No grazing	21 days	No	Aphids, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, phylloxera, spittle bug, stink bug
	Avenger	Innvictus Crop Care	5.70 5.70	Danger	Yes	3A 4A	Pyrethroid Neonicotinoid	12 hr.	No grazing	21 days	No	Aphids, leafhoppers, phylloxera, spittle bug, black pecan aphid
	Brigadier	FMC	11.30 11.30	Warning	Yes	3A 4A	Pyrethroid Neonicotinoid	12 hr.	No grazing	21 days	No	Aphids, hickory shuckworm, leaffooted bug, pecan leaf casebearer, pecan nut casebearer, pecan phylloxera, stink bug
	Swagger	Loveland Products, Inc.	5.70 5.70	Danger	Yes	3A 4A	Pyrethroid Neonicotinoid	12 hr.	No grazing	21 days	No	Aphids, leafhoppers/ sharpshooters, phylloxear species, sting bugs
Iron phosphate + Spinosad	Brandt Antixx	Brandt Consolidated	0.97 0.07	Caution	No	Unknown	Unknown	4 hr.	—	—	Yes	Snail and slug (bait)
Neem oil + Azadirachtin	Debug Optimo	Agro Logistics		Caution	No	Unknown	Unknown	4 hr.	—	0 days	Yes	Aphids, casebearer, phylloxera
Hydramethylon + Methoprene	Extinguish Plus	Wellmark	0.365 0.25	Caution	No	7A 20A	Unknown	12 hr.	—	—	No	Red imported fire ant (nonbearing trees and nursery stock)
Chlorantraniliprole + Lambda-cyhalothrin	Besiege	Syngenta Crop Protection	9.26 4.63	Warning	Yes	28 3	Diamides Pyrethroid	24 hr.	—	14 days	No	Hickory shuckworm, pecan aphids, pecan nut casebearer, phylloxera, spittle bug, pecan weevil, stink bug
Pyrethrins *Beauveria bassiana* Strain GHA	BotaniGard Maxx	LAM International	0.75 0.06	Warning	No	3	Unknown	12 hr.	—	—	—	Aphids, mites, pecan weevil, sharpshooters, pecan nut casebearer
Rosemary oil Geraniol Peppermint oil	Brandt Ecotec Plus	Brandt Consolidated	10.00 5.00 2.00	Warning	No	Unknown	Unknown	—	—	0 days	Yes	Mites, aphids, caterpillars, leafminers
Iron phosphate Spinosad	Bug-N-Sluggo	Certis	0.97 0.07	Caution	No	Unknown	Unknown	4 hr.	—	0 days	Yes	Snails

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Table 10 *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	Labeled pests
Capsicum oleoresin extract	Captiva	Gowan	7.60	Caution	No	Unknown	Unknown	4 hr.	—	0 days	No	Mites, leafhoppers, leaffooted bugs, stink bug
Garlic oil			23.4									
Soybean oil			59.3									
Capsicum oleoresin extract	Captiva Prime	Gowan	7.60	Caution	No	Unknown	Unknown	4 hr.	—	0 days	Yes	Insect repellent
Garlic oil			23.40									
Canola oil			55.00									
Bifenthrin	Avenger	Innvictus Crop Care	5.70	Danger	Yes	3A	Pyrethroid	12 hr.	No grazing	21 days	No	Aphids, leafhoppers, phylloxera, spittle bug, black pecan aphid
Imidacloprid			5.70			4A	Neonicotinoid					
Geraniol	Biomite	Arysta	0.417	Warning	No	Unknown	Unknown	4 hr.	—	—	Yes	Mites
Citronella			0.417									
Nerolidol			0.417									
Farnsol			0.167									
Clove oil	Envirepel 38	Cal Crop	12.50	Caution	No	Unknown	Unknown	12 hr.	—	24 hr.	No	Aphids, casebearer, catacolas, borers, mites, leafminers, phylloxera, sawflies, shuckworm, spittle bugs, twig girdlers, webworms, walnut caterpillar, weevils
Garlic			38.00									
Clove oil	Ex-icute		6.00	Caution	No	Unknown	Unknown	—	—	None stated	Yes	Aphids, leaffooted bug, scale, shot hole borer, stink bug
Sesame oil			5.00									
Rosemary oil			3.00									
Soybean oil			37.00									
Cyantraniliprole	Minecto Pro	Syngenta Crop Protection	12.70	Warning	Yes	28	Unknown	12 hr.	No grazing	21 days	No	Pecan nut casebearer, hickory shuckworm
Abemectrin			2.68			6						
Abamectin, Avermectin B1	Obelisk	Rotam North America	2.50	Warning	Yes	6	Unknown	12 hr.	No grazing	21 days	No	Black pecan aphid, yellow aphids, sharpshooters, leaf phylloxera, spittle bug
Imidacloprid			26.80			4A						
Imidacloprid	Triple Crown	Winfield Unites	13.83	Warning	Yes	4A	Neonicotinoid	12 hr.	No grazing	21 days	—	Black pecan aphid, fire ants, hickory shuckworm, leaffooted bugs, pecan leaf casebearer, pecan nut casebearer, phylloxera, pecan weevil, stink bugs, yellow pecan aphid
Bifenthrin			7.87			3A	Pyrethrin					
Zeta-cypermethrin			2.70			3A	Pyrethrin					
Chlorpyrifos + Lamda-cyhalothrin	Lambdafos	Drexel	28.12	Warning	Yes	1B	Organophosphate	24 hr.	No grazing	28 days	No	Blackmargined aphid, yellow pecan aphid, black pecan aphid, fall webworm, pecan nut casebearer, ants, brown marmorated stink bug, stink bug, hickory shuckworm
			1.44			3A	Pyrethroid					
Rosemary oil	Rid-Bugs		2.00		Yes	Unknown	Unknown	—	—	—	Yes	Mites, scale
Clove oil			2.00									
Sesame oil			5.00									
Soybean oil			91.00									

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Table 10 *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	Labeled pests
	Isomate C Plus	Pacific Biocontrol Corporation		Warning	No	—	Pheromone	—	—	—	Yes	Hickory shuckworm
	Isomate CTT			Warning	No	—	Pheromone	—	—	—	Yes	Hickory shuckworm
	Isomate CM Flex			Warning	No	—	Pheromone	—	—	—	Yes	Hickory shuckworm
	Isomate CM Ring			Warning	No	—	Pheromone	—	—	—	Yes	Hickory shuckworm
	Isomate DWB			Caution	No	—	Pheromone	—	—	—	Yes	Dogwood borer

IRAC – Insecticide Resistance Action Committee http://www.irac-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.

IRAC Mode of Action Classification

1A Carbamate; Nerve action
1B Organophosphate; Nerve action
2B Phenylpyrazoles; Nerve action
3A Pyrethroid; Nerve action
4A Neonicotinoid; Nerve action
4C Sulfoxaflor; Nerve action
6 Avermectin; Nerve and muscle action
7A Juvenile hormone mimic; Growth regulation
7B Fenoxycarb; Growth regulation
9 Feeding blocker; Selective homopteran feeding blockers
10B Mite growth inhibitor; Mite growth inhibitors – growth regulation
11A Bacillus thuringiensis; Microbial disruptors of insect midgut membranes
12 Energy metabolism inhibitors; Inhibitors of mitochondrial ATP synthase
15 Growth regulation; Inhibitors of chitin biosynthesis – growth regulation
18 Growth regulator; Ecdysone receptor agonist – growth regulation
20B Energy metabolism inhibitors; Mitochondrial complex electron complex transport inhibitors – energy metabolism
21 Energy metabolism inhibitors; Mitochondrial complex electron complex transport inhibitors – energy metabolism
23 Growth regulation; Inhibitors of acetyl CoA carboxylase – lipid synthesis, growth regulation
28 Diamides; Ryanodine receptor modulators – nerve and muscle action
Unknown Compounds of unknown or uncertain mode of action

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