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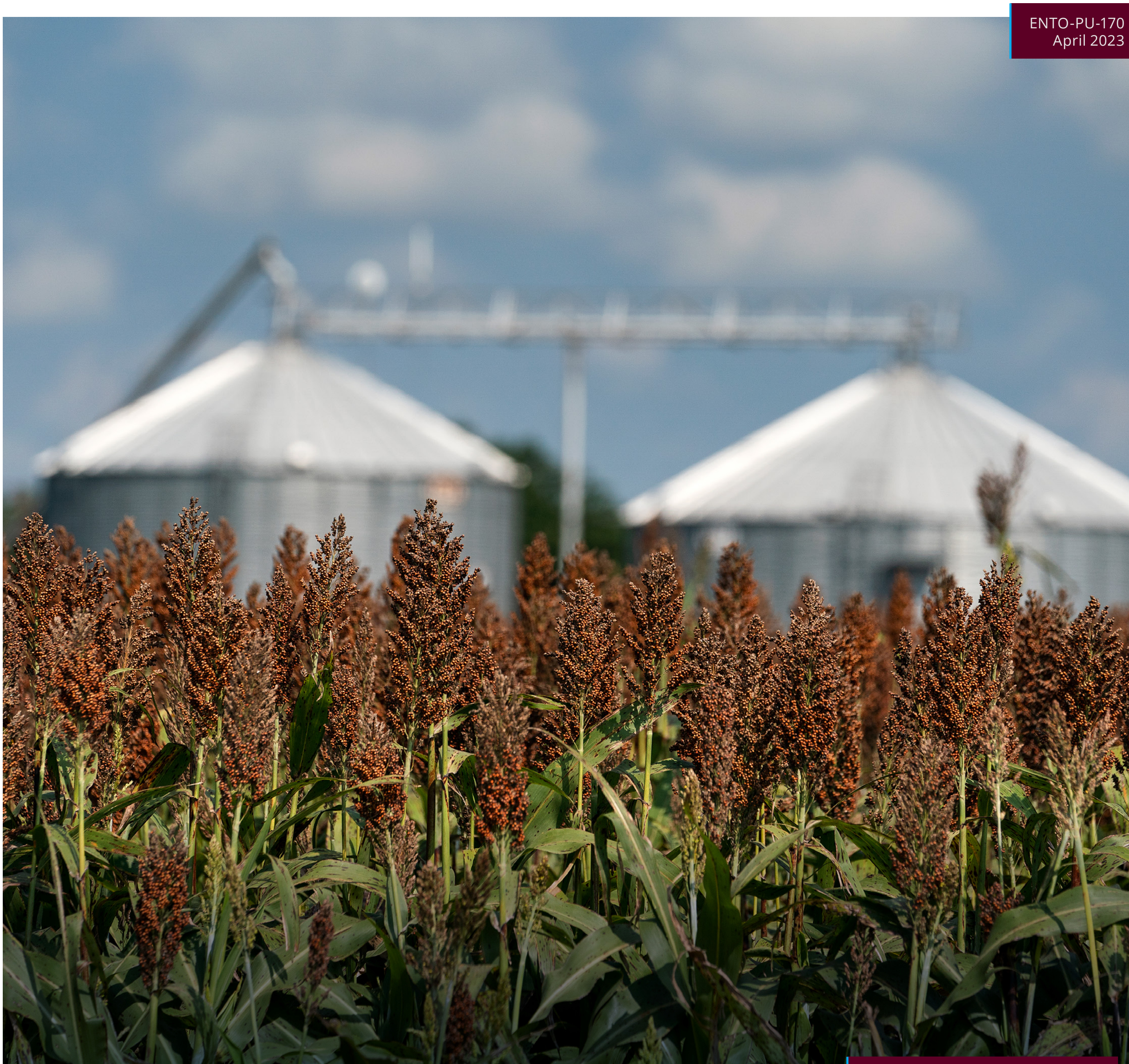

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MANAGING INSECT AND MITE PESTS OF TEXAS SORGHUM

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SORGHUM PRODUCTION: An integrated approach

Sorghum is a leading crop commodity in Texas with about 1.9 million acres planted annually. The crop's low production costs and high tolerance to heat and drought stress minimize the risks associated with crop production in Texas, making sorghum an attractive alternative to other row crops. Sorghum is also an important rotation crop that helps control weeds, diseases, and insect pests. However, the low risk of growing sorghum is often offset by low commodity prices and limited yield potential on dryland or marginal production acres.

To meet production goals and maintain profits, growers need to adopt an integrated approach to managing insect and mite pests on sorghum. Integrated pest management (IPM) takes advantage of all appropriate pest management strategies, including the judicious use of pesticides. Well-implemented IPM programs include several cultural practices that reduce pest damage, such as:

- Ensuring that the soil has enough nutrients.
- Planting into clean, weed-free fields.
- Managing weeds adjacent to the field that may harbor pests.
- Planting hybrids with resistance to pests.
- Planting at the optimum time.
- Rotating crops.
- Destroying crop residues.
- Treating for pests only when necessary.
- Preserving beneficial insects.

The benefits of IPM include a healthier environment for people in rural and urban communities; reduced harm to nontarget organisms, many of which are important for pest management; and the achievement of yield goals while minimizing production costs.

This guide will explain insect pest biology, damage, and management options for grain sorghum production. Management of insect pests attacking sorghum grown for forage and hay is presented in the publication, *Managing Insect Pests of Texas Forage Crops*, which is available from the Texas A&M AgriLife Extension Service at https://agrilifelearn.tamu.edu/s/.

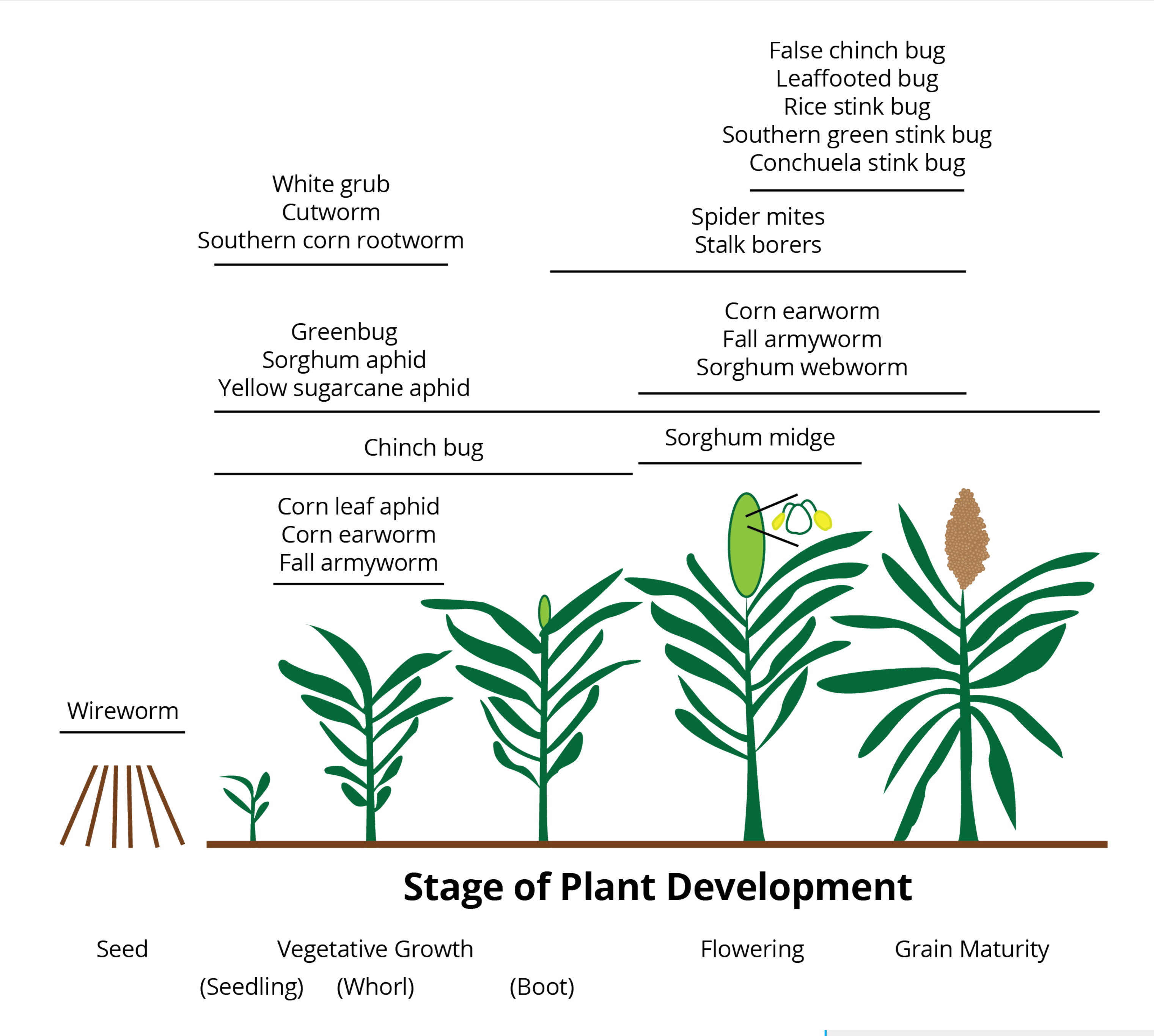

Figure 1. Sorghum insect pest occurrence.

SAMPLING FIELDS TO MAKE INSECT CONTROL DECISIONS

To determine how severe an infestation is and whether insecticide is needed, sample insects and mites in the field. Insect pest numbers can rapidly change. Inspect the sorghum at least once a week, especially during critical periods when insect pests are likely to be present (Fig. 1). Record the information collected during each field inspection to determine changes in insect abundance and plant damage.

The number of samples needed depends on the size of the sorghum field, the growth stage of the plant, and the uniformity and severity of the infestation. Because insect pests are seldom distributed evenly in a sorghum field, examine plants from all parts of the fields—avoid checking only the borders.

Growers can estimate the abundance of most insects in sorghum by examining some of the plants and plant parts. Randomly select and carefully inspect plants to detect insect pests and associated damage. During the inspection, consider other factors such as predators, parasitized aphids, and plant growth stage and condition.

Some insects, especially those known to infest sorghum grain heads, are effectively sampled by using the "beat-bucket" method:

1. Vigorously shake the grain sorghum heads into a 2½- to 5-gallon bucket where you can easily see and count the insects.
2. Sample at least 30 plants from a field. In fields larger than 40 acres, take at least one sample per acre.
3. Insect pests that live in the soil are hard to control once the crop has been planted. Therefore, most of these species must be treated preventively when the risk is high.

ECONOMIC INJURY LEVEL AND ECONOMIC THRESHOLDS

The *economic injury level* is the abundance of an insect pest or the amount of plant damage that justifies applying insecticide. The economic injury level is used to develop the action level or *economic threshold*. The economic threshold is always lower than the economic injury level. Early action can help prevent the pest from causing economic loss and allow time to implement a management plan, such as an insecticide application or early harvest.

Although economic thresholds in this publication are based on research, consider them only as guidelines because environmental and crop conditions can influence economic thresholds from year to year and region to region.

INSECTICIDES

Applying insecticide is often the only practical way to control insect and mite pests that are at or near damaging levels. The key disadvantages of insecticides are their cost and potential to harm beneficial insects. Loss of beneficial insects that feed on insect pests may lead to secondary pest outbreaks or pest resurgence. To minimize these problems, use the insecticide that is the least toxic to the pest's natural enemies. Other factors to consider when buying an insecticide are its cost and effectiveness.

Apply insecticide only when necessary to prevent economic loss. Otherwise, the cost of control can exceed the potential benefits. Use economic thresholds, if available, to consider the cost of control and market value of the crop.

SOIL INSECTICIDE TREATMENTS

Insecticides for controlling various pests that live in the soil and some early season sucking pests can be applied before the crop is planted, at planting, or as a side-dress application. Choose the formulation, either granular or liquid, appropriate for the target insect and the equipment available.

Pre-plant row treatments require special equipment to incorporate the insecticide to a depth of 2 to 4 inches. In fields planted on raised beds, make row treatments during or after bed formation. Further cultivation or bed shaping changes the position of the insecticide in the row. Follow the label directions for placement of the insecticide in the row.

To apply insecticide to the soil at planting, use T-band or in-furrow applications:

1. Choose the technique according to the pest insect and the insecticide label.
2. In-furrow applications are best applied with the applicator spout or spray nozzle positioned just behind the row opener and in front of the row coverer or press wheel.
3. T-band applications are banded 6 to 8 inches wide and may be placed across the seed furrow, as well as the covering soil or behind the row closer or press wheel.
4. Incorporate the insecticide with covering shovels, short parallel chains, loop chains, press wheels, finger tines, or other suitable devices.

Do not apply insecticides directly on seed unless the label clearly instructs that usage. Failing to follow label directions usually reduces seed germination and violates legal use of the insecticide.

INSECTICIDE SEED TREATMENTS

Insecticides applied directly to seeds to control pre- and post-emergent insect pests are called *insecticide seed treatments*. Seed treated with any pesticide must be dyed an unnatural color to distinguish it from untreated grain. The color is added to prevent unintended use as oil, food for people, or feed for animals. The pigments may change the seed texture and movement in planters during planting operations. The seed bag will offer suggestions on talcs or other flowing agents to mix with the seed.

The container (such as the bag or a center-flow container) must carry labels that include:

- A notice that the seeds have been treated.
- The commonly accepted chemical name of the applied substance.
- The application rate.
- A caution statement if the treatment substance can harm humans or other vertebrates if it remains on the seed.
- A statement with the words, "Warning–poison treated. Do not use for food, feed, or oil purposes."
- Before handling seed treated with any pesticide, read and follow the directions on the label.

Some seed companies package seed treated with insecticide, while others treat seed on request. Although you or another third party could apply a seed treatment, consult the seed dealer before treating purchased seed. Third-party application of a seed treatment may nullify any implied warranty for the seed.

FOLIAR APPLICATION OF INSECTICIDES

Controlling some insect pests requires thorough coverage of the plants with insecticide. Complete coverage can be challenging if dense canopies have formed due to hybrid leaf structure and narrow row spacing. To ensure good coverage, consider a high spray volume per acre—no less than 10 gallons per acre (GPA) and preferably 15 GPA for ground application—to move the insecticide through the canopy and onto the lowest leaves.

Other ways to increase insecticide penetration into the crop canopy include selecting the appropriate nozzles, lowering the boom to just above the crop surface, slowing the ground application equipment, and when appropriate, increasing the application pressure. Calibrate the sprayer carefully to ensure that the recommended amount of insecticide is applied.

Follow the directions on the container label carefully to avoid hazards to the applicator, wildlife, and the environment.

PROTECTING BEES AND OTHER POLLINATORS

Honeybees and other insect pollinators forage in sorghum fields for the pollen in flowering sorghum as well as the flowering weeds in and around fields. Honeybees also collect the sugary honeydew deposited on sorghum leaves by aphids. When possible, use pesticides that are less toxic to bees. Most of the insecticides listed in this publication are highly toxic to bees. Exceptions include Blackhawk, Heligen, Sefina, Sivanto Prime, and Vantacor.

Some insecticides kill bees when they contact the chemical residues on or in plants. Adopt these practices to help prevent bee poisoning.

- Apply insecticides late in the evening or at night when bees are not foraging in the field.
- Avoid pesticide drift onto bee colonies. During hot evenings, bees often cluster on the front of their hives. Pesticide drift onto clustering bees can kill many bees.
- Avoid insecticide drift onto blooming plants around the field.
- Make sure that the producer, applicator, and beekeeper cooperate closely to minimize bee mortality.

For directions and restrictions on protecting bees and other insect pollinators, read the "Directions for Use" section of the product label. New labels include this information in a bee advisory box highlighted by the bee icon (Fig. 2).

Figure 2. Icon on pesticide labels identifying steps to protect bees and other pollinators.

INBRED LINES FOR HYBRID SEED PRODUCTION

Compared to hybrids, inbred lines used to produce sorghum hybrid seed have lower economic thresholds. The thresholds are lower in seed-production fields because of the crop's higher value, its increased susceptibility to damage by insecticides and insect pests, and the greater damage caused by insects that reduce seed quality and germination. To minimize these problems, regularly monitor fields producing hybrid seed.

ENDANGERED SPECIES ACT

The Endangered Species Act is designed to protect and aid in the recovery of animals and plants that are in danger of becoming extinct. Because of this act, restrictions have been set on the use or application methods of many pesticides in designated biologically sensitive areas. These restrictions are subject to change. To learn what restrictions apply to your area, read the sections on environmental hazards and endangered species on product labels, and contact the local office of the U.S. Fish and Wildlife Service. Regardless of the law, pesticide users can be good neighbors by knowing how their actions may affect people and the natural environment.

INSECT PESTS OF SEEDS AND ROOTS

Wireworms (true wireworms and false wireworms)

Description: True wireworms (*Elateridae*) and false wireworms (*Tenebrionidae*) are the immature stages of click and darkling beetles, respectively. Wireworms are usually shiny, slender, cylindrical, hard bodied, and yellow to brown (Fig. 3).

Figure 3. False wireworms (top and bottom) and true wireworms (middle).

Damage and control: Wireworms feed on planted sorghum seed, preventing germination, and they may burrow into the crown and feed on seedling plant roots. This injury may result in dead heart and reduced plant stands and/or vigor.

Several cultural practices can reduce wireworm abundance and damage in sorghum, including:

- Cultivating to reduce non-crop plant material.
- Preparing good seedbeds.
- Planting when soil moisture and temperature are adequate to promote rapid seed germination.
- Planting in a field where a tap-rooted crop such as cotton was grown the previous year.
- Wireworms are best managed using at-planting, soil-applied insecticides or insecticide seed treatments.

Insecticides: See Table A in the *Insecticides* section for a labeled list of treatment options.

Threshold: There is no established threshold for wireworms since they must be treated preventively.

Red imported fire ants

Description and damage: Under some conditions in East and South Texas, red imported fire ants (*Solenopsis invicta*) feed on planted sorghum seed. Worker ants chew through the thin seed coat and remove the embryo (germ). They rarely consume the endosperm (starch) of the seed. Although the ants prefer water-soaked or germinating seeds, they also damage dry seeds.

Control: To reduce damage by red imported fire ants, use the cultural management practices recommended for wireworms. Use seed with good vigor, and plant it into a well-prepared seedbed when the soil temperature and moisture are adequate for rapid seed germination. Pack the covering soil firmly to prevent fire ants from easily accessing the planted seed. Insecticide seed treatments labeled for red imported fire ants offer good protection. Applying a granular or liquid insecticide in-furrow at planting may also provide effective control.

Insecticides: See Table A in the *Insecticides* section for a labeled list of treatment options.

Threshold: There is no established threshold for fire ants since they must be treated preventively.

White grubs

Description: White grubs (*Phyllophaga crinita* and other species) are the larvae of May or June beetles. They are characteristically C-shaped with white bodies and tan to brown heads and legs (Fig. 4). Because the last abdominal segment is transparent, dark-colored digested material is visible in the larvae. Their size varies by age and species.

Figure 4. White grubs.

Damage: Grubs damage sorghum by feeding on the roots. They may kill small seedlings, causing stand loss. If the grubs severely prune the roots of larger plants, they may lodge, become stunted, or become more susceptible to drought and stalk rot organisms.

Scouting and control: White grubs are rarely serious pests of sorghum. However, because they cannot be controlled once the crop has been planted, they must be controlled preventively. Detection of white grubs prior to planting can be accomplished by digging and examining 1 square foot of soil in every 5- to 10-acre section. If white grubs average 1 per square foot, consider applying insecticide at planting or utilizing an insecticide seed treatment.

Planting sorghum in a field where a non-grass crop (such as cotton or soybean) was grown the previous year is the most important cultural management practice for avoiding white grubs.

Detecting white grubs prior to planting can be accomplished by examining (digging) 1 square foot of soil in each 5 to 10 acres.

Insecticides: See Table A in the *Insecticides* section for a labeled list of treatment options.

Threshold: The treatment decision for white grubs must be made prior to planting (Table 1).

Table 1. Action threshold for **white grubs** prior to planting.

Sample Timing	Action Threshold
Before planting	If white grubs average one or more per square foot of soil, a preventative insecticide may be needed.
Post planting	No treatment options.

Southern corn rootworms

Description: The adult southern corn rootworm (*Diabrotica undecimpunctata howardi*) is also called the spotted cucumber beetle. The adult overwinters in surface debris but may become active during warm weather. In early spring, the females deposit eggs in the soil around the base of plants. There are multiple generations per year.

The larvae are small, brown-headed worms with wrinkled, creamy-white skin (Fig. 5). They chew into germinating seeds, roots, and crowns of sorghum plants. The symptoms of rootworm damage include reduced stands, lower plant vigor, and the occurrence of dead heart, or the death of the newest growth in the central whorl of young plants. Later in the season, maturity may be delayed, the plants may lodge, and weeds may multiply because the plant stand is not uniform. The shaded areas on the map (Fig. 6) indicate where the pest is most likely to damage sorghum in Texas.

Figure 5. Southern corn rootworm larva (top) and adult (bottom).

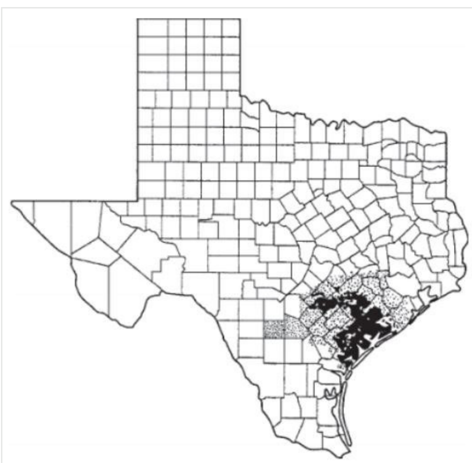

Figure 6. Areas in Texas where economically damaging infestations of southern corn rootworms commonly occur.

Cultural management practices include keeping fields clean of grassy weeds, plowing or disking 30 days before planting, planting early, and planting at a slightly higher-than-normal seed rate.

Base the need for insecticide treatment on the field's history of damage by rootworms. Insecticide seed treatments and application of insecticides at planting offer good protection against southern corn rootworm. Applications of insecticides targeting adult corn rootworms post-crop emergence are considered impractical, and effective control questionable.

Insecticides: See Table A in the *Insecticides* section for a labeled list of treatment options.

Threshold: There is no established threshold for southern corn rootworms, and insecticide treatments must be made prior to planting.

STEM- AND LEAF-FEEDING INSECTS

Cutworms

Description: Cutworms are the larval stages of moths that are active at night. Several species of cutworms (*Agrotis* and *Euxoa* spp.) can damage sorghum. The moths prefer to lay eggs in grassy and weedy fields, usually in the soil or on stems or leaves of sorghum or grassy weeds. The eggs hatch in 2 to 14 days.

Damage: The typical cutworm larva attacking sorghum is plump and curls into a C-shape when disturbed (Fig. 7). The larvae vary from grayish white to grayish black or brown, depending on the species. Fully grown larvae are 1 to 2 inches long. Some species overwinter in the soil as pupae and others as adults, but most overwinter as cells of small larvae in clumps of grass or in the soil under trash. They begin feeding in the spring and grow until early summer, when they pupate in the soil. The larvae of most species stay underground during the day and feed at night.

Figure 7. Cutworm larva and damage.

Table 2. Treatment threshold for **cutworms** based on feeding behavior.	
Cutworm Feeding Behavior	**Threshold**
For soil-surface or subterranean-feeding cutworms	When adequate stands for the crop environment are threatened.
For aboveground leaf-feeding cutworms	When > 30% of leaf tissue has been consumed.

The most common cutworms in sorghum feed at the soil surface. The feeding cuts plants off at, slightly below, or above the soil surface. Some cutworms, such as climbing or army cutworms, feed on the aboveground plant parts; others are subterranean and feed on underground plant parts, including seedling roots.

Scouting and control: Cultural control methods for cutworms include destroying weeds, thoroughly preparing the seedbed at least 4 to 6 weeks before planting and plowing under or using herbicides to reduce weeds in late summer or early fall. Cutworms are more severe in weedy fields.

When scouting for cutworms in sorghum, look for severed, dead, and dying plants. For surface-feeding and subterranean cutworms, calculate the number of damaged plants per foot of row.

Insecticides: Insecticides applied at planting and insecticide seed treatment will suppress cutworm populations. Insecticide sprayed as a broadcast treatment on the ground and on plants usually protects against cutworms (Table B). Because cutworms spend the day hidden in the soil, insecticides are sometimes more effective if they are applied in the late afternoon. Foliar insecticides are more effective on climbing cutworms than on subterranean cutworms.

Threshold: The treatment threshold is based on the feeding behavior of the cutworms present, feeding underground (subterranean) or at the soil surface which threatens crop stand, and aboveground leaf feeding resulting in defoliation (Table 2).

Yellow sugarcane aphids

Description: Yellow sugarcane aphids (*Sipha flava*) are usually lemon yellow (Fig. 8) but sometimes pale green. They are covered with small spines and have two double rows of dark spots on their backs. There are winged and wingless forms.

This aphid feeds on many grasses, including Johnsongrass and dallisgrass. The females give birth to living young for 28 days, averaging two nymphs a day for each female. The nymphs mature in 13 to 19 days, and the adults may live 25 to 30 days.

Yellow sugarcane aphids are most often found feeding on seedling sorghum, but they are occasionally found feeding on later stages.

Figure 8. Yellow sugarcane aphid adults and nymphs.

Damage: Yellow sugarcane aphids feed on the underside of sorghum leaves and inject toxin. Aphids feeding on seedlings turns the leaves purple and stunts their growth. The estimated yield loss associated with yellow sugarcane aphid damage, as evidenced by purpling discoloration, is presented in Table 3. By the time that the discoloration is visible, the aphids have significantly injured the plants. Damage often leads to delayed maturity and plant lodging, which may be increased by associated stalk rots.

Table 3. Estimated yield loss based on damage by **yellow sugarcane aphids** on the plant up to the third true-leaf stage.	
Description/Plant	**% Yield Loss/Plant**
No discoloration	0
Localized discoloration	8
< 1 entire leaf discolored	11
1 entire leaf discolored	31
> 1 entire leaf discolored	54
> 2 entire leaves discolored	77
Dying/dead plant	100

Scouting and control: Many predators feed on yellow sugarcane aphids, but they are rarely parasitized. Scout sorghum by inspecting plants twice weekly from emergence until they have at least five true leaves. Infestations of a week or less can significantly damage very small seedling sorghum plants with one to three true leaves. As the plants grow, they become more tolerant of aphid feeding. The presence of purple seedlings can indicate an infestation of yellow sugarcane aphids. However, purple leaves can also develop in response to root injury, phosphorous deficiency, or cold, wet, or compacted soil.

Insecticides: Yellow sugarcane aphids on seedling sorghum are best controlled preventively using insecticide seed treatments, but curative foliar insecticide applications are also effective. Mid- to late-season infestations must be controlled using foliar insecticides (Table B).

Threshold: The threshold for determining the need for treating for yellow sugarcane aphids is dependent on the stage of the sorghum. In seedling sorghum, the threshold is based on the percentage of infested plants on one true leaf (Table 4), two true leaves (Table 5), or three true leaves (Table 6). On later sorghum growth stages, the threshold is dependent on damage (Table 7).

Sorghum aphids

Description: Since the sorghum aphid (*Melanaphis sorghi*), also referred to as sugarcane aphid or white sugarcane aphid, was first recorded feeding on sorghum in Texas in 2013, it has become one of the most damaging insect pests of grain and forage sorghum in much of the United States.

Sorghum aphids are pale yellow, gray, or tan. The feet, antennae, and cornicles ("tailpipes") are black (Figs. 9 and 10). In contrast:

- Greenbugs are light green with a dark-green stripe running down the back.
- Corn leaf aphids are dark green and typically feed in the whorl of the sorghum plant.
- Yellow sugarcane aphids are bright yellow with rows of dark spots and short cornicles (Fig. 9) and do not produce honeydew.

The sorghum aphid feeds primarily on the underside of sorghum leaves. Although the initial colonies consist of just a few aphids, they can rapidly increase until they cover much of the lower leaf surface. The aphids produce large amounts of honeydew, which collects on the tops of leaves, making them sticky and shiny. Sorghum aphids can also move into the grain head (panicle).

Table 4. Treatment threshold shown as the percentage of **first true-leaf sorghum plants** infested with **yellow sugarcane aphids** dependent crop yield potentials, crop market value, and control costs.

Crop Yield Potential (lb./Acre)	Value ($/100 lb.)	Control Cost ($/Acre)				
		$6	$8	$10	$12	$15
2,000	6	13	16	21	25	31
	7	11	15	19	23	29
	8	10	14	17	21	26
	9	10	12	16	19	24
	10	9	11	14	17	31
4,000	6	7	9	12	14	21
	7	6	8	10	12	17
	8	5	6	8	10	14
	9	4	5	7	8	12
	10	4	4	6	6	10
6,000	6	4	5	7	8	10
	7	3	4	5	6	7
	8	2	3	4	4	5
	9	2	2	3	3	4
	10	1	2	2	2	3
8,000	6	2	3	4	4	5
	7	2	2	3	3	4
	8	1	1	2	2	3
	9	1	1	1	1	2
	10	1	1	1	1	1

Table 5. Treatment threshold shown as the percentage of **second true-leaf sorghum plants** infested with **yellow sugarcane aphids** dependent crop yield potentials, crop market value, and control costs.						
Crop Yield Potential (lb./Acre)	Value ($/100 lb.)	Control Cost ($/Acre)				
		$6	$8	$10	$12	$15
2,000	6	22	29	36	43	52
	7	20	27	33	39	47
	8	18	24	30	35	43
	9	17	22	27	32	39
	10	15	20	25	30	35
4,000	6	13	17	21	24	29
	7	11	14	17	20	24
	8	9	12	14	17	20
	9	8	10	12	14	16
	10	7	8	10	11	13
6,000	6	8	10	12	14	16
	7	6	7	9	10	12
	8	5	6	7	8	9
	9	4	4	5	6	7
	10	3	3	4	4	5
8,000	6	5	6	7	8	9
	7	3	4	5	5	6
	8	2	3	3	4	4
	9	2	2	2	3	3
	10	1	1	2	2	2

Figure 9. Winged and wingless sorghum aphids.

Figure 10. Key characteristics of aphid species that affect grain sorghum.

Table 6. Treatment threshold shown as the percentage of **third true-leaf sorghum plants** infested with **yellow sugarcane aphids** dependent crop yield potentials, crop market value, and control costs.

Crop Yield Potential (lb./Acre)	Value ($/100 lb.)	Control Cost ($/Acre)				
		$6	$8	$10	$12	$15
2,000	6	55	74	77	96	100
	7	50	68	73	87	100
	8	46	61	67	81	100
	9	42	56	63	76	95
	10	38	51	59	70	88
4,000	6	32	42	51	61	75
	7	26	35	44	52	64
	8	22	29	38	45	54
	9	18	24	33	39	46
	10	15	20	29	33	39
6,000	6	18	24	33	39	46
	7	14	18	27	31	36
	8	10	14	22	25	28
	9	8	10	17	20	22
	10	6	8	14	16	17
8,000	6	10	14	22	25	28
	7	7	9	16	16	20
	8	5	6	12	14	15
	9	3	4	8	10	11
	10	2	3	7	8	9

Table 7. Treatment thresholds for **yellow sugarcane aphids on sorghum plants with more than three true leaves.**

Growth Stage	Threshold
Four true leaves to 6 inches	20% damaged plants (sign of purpling) with yellow sugarcane aphids present.
6 inches to boot	Purpling evident, but before entire leaves are killed on 20% of plants.
Boot to heading	One dead leaf on 20% of plants.
Heading to hard-dough	Two dead leaves on 20% of plants.

All are females and give birth to live young. In about 5 days, the immature aphids develop into adults, which live for about 4 weeks. Because sorghum aphid populations can increase rapidly, monitor them one to two times a week once found in a field to determine if the infestations have reached treatment thresholds.

Sorghum aphids overwinter primarily on Johnsongrass as well as volunteer and regrowth sorghum that survives the cold.

Damage: Sorghum aphids feed by sucking plant sap. Their feeding causes the leaves to turn yellow, purple, and then brown as the leaf tissue dies (Fig. 11). Infestations on pre-boot sorghum can cause significant grain loss and poor head emergence. During flowering and grain development, they can greatly reduce yields, even more so under drought conditions. Yield loss is minimal once the grain reaches the hard-dough stage. However, high infestations of sorghum aphids may lead to lodging and harvest delays because of honeydew contamination. Sorghum stressed by sorghum aphid feeding is more susceptible to stalk rots and lodging. Infestations also produce large amounts of honeydew, which can interfere with harvest. The sticky leaves and stalks clog combines at harvest and reduce separation of the grain from the plants. Clogged grain separators can cause as much as 50 percent grain loss. Honeydew can increase costs further when harvest is interrupted to clean the combines.

Figure 11. Sorghum aphid colonies and damage.

Scouting: Begin scouting for sorghum aphids soon after plant emergence and make it a part of a weekly field-monitoring program for all sorghum pests. Once sorghum aphids are found, begin more intensive scouting. The following is a suggested sampling protocol.

1. Once a week, walk at least 25 feet into the field and examine the plants along 50 feet of row.
2. Inspect the underside of leaves from the upper and lower canopy. The presence of winged aphids on the upper surface of upper leaves indicates that adults have recently migrated into the field. Inspect 15 to 20 plants per location.
3. Sample each side of the field as well as sites near Johnsongrass and tall grain sorghum plants.
4. Check at least four locations for a total of 60 to 80 plants per field.
5. If you see honeydew on a leaf, look on the underside of the leaves above it to confirm that the cause is sorghum aphids. However, do not rely solely on obvious honeydew to detect infestations as colonies that are too small to produce noticeable honeydew could easily be overlooked. Instead, look closely for small colonies on the underside of lower and upper leaves.
6. If no sorghum aphids are present or if only a few wingless or winged aphids are on the upper leaves, continue scouting once a week.
7. If you find sorghum aphids on lower or mid-canopy leaves, scout more intensively.
8. Record the numbers of plants that are not infested, plants infested with fewer than 50 aphids each, and plants with 50 or more aphids (Fig. 12).
9. Check at least 10 plants at four locations across the field.
10. Calculate the percentage of plants infested with 50 or more aphids: (Number of plants with 50 or more aphids ÷ Total number of plants inspected) × 100. See Table 8 for action thresholds.

To determine if the infestation may impair harvest, scout sorghum 2 to 3 weeks before harvest.

Figure 12. Leaf with 50 sorghum aphids.

Control: Sorghum aphids are best managed using an integrated approach including landscape host management, planting date, host plant resistance, natural enemy preservation, and insecticides when justified.

Planting date and hybrid maturity

One of the most effective ways to manage sorghum aphids is to plant early in the normal planting period. Although the aphids can reduce yields up to the hard-dough stage, infestations during pre-boot, boot, and head emergence are the most damaging. Early planting reduces the risk of infestations reaching high numbers during these critical periods. Early planting can also shift the peak infestations closer to harvest and reduce or avoid the need for insecticide applications. Another means of reducing the window for sorghum aphid infestation potential is to select an early maturing hybrid. However, when considering early planting and hybrid maturity, factor in the effect on yield potential.

Planting sorghum aphid-resistant hybrids

Many seed companies market hybrids with resistance or "tolerance" to sorghum aphids. Compared to susceptible hybrids, sorghum aphid populations on resistant hybrids increase slower, cause less leaf damage, and are less likely to require an insecticide treatment. However, no current hybrids are immune to sorghum aphid infestation and damage. Thus, continue to monitor resistant hybrids for the presence of sorghum aphids and apply insecticides if the infestations exceed action thresholds. Also, stay-green sorghum hybrids tolerate drought better than other hybrids and have withstood sorghum aphid injury better under drought-like conditions.

In addition to sorghum aphid resistance, consider yield and other agronomic qualities when selecting hybrids. Those that are high yielding and well adapted yet susceptible to aphids may be more profitable. Protect these hybrids from sorghum aphid damage by scouting often and, if infestations exceed the action threshold, timing insecticide applications appropriately.

Managing Johnsongrass and volunteer sorghum

Infestations of sorghum aphids can sometimes be associated with nearby stands of Johnsongrass or volunteer sorghum. Sorghum aphid infestations in a sorghum field often begin on field edges bordering ditch banks or in fields with Johnsongrass or volunteer sorghum. To reduce the risk of infestation, eliminate these potential sources of aphids.

Managing sorghum aphids before harvest

Although sorghum aphid infestations present after grain fill may have less of an effect on yield, they can continue to produce large amounts of honeydew, which can interfere with harvest. This risk increases when sorghum aphids are present in the panicle. Rain can help wash honeydew from leaves, but if it appears that aphids are likely to hinder harvest, consider applying an insecticide, and be aware of the insecticide pre-harvest interval. Harvest aid chemicals such as glyphosate and sodium chlorate have been used to kill sorghum leaves to reduce sugarcane aphid infestations before harvest.

Figure 13. Beneficial lady beetle larva (top) and adult (bottom).

Figure 14. Beneficial syrphid fly (from left) larva, pupa, and adult.

Figure 15. Beneficial insects (from left): minute pirate bug feeding on whitefly nymphs, lacewing larva, and *Scymnus* lady beetle larva.

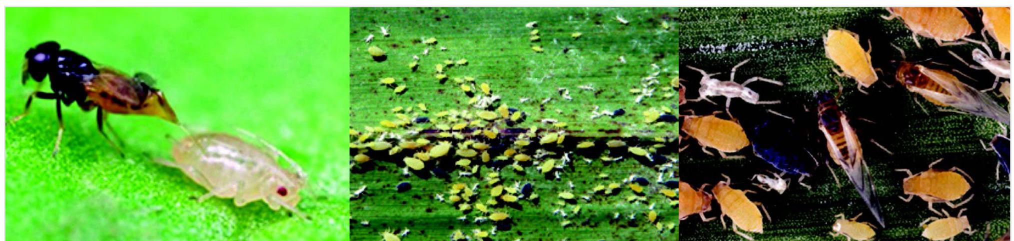

Figure 16. An *Aphelinus* wasp parasitizing an aphid (left); black or blue-black aphids, or mummies (center) that have been killed by the *Aphelinus* larva feeding inside the sorghum aphid; mummies (right) showing the round exit hole where the adult wasp emerged from the dead sorghum aphid.

However, if the plants are slow to desiccate, the aphids may have time to move up into the sorghum panicle and continue to feed and produce honeydew. For this reason, consider using high rates of harvest aids that kill leaves quickly or include an effective insecticide with the harvest aid. An insecticide application is often more effective than harvest aids alone. Read and follow the label directions for the harvest aids and observe pre-harvest intervals for both the harvest aids and insecticides.

Managing sorghum midges, headworms, and stinkbugs when sorghum aphids are present

Most insecticides effective for sorghum aphid control are ineffective for midge, headworm, or stinkbug control in sorghum. Many insecticides labeled for these pests are toxic to beneficial insects, including lady beetles, syrphid flies, and parasitic wasps (Figs. 13 through 16) which help suppress aphid infestations. Preserving these natural enemies whenever possible is an important goal in managing aphids. All of the pyrethroid insecticides, dimethoate, and methomyl that have activity on midges, headworms, and stink bugs are broad-spectrum insecticides that are highly toxic to the natural enemies attacking sorghum aphids. Thus, sorghum aphid infestations can rapidly increase following their use and treated fields should be closely monitored.

For control of midges when sorghum aphids are present, Blackhawk is less toxic to natural enemies than the other alternatives. However, data for Blackhawk efficacy for midge control are limited, and it is not recommended when midge pressure is high.

For control of corn earworms, fall armyworms, and sorghum webworms when sorghum aphids are present, Blackhawk, Heligen (corn earworms only), and Vantacor are less toxic to natural enemies than the alternatives while remaining effective on the headworm complex. Besiege is a premix of the same active ingredient as Vantacor plus a pyrethroid, and therefore is not as safe for beneficial insects as Vantacor alone. All of the insecticides labeled for stink bugs are toxic to most aphid natural enemies.

Insecticides: Insecticide options can be found in Table C of the *Insecticides* section.

Insecticide seed treatments

The insecticide seed treatments clothianidin (NipsIt Inside, Poncho), imidacloprid (Gaucho and others), and thiamethoxam (Cruiser) are labeled for control of sorghum aphids and other seedling pests. These treatments protect seedlings from aphid damage for about 4 to 6 weeks after planting. The value of seed treatment to control sorghum aphids depends on how soon after planting the aphids infest the field. Insecticide seed treatments tend to be more valuable for sorghum aphid management in more southern areas and for late plantings.

In-furrow insecticides

Currently, Sivanto Prime has a supplemental label for in-furrow applications to control aphids. In-furrow applications have proven to be highly effective, and depending on soil type and precipitation, may provide more than 70 days control. However, such preventative treatments are not always economically justified in cases where foliar applications timed at threshold are possible.

Chemigation

Sefina, Sivanto Prime, and Transform may be applied by chemigation via overhead sprinkler irrigation systems. This application method is highly effective for managing sorghum aphid infestations. Chemigation can reduce application

Table 8. Action thresholds for **sorghum aphids based** on sorghum growth stages.	
Sorghum Growth Stage	Threshold
Pre-boot to boot	20% of plants infested with 50 or more aphids.
Flowering to milk stage	30% of plants infested with 50 or more aphids.
Soft-dough to hard-dough	30% of plants infested with established aphid colonies and localized areas with heavy honeydew.
Black layer	Heavy honeydew and established aphid colonies. Treat only to prevent harvest problems.

costs and may require less insecticide because it covers the crop more thoroughly than conventional application methods. Chemigation requires an initial investment in chemical injection equipment as well as additional management time. Safety features and practices are necessary for safe and effective chemigation. Preventing groundwater contamination is of key importance.

Foliar insecticide applications

Regardless of the insecticide used, good coverage of the crop canopy, including the lower leaves, is necessary for optimal control. Adjust the spray volume according to anticipated spray coverage. Generally, spray volumes of 10 to 15 GPA are recommended for ground applications. For aerial applications, at least 5 GPA is recommended.

Adding a spray adjuvant usually does not increase sorghum aphid control over the insecticide alone. Exceptions do occur, especially under hot, dry conditions such as those in the Texas High Plains, where much of the spray would evaporate before reaching the plants.

Thresholds: Use action thresholds as guides, considering the weather and your ability to make timely, effective insecticide applications.

The best indicators that insecticide is needed to reduce honeydew contamination at harvest are the movement of aphids to the head late in the season and the presence of honeydew in the head. The threshold is based on sorghum growth stages and the percentage of infested plants encountered (Table 8).

In Table 8, the term "localized area" refers to a single plant or group of adjacent plants with sorghum aphid colonies. Finding several of these areas indicates that the sorghum aphid infestation is well established and increasing in the field. Alternatively, a threshold of 50 sorghum aphids per inspected leaf may be utilized as an action threshold.

Corn leaf aphids

Description: Corn leaf aphids (*Rhopalosiphum maidis*) are oval and dark bluish green with black antennae, cornicles, and legs (Fig. 17). There are winged and wingless forms. These aphids are usually found deep in the whorl of pre-boot sorghum, but they also occur on the underside of leaves, on stems, or in grain heads. When abundant, corn leaf aphids within the whorl of sorghum plants are easy to see. To detect small aphid populations, pull the whorl leaf from the plant and unroll it.

Because corn leaf aphids prefer to live and feed in the whorl of sorghum plants, aphid numbers normally decline rapidly after the grain head emerges (exerts) from the boot.

Damage: When feeding, corn leaf aphids suck plant juices but do not inject toxin like greenbugs and yellow sugarcane aphids. The most apparent feeding damage is yellow mottling of the leaves that unfold from the whorl.

Corn leaf aphids rarely cause economic loss to sorghum. In fact, they can be considered helpful because they attract beneficial insects such as lady beetles, which feed on the aphids. When corn leaf aphid numbers decline, the beneficial insects can then attack greenbugs, sorghum aphids, and other insect pests. Beneficial insects are also believed to move to adjacent crops such as cotton and feed on insect pests there.

Figure 17. Corn leaf aphid.

Occasionally, corn leaf aphids will become so abundant on a few plants in a field that they hinder grain head exertion and development. These aphids are more likely to damage moisture-stressed than unstressed sorghum plants. Although very rare, infestations on seedling sorghum might cause stand loss, and grain head infestations could cause harvesting problems. The aphid also transmits the virus that causes maize dwarf mosaic.

Scouting and control: Because the corn leaf aphid is rarely an economically damaging pest, sampling procedures and damage assessment information for corn leaf aphids have not been developed. Applying insecticide to control corn leaf aphids is rarely justified.

Insecticides: Early season corn leaf aphids are easily controlled with insecticide seed treatments. Foliar insecticides are the best options for managing corn leaf aphids during the whorl stage and later. See Table C in the *Insecticides* section for insecticides labeled for managing corn leaf aphids.

Threshold: There is no established threshold for corn leaf aphids in sorghum. However, a general guide to making a treatment decision is dependent on infestation and plant stress (Table 9).

Table 9. Action threshold for **corn leaf aphids.**
Treatment is rarely justified for healthy plants.
If corn leaf aphids are abundant (1,000s per leaf) and the plants are drought stressed, treatment may be justified.

Greenbugs

Figure 18. Greenbug colony (left) and greenbugs (right).

Description: The greenbug (*Schizaphis graminum*) is an aphid that sucks plant juices and injects toxin into sorghum plants. The adult greenbug is light green and about 1/16 inch long. It has a characteristic dark-green stripe down the back (Fig. 18). The tips of the cornicles and leg segments furthest from the body are usually black. A colony can have winged and wingless forms.

Females produce living young (nymphs) without mating. Because there are no males, populations can develop quickly. Under optimum conditions, the life cycle is completed in 7 days. Each female produces about 80 offspring during a 25-day period.

Damage: Greenbugs usually feed in colonies on the underside of leaves and produce large amounts of honeydew. Although feeding in itself can be injurious, the most serious damage caused by greenbugs is from their saliva, which is toxic to sorghum. The toxin causes yellowing, then reddening, and eventual necrosis and death of the leaf tissue. The reddened areas enlarge as greenbug numbers increase. Damaged leaves begin to die, turning yellow then brown. Damage at the seedling stage may result in stand loss.

Although larger sorghum plants tolerate more greenbugs, these plants can also be heavily damaged. Yield reductions during the boot, flowering, and grain development stages depend on the number of greenbugs, the general health of the plants, and the length of time that the insects have infested the plants. Large populations of greenbugs on booting and older plants can reduce yields and weaken plants, which may lodge later.

Sorghum plants can lose about 30 percent of their leaves to greenbug feeding before yield is reduced. Control greenbug infestations before they kill more than two normal-sized leaves on 20 percent of plants after sorghum flowering and before the hard-dough stage.

Scouting: The greenbug may be a pest during the seedling, boot, and heading stages. To detect an infestation, look for reddish leaf spots caused by the toxin greenbugs inject into the plant. Do not mistake greenbug damage for the natural aging and gradual deterioration (senescence) of the small bottom leaves.

Once a week, scout for greenbugs by examining at least 40 randomly selected plants per field. Because greenbugs are seldom distributed evenly in an area, examine plants from all parts of the field, not just on the borders. Check more than 40 plants if the fields are larger than 80 acres or if making a control decision is difficult. Scout the fields more often when the weather is warm and dry, as these are favorable conditions for rapid greenbug reproduction.

In seedling sorghum plants less than 6 inches tall, greenbugs may infest any part of the plant, including the whorl and in the soil at the base of the plant. When scouting seedling sorghum, examine the entire plant and the soil around its base. Note the presence or absence of greenbugs and any damage to the plants, such as yellowing or dead tissue.

In more mature sorghum, greenbug colonies usually begin on the underside of lower leaves and move up the plant. On most sorghum hybrids, you will need to examine the underside of the lower leaves only. However, in some cases, colonies may appear first on the underside of upper leaves. Do not confuse greenbugs with the bluish-green corn leaf aphid, often found with greenbugs in the plant whorl (Fig. 17).

Control: Early in the season, rain, lady beetles, and other predators suppress aphid abundance. However, the increase of natural enemies has a lag time of 1 to 2 weeks. In the spring, a common parasitic wasp usually causes the aphids to decline rapidly.

Knowing whether greenbug numbers are increasing or decreasing from week to week can help you determine whether insecticide treatment is justified. For example, it would not be justified if the populations had reached the recommended treatment level based on leaf damage but had declined substantially from previous observations.

Host plant resistance: Plant sorghum hybrids that are resistant to greenbugs. Because thresholds are based on plant damage, the action thresholds for resistant sorghums are the same as for susceptible sorghums.

Insecticides: Greenbugs on seedling sorghum are best controlled preventively using insecticide seed treatments, but curative foliar insecticide applications are effective. Mid- to late-season infestations must be controlled using foliar insecticides (Table C).

Thresholds: When estimating leaf damage, consider any leaf to be dead if more than 75 percent of its surface is red, yellow, or brown. Do not mistake greenbug damage for the natural aging and gradual deterioration (senescence) of the small bottom leaves. Greenbug thresholds are based on the plant's growth stage and the amount of greenbug feeding damage (Table 10). These thresholds are guides and should be lowered for stressed plants. Additionally, these guidelines assume that greenbugs are increasing so rapidly that beneficial insects cannot control them. Insecticide treatment is usually unnecessary when more than 20 percent of the greenbugs appear brown and swollen from being parasitized.

Table 10. Treatment thresholds for **greenbugs** on sorghum growth stages.

Growth Stage	Threshold
Emergence to about 6 inches	20% damaged plants (beginning to yellow).
6 inches to boot	Red spotting or yellowing of leaves, but before entire leaves are killed on 20% of plants.
Boot to heading	One dead leaf on 20% of plants.
Heading to hard-dough	Two dead leaves on 20% of plants.

Figure 19. Chinch bug adults and nymphs.

Chinch bugs

(See page 24 for false chinch bugs.)

Description: Adult chinch bugs (*Blissus leucopterus*) are black with reddish-yellow legs and conspicuous, white, fully developed forewings, each with a black triangular spot at the middle of the outer edge (Fig. 19). Immature chinch bugs are shaped like the adults but lack wings.

Young nymphs are yellowish but later turn reddish with a white or pale-yellow band across the front part of the abdomen. The older nymphs are black and gray with a conspicuous white spot on the back between the wing pads.

Chinch bugs lay eggs behind the lower leaf sheaths of sorghum plants, on roots, or in the ground near the host plant. The life cycle is completed in 30 to 40 days, and there are at least two generations per year. Chinch bugs overwinter as adults in bunchgrass. They begin moving to sorghum when temperatures reach 70 degrees F.

Damage: Adult and immature chinch bugs suck juices from stems, leaves, and underground plant parts. Chinch bugs inject saliva that is toxic to the plants. Young plants are highly susceptible. Although older plants can better withstand attack, they too become reddened, weakened, and stunted. Chinch bugs proliferate in hot, dry weather, when many adult and immature bugs often migrate from wild bunchgrasses or small grains into sorghum.

Generally, one chinch bug per seedling sorghum plant reduces grain yield by 2 percent.

Scouting: Scout sorghum for chinch bugs during the seedling stage until plants are about 18 inches tall. Look for chinch bugs around the base of the plant just at or below the soil line. Be sure to pull back the lower leaf sheaths to look for chinch bugs. Examine plants in at least five places in the field.

Table 11. Treatment thresholds for **chinch bugs** on sorghum growth stages.

Growth Stage	Threshold
Emergence to about 6 inches	Two or more chinch bugs on 20% of the plants.
Plants > 6 inches tall	75% infested plants.

Control: Cultural practices that stimulate dense, vigorous plant stands deter chinch bugs and usually reduce injury. Plant sorghum as early as practical to avoid infestations.

Insecticide seed treatments and at-planting insecticides can prevent chinch bug infestations, but foliar insecticides may be necessary curatively.

In fields with a history of economically damaging chinch bug infestations, using insecticide seed treatments or applying insecticides at planting is recommended. Granular insecticides must receive about ½ inch of rainfall after application to effectively suppress early season chinch bug infestations.

Because chinch bugs feed on the lower leaves, stem, and underground, insecticide coverage and effective control with foliar insecticides are often difficult to achieve on plants in the boot stage or later. On large plants, high application volumes or sprays directed at the plant base will enhance control. Aerial applications are seldom effective.

Insecticides: Insecticide seed treatments or at-planting insecticides most often provide sufficient preventive control of chinch bugs, and when used, foliar insecticide applications are rarely necessary. See Table D in the *Insecticides* section for a list of insecticides labeled for chinch bug control.

Threshold: Chinch bug thresholds are based on plant growth stage and the percentage of infested plants (Table 11).

Corn earworms and fall armyworms (whorl-feeding worms)

See *Headworm complex* for more detailed information on corn earworms and fall armyworms.

Description: Corn earworms (*Helicoverpa zea*) and fall armyworms (*Spodoptera frugiperda*) infest the whorls and grain heads of sorghum plants. If there are no grain heads, the insects lay eggs on the leaves. Young larvae feed on tender, folded leaves in the whorl. Once larvae are 1 to 1¼ inches long, they will complete feeding in 3 to 4 days, and then exit the plant and pupate in the soil. See the *Headworm* section for figures of corn earworms and fall armyworms.

Damage: Damaged leaves unfolding from the whorl are ragged with "shot holes." Although this may look dramatic (Fig. 20), the damage usually does not significantly reduce yields, and controlling larvae during the whorl stage is seldom economically justified.

Figure 20. Typical fall armyworm damage to whorl-stage sorghum.

Removal of leaf tissue by whorl-feeding caterpillars simply reduces the photosynthetic capabilities of the plant. Drought-stressed sorghum is more sensitive to whorl-feeding caterpillars than healthy, well-watered plants. Just prior to the boot stage, the larvae may feed on the developing panicle, reducing grain formation potential.

Scouting and control: To find larvae in a sorghum whorl, pull the whorl leaf from the plant and unfold it. Larval excrement (frass) is present where larvae feed within the whorl.

Larval mortality can be high in whorl-feeding populations due to predators, parasitoids, and diseases. Populations are most often undetected until the larvae are large, damage has already occurred, and the larvae are deep within the whorl where insecticide coverage is extremely difficult. Thus, effective control with insecticides is very challenging.

Insecticides: Due to the difficulty of reaching larvae with foliar insecticides, foliar applications of insecticides are usually not highly effective. High volumes of spray applied by ground and directed into the whorl are needed to move insecticide into the whorl where larvae are feeding. Vantacor and Besiege are labeled for corn earworms and fall armyworms.

Because these products are absorbed by the leaf, they tend to offer greater control than contact insecticides, but still may only provide 80 percent control at best. Chemigation with Besiege or Vantacor can improve control by moving the insecticide into the whorl with the high volume of water. Pyrethroid insecticides are less effective on medium- to large-sized larvae and are toxic to beneficial insects. See Table G in the *Insecticides* section for a list of insecticides labeled for corn earworm and fall armyworm management.

Threshold: There is no well-established threshold for whorl-feeding corn earworms or fall armyworms. A general threshold is based on the reduction in leaf area when larvae less than 1 inch long are common (Table 12).

Table 12. Action threshold for whorl-feeding corn earworms and fall armyworms.
Treatment may be justified when 30 percent or more of the plant leaf area is consumed and small (< 1-inch-long) larvae are common.

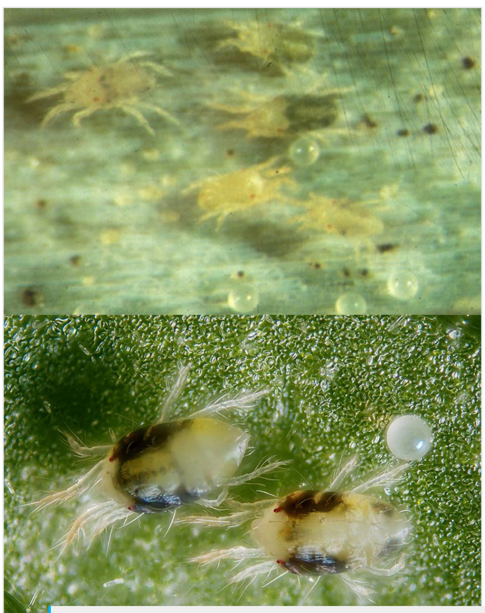

Figure 21. Banks grass mite adults and eggs (top) and two-spotted spider mites.

Spider mites

Description: Banks grass mites (*Oligonychus pratensis*) and two-spotted spider mites (*Tetranychus urticae*, Fig. 21) can infest sorghum, especially under hot, dry conditions. These mites are tiny, and females are larger than males. Each female lays about 50 eggs in webbing on the underside of sorghum leaves. The eggs are spherical, pearly white, and ¼ the size of the adults. They hatch in 2 to 3 days. Under favorable conditions, the life cycle takes about 5 to 7 days to complete.

Mite infestations begin along the midrib of the lower leaves. As the mites become more abundant on the lower leaves, the infestation spreads upward through the plant. The undersides of heavily infested leaves have a dense deposit of fine webbing spun by the spider mites. Spider mite abundance generally increases after the grain heads emerge.

Damage: Spider mites suck juices from the underside of sorghum leaves, causing the infested areas to initially become pale yellow then turn reddish on the top later. The entire leaf may turn brown.

If many mites infest sorghum early in kernel development, the plants become less able to make and fill grain. Mites do not affect the grain after the kernels reach hard-dough. However, if spider mites are very abundant, the sorghum plants may lodge, reducing yields.

Drought-stressed sorghum will be more prone to injury from spider mites than well-watered sorghum.

Scouting and control: Inspect the underside of the lower leaves carefully. Mite infestations usually begin along field borders and may spread quickly throughout the field. Hot, dry weather may favor a rapid increase in mites. They may also increase after an insecticide application for other pests, such as greenbugs or midges. If the increase occurs after such an application, the cause may be the tolerance of mites to some insecticides, the destruction of beneficial insects, or the dispersal of mites from colonies, which can increase their reproduction rate.

Natural enemies do not always control spider mites adequately. Spider mites increase faster on moisture-stressed plants than on non-stressed plants. If possible, time irrigation to prevent plant stress. Rain can suppress spider mite population growth. Spider mites may also move from small grains such as wheat to sorghum. To avoid this problem, plant sorghum away from small grains.

Insecticides: The use of miticides to control mites in sorghum has been erratic. Miticide application may be justified when damage appears on 30 percent of the leaf area of most sorghum plants in the field (Table E). Thorough coverage is required; apply at least 5 gallons of spray mixture per acre by air and 10 to 20 gallons per acre by ground.

Threshold: There is no well-established threshold for spider mites in sorghum. A general threshold is based on infested leaves (Table 13).

Table 13. Action threshold for **spider mites.**
Treat when 30% of the leaf area is infested with mites on most plants.

INSECTS THAT FEED ON DEVELOPING GRAIN IN THE HEAD

Sorghum midges

Description: The sorghum midge, *Stenodiplosis* (*Contarinia*) *sorghicola*, is one of the most damaging insects of sorghum in Texas, especially in the eastern half of the state. The adult sorghum midge is a small, fragile-looking, orange-red fly with a yellow head, brown antennae and legs, and gray, membranous wings (Fig. 22).

Figure 22. Sorghum midge adult (top), midge adults on blooming head (middle), and pupal skins (bottom).

During the single day of adult life, each female lays about 50 yellow-white eggs in the flowering spikelets of sorghum. The eggs hatch in 2 to 3 days.

At first, the larvae are colorless. When fully grown, the larvae are dark orange. They complete development in 9 to 11 days and pupate between the spikelet glumes. Shortly before the adult emerges, the pupa moves toward the upper tip of the spikelet. After the adult emerges, it leaves a clear or white pupal skin at the tip of the spikelet—a sure sign of sorghum midge damage (Fig. 22).

Under favorable conditions, a generation is completed in 14 to 16 days, and midge numbers increase during the season with each subsequent generation. Thus, late-planted sorghum is at risk to large infestation of adults moving in from fields planted earlier.

Sorghum midges overwinter in cocoons inside spikelets of sorghum or Johnsongrass that fall to the ground and become covered with litter. Adult sorghum midges emerge in the spring before flowering sorghum is available, and these adults infest Johnsongrass. Sorghum midges developing in Johnsongrass disperse to sorghum when it flowers.

Early season infestations in sorghum are usually below damaging levels. As the season progresses, sorghum midge populations increase, especially when late planting makes flowering sorghum available in the area. Numbers often drop late in the season.

Damage: The larva damages sorghum by feeding on a newly fertilized ovary, which prevents normal kernel development. Grain loss can be extremely high. The glumes of an infested spikelet fit tightly together because no kernel develops. Typically, a sorghum grain head infested by sorghum midges has normal kernels scattered among spikelets that do not bear kernels, depending on the degree of damage.

The sorghum midge lays eggs in spikelets when yellow anthers appear on the sorghum head. An individual grain head requires 7 to 9 days to complete flowering, though it may take 2 to 3 weeks for all of the heads in a field to complete flowering. Thus, a field can remain susceptible to midge infestation for several weeks, depending on how uniformly the plants flower. Once the anthers turn reddish brown, they are no longer susceptible to midge infestation.

Scouting: Begin scouting for sorghum midges soon after head emergence, when yellow blooms first appear in the field. Scout at midmorning when the temperature rises to about 85 degrees F. The adult lives for 1 day, and each day, a new brood of adults emerge. For this reason, it is necessary to sample flowering fields almost daily.

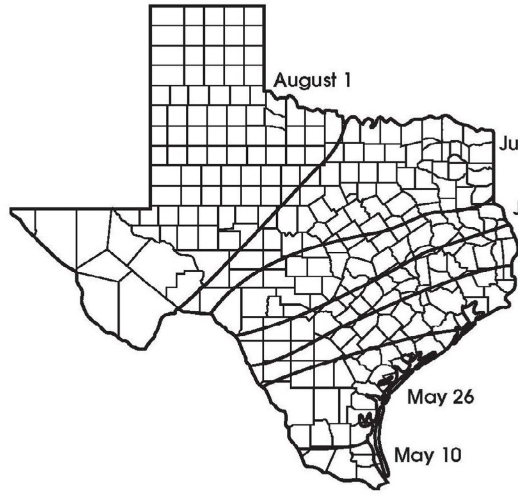

Figure 23. Estimated latest sorghum flowering dates most likely to escape significant damage by sorghum midges.

Look for adults on the yellow blooms by carefully inspecting at close range all sides of the randomly selected flowering grain heads. The reddish, gnat-like adults crawl on or fly around the flowering heads. During inspection, handle the grain heads carefully to avoid disturbing the adult midges. Another sampling method is to gently but quickly slip a clear, 1-gallon plastic bag over the head. Tap the head to disturb the midges, which will fly up in the bag, where you can easily see and count them. A faster yet still efficient method is to turn the head downward into a white plastic bucket or pail and beat the head in the bucket to knock the midges from the head. Remove the head and count any sorghum midge in the pail or bucket. A 1-gallon milk jug with the bottom cut out also works well for this type of sampling.

Because they are relatively weak fliers and rely on wind currents to help them disperse, adult sorghum midges are usually most abundant along the edges of sorghum fields. For this reason, inspect plants along field borders first, particularly those downwind of earlier flowering sorghum or Johnsongrass. If the grain heads along the field edges have few or no sorghum midges, there should be little need to sample the entire field. However, if you find more than one sorghum midge per flowering grain head in a field border area, inspect the rest of the field. Flowering heads are those with yellow blooms. Sample at least 20 flowering grain heads for every 20 acres in a field. For fields smaller than 20 acres, sample 40 flowering grain heads. Record the number of sorghum midges for each flowering head sampled, then calculate the average number of midges per flowering head. Almost all of the sorghum midges seen on flowering sorghum heads are female.

Control: Late-planted and late-flowering sorghum are especially vulnerable to the sorghum midge. The most effective cultural management practice is planting sorghum early and uniformly so that flowering occurs before the sorghum midges reach damaging levels. It is critical to plant hybrids early enough to prevent grain heads from flowering late (Fig. 23).

Cultural practices that promote uniform heading and flowering in a field are also important for reducing sorghum midge infestations. Use cultivation and/or herbicides to eliminate Johnsongrass inside and outside the field. Where practical, disk and deep plow the previous year's sorghum crop to destroy overwintering midges.

Insecticides: Foliar insecticides are the only option to curatively manage a sorghum midge infestation (Table F). Insecticide residues should kill the adults and prevent egg laying 1 to 2 days after treatment. However, if adults still are present 3 to 5 days after the first insecticide application, apply a second insecticide treatment immediately. Making several insecticide applications at 3-day intervals may be justified if the yield potential is high and sorghum midges exceed the economic threshold.

Threshold: The economic threshold for sorghum midges per sorghum panicle are presented in Table 14. The economic threshold for sorghum midges is based on crop yield potential, crop value, and control cost. Where flowering is non-uniform, multiply the threshold by percentage of flowering heads. Broad-spectrum insecticides (Mode of Action 1A and 3A in Table 14) will kill beneficial insects in the field and increase the risk of sorghum aphid damage if these insects are present.

Headworm complex (corn earworms, fall armyworms, and sorghum webworms)

Description: Corn earworm (*Helicoverpa zea*) and fall armyworm (*Spodoptera frugiperda*) moths lay eggs on leaves or grain heads of sorghum. Newly hatched corn earworm larvae are pale and only 1⁄16 inch long. They grow rapidly, and older larvae range from pink, green, or yellow to almost black (Figs. 24 through 26). Each body segment has several long bristles or hairs. Many larvae are conspicuously striped. Along the side is a pale stripe edged above with a dark stripe. Down the middle of the back is a dark stripe divided by a narrow white line that makes the dark stripe appear doubled. Fully grown larvae are robust and 1½ to 2 inches long.

Young fall armyworm larvae are greenish, have black heads, and lack bristles. Mature larvae vary from greenish to grayish brown and have a light-colored, inverted Y-shaped suture on the front of the head (Figs. 25 through 27) and dorsal lines running lengthwise on the body. The tail end has four large black spots on the upper side.

Sorghum webworms (*Nola sorghiella*) commonly infest grain heads of sorghum planted 2 to 3 weeks later than normal. This insect occurs primarily in the more humid eastern half of Texas.

The adults are small white moths that are active at night. They lay about 100 eggs singly on flowering parts or kernels of sorghum. The eggs are round to broadly oval and are flattened from top to bottom.

Webworm larvae are somewhat flattened, yellowish or greenish brown, and marked with four lengthwise reddish to black dorsal stripes (Fig. 28). When mature, the larvae are about ½ inch long and covered with many spines and hairs. A silk cocoon encloses the reddish-brown pupal stage. A generation requires 1 month, and as many as six generations may develop in a year. The larva overwinters in a cocoon on the host plant.

Egg laying among all of the headworm complex pests is usually greatest at flowering but may occur during any stage of grain development.

Damage: Headworm complex larvae feed on the flowers and then on the developing grain, hollowing out the kernels. The last two larval stages cause about 80 percent of the damage.

Frass and fragments of grain kernels accumulate on top of the upper leaves and on the ground under plants where the larvae are feeding. Infestations are less common in early planted sorghum and in sorghum hybrids with loose (open) grain heads.

Table 14. Treatment threshold shown as the number of **sorghum midges** per panicle at different crop yield potentials, crop market value, and control costs.

Crop Yield Potential (lb./Acre)	Value ($/100 lb.)	Control Cost ($/Acre)			
		$6	$8	$10	$15
	6	0.67	0.89	1.12	1.68
	7	0.57	0.77	0.96	1.44
2,000	8	0.50	0.67	0.84	1.26
	9	0.45	0.60	0.75	1.12
	10	0.40	0.54	0.67	1.01
	6	0.34	0.45	0.56	0.84
	7	0.29	0.38	0.48	0.72
4,000	8	0.25	0.34	0.42	0.63
	9	0.22	0.30	0.37	0.56
	10	0.20	0.27	0.34	0.50
	6	0.22	0.30	0.37	0.56
	7	0.19	0.26	0.32	0.48
6,000	8	0.17	0.22	0.28	0.42
	9	0.15	0.20	0.25	0.37
	10	0.13	0.18	0.22	0.34
	6	0.17	0.22	0.28	0.42
	7	0.14	0.19	0.24	0.36
8,000	8	0.13	0.17	0.21	0.31
	9	0.11	0.15	0.19	0.28
	10	0.10	0.13	0.17	0.25

These economic thresholds are 30 percent below the economic injury level.

Figure 24. Corn earworm larvae.

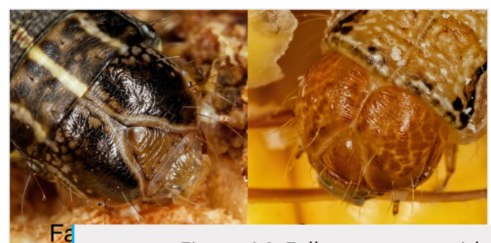

Figure 26. Fall armyworm with characteristic inverted-Y marking (left) and corn earworm (right).

Figure 25. Fall armyworm (top) and corn earworm (bottom).

Figure 27. Fall armyworm.

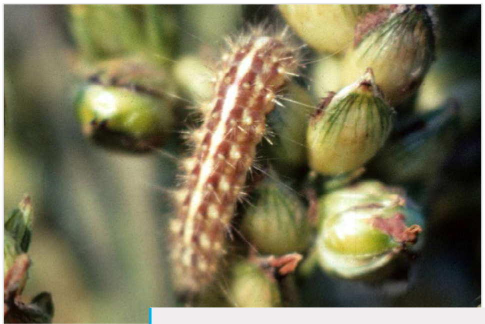

Figure 28. Sorghum webworm.

A single corn earworm can consume 4.65 grams of sorghum grain during its development, but the large larvae (½ inch long or larger) consume the about 80 percent of this total amount. It requires five medium-sized larvae (¼ to ½ inch long), and 68 small larvae (less than ¼ inch long) to consume as much grain as a single large larva.

Scouting: Sampling for headworms is best accomplished using a bucket-sampling technique:

1. Begin sampling for headworms soon after the field finishes flowering. Continue at 5-day intervals until the hard-dough stage. However, if scouting for midges during flowering, it is recommended to sample headworms at the same time to get an idea of headworm egg hatch and pest density potential.
2. Shake grain sorghum heads vigorously into a 2.5- to 5-gallon bucket, where you can easily see and count the larvae.
3. Sample at least 30 plants from a field. In fields larger than 40 acres, take at least one sample per acre.
4. Avoid sampling more than 10 heads into a single bucket sample.
5. Calculate the average number of larvae, by size, per sorghum head, and keep sorghum webworm counts separate.
6. The threshold is based on the number of large larvae, so count five medium corn earworm larvae, five medium fall armyworm larvae, or five sorghum webworm larvae as one large larva. Consider small larvae only if they are extremely abundant (greater than 100).

Control: Many larvae normally die because of environmental conditions, predators, parasites, pathogens, and cannibalism. Although most corn earworm larvae larger than ½ inch will survive to complete development, only about 20 percent of medium-sized larvae (¼ to ½ inch long) survive to large larvae. It is common for small larvae (less than ¼ inch long) to suffer 90 percent mortality.

Table 15. Economic thresholds for the number of large (> 1/2-inch-long) headworms per panicle based on crop yield potential, crop market value, and control cost. Count five medium (1/4- to 1/2-long) corn earworms, five medium (1/4- to 1/2-inch-long) fall armyworms, and five sorghum webworms as one large headworm*.

Crop Yield Potential (lb./Acre)	Value ($/100 lb.)	Control Cost ($/Acre)					
		$6	$8	$10	$15	$20	$25
2,000	6	0.96	1.27	1.59	2.39	3.18	3.98
	7	0.82	1.09	1.36	2.05	2.73	3.41
	8	0.72	0.96	1.19	1.79	2.39	2.99
	9	0.64	0.85	1.06	1.59	2.12	2.65
	10	0.57	0.76	0.96	1.43	1.91	2.39
4,000	6	0.48	0.64	0.80	1.19	1.59	1.99
	7	0.41	0.55	0.68	1.02	1.36	1.71
	8	0.36	0.48	0.60	0.90	1.19	1.49
	9	0.32	0.42	0.53	0.80	1.06	1.33
	10	0.29	0.38	0.48	0.72	0.96	1.19
6,000	6	0.32	0.42	0.53	0.80	1.06	1.33
	7	0.27	0.36	0.45	0.68	0.91	1.14
	8	0.24	0.32	0.40	0.60	0.80	1.00
	9	0.21	0.28	0.35	0.53	0.71	0.88
	10	0.19	0.25	0.32	0.48	0.64	0.80
8,000	6	0.24	0.32	0.40	0.60	0.80	1.00
	7	0.20	0.27	0.34	0.51	0.68	0.85
	8	0.18	0.24	0.30	0.45	0.60	0.75
	9	0.16	0.21	0.27	0.40	0.53	0.66
	10	0.14	0.19	0.24	0.36	0.48	0.60

These values are 70 percent of the economic injury level.
It requires 68 (less than 1/4 inch long) small corn earworm or fall armyworm larvae to equal one large larva. Do not consider small larvae when considering treatment unless extremely abundant.

Insecticides: All insecticides targeting headworms are foliar insecticides. Some insecticides are most effective if targeting small larvae, such as pyrethroids and *Hear*NPV (Heligen). Additionally, some insecticides are species specific. For instance, *Hear*NPV is only effective on corn earworms.

Sorghum webworms and fall armyworms are naturally tolerant to pyrethroids, and pyrethroid resistance is common in corn earworms in Texas.

Insecticides listed for managing headworms in sorghum are presented in Table G in the *Insecticides* section.

Threshold: The economic threshold is based on large larvae, crop yield potential, crop market value, and control cost (Table 15). Count five medium corn earworms, five medium fall armyworm larvae, or five sorghum webworm larvae as one large larva. Consider small larvae only if they are extremely abundant (greater than 100 per panicle).

Stink bugs and leaf-footed bugs

Description: During grain development, stink bugs and leaf-footed bugs can move from alternate host plants into sorghum. These bugs have piercing-sucking mouthparts and feed on developing grain kernels.

There are a number of stink bugs that may be found infesting sorghum, but keep in mind that some stink bugs are beneficial predators.

The adult rice stink bug (*Oebalus pugnax*) is straw colored, shield shaped, and ½ inch long (Fig. 29). This stink bug is very common along the Gulf Coast but can develop high populations in South and Central Texas as well. The female lays about 10 to 40 short, cylindrical-shaped, light-green eggs in a cluster of two rows. The eggs hatch after 5 days. The nymphs require 15 to 28 days to become adults.

Figure 29. Rice stink bug.

Adult southern green stink bugs (*Nezara viridula*) are bright green, shield shaped, and slightly larger than ½ inch long (Fig. 30). The female lays 30 to 130 cream-colored eggs in masses. The eggs hatch after 5 days, and the nymphs require about 32 days to become adults.

Several species of brown stink bugs are also commonly found infesting sorghum in the eastern half of Texas. The most common species of brown stink bug in Texas sorghum is *Euschistus servus* (Fig. 30). The brown stink bug female will lay an average of 60 eggs in about 18 egg masses. The nymphs require about 30 days to become adults.

The conchuela stink bug (*Chlorochroa ligata*) is most common in the western half of Texas but can also occur in Central Texas. The color of this adult stink bug varies from dull olive or ash gray to green, purplish pink, to reddish brown (Fig. 30). The most characteristic markings are orange-red bands along the lateral margins of the thorax and wings and a spot of the same color on the back at the base of the wings.

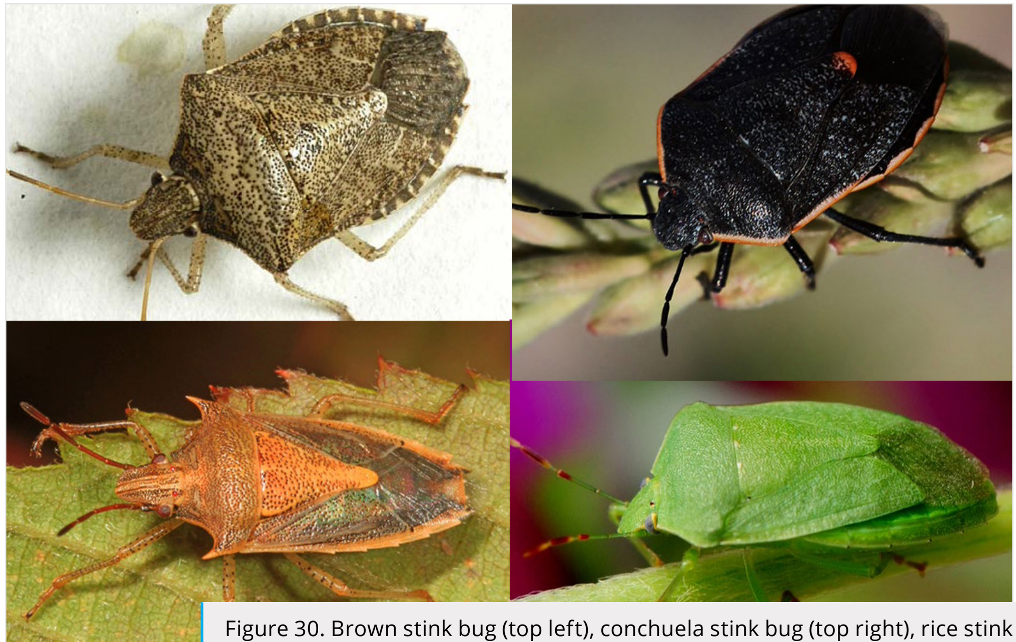

Figure 30. Brown stink bug (top left), conchuela stink bug (top right), rice stink bug (bottom left), and southern green stink bug (bottom right).

The leaf-footed bug (*Leptoglossus phyllopus*) is not a stink bug but damages sorghum similarly to stink bugs. Leaf-footed bugs are common in the eastern half of Texas and are usually most common in late-planted sorghum. Leaf-footed bug adults are brown, oblong, and just longer than ¾ inch. A white band extends across the front wings. The lower part of each hind leg is dilated or leaflike (Fig. 31).

Figure 31. Leaf-footed bug.

Damage: Feeding can reduce grain weight, grain size, and seed germination. The bugs cause more damage during early kernel development and less as the grain develops to the hard-dough stage. Fungi often infect damaged kernels, causing them to turn black and further deteriorate in quality. Damaged kernels rarely develop fully and may be lost during harvest. The extent of damage depends on the species of bug, the number of bugs per grain head, and the stage of kernel development when the infestation occurs. However, the difference among insect species in damage potential is not great, and thus they can be considered equal for management decision purposes. The flowering stage is most sensitive to damage, followed by the milk stage, the soft-dough stage, and lastly, the hard-dough stage. The hard-dough stage is not very sensitive to stink bug and leaf-footed bug feeding. For example, there is no measurable yield impact from as many as 15 rice stink bugs per panicle, but there may be an impact on grain quality.

Insecticides: The only insecticide options for managing grain-feeding bugs are foliar insecticides. Insecticides recommended for treating for stink bugs and leaf-footed bugs are in Table H in the *Insecticides* section. However, rice stink bugs have been found to be resistant to pyrethroids, especially in South Texas and along the Gulf Coast. Additionally, brown stink bugs tend to be more tolerant to pyrethroid insecticides than southern green and conchuela stink bugs.

Scouting: Grain-head-feeding bugs tend to congregate on grain sorghum heads and are often clumped in distribution, most often along the field margins. The beat-bucket technique is the most efficient way to sample for grain-feeding bugs (see *Sampling for headworms* above).

Threshold: For purposes of sampling and computing, thresholds for stink bugs and leaf-footed bugs can be combined into a single count. The economic thresholds are dependent upon the stage of grain development. The thresholds at flowering (Table 16), milk (Table 17), and soft-dough (Table 18) stages are based on all grain-feeding stink bugs and leaf-footed bugs combined, and it is based on crop yield potential, crop market value, and control cost.

Table 16. **Flowering stage**, economic thresholds for the number of **stink bugs and leaf-footed bugs** per panicle.

Crop Yield Potential (lb./Acre)	Value ($/100 lb.)	Control Cost ($/Acre)				
		$6	$8	$10	$12	$15
2,000	6	1.07	1.42	1.78	2.14	2.67
	7	0.92	1.22	1.53	1.83	2.29
	8	0.80	1.07	1.33	1.60	2.00
	9	0.71	0.95	1.19	1.42	1.78
	10	0.64	0.85	1.07	1.28	1.60
4,000	6	0.53	0.71	0.89	1.07	1.33
	7	0.46	0.61	0.76	0.92	1.14
	8	0.40	0.53	0.67	0.80	1.00
	9	0.36	0.47	0.59	0.71	0.89
	10	0.32	0.43	0.53	0.64	0.80
6,000	6	0.36	0.47	0.59	0.71	0.89
	7	0.31	0.41	0.51	0.61	0.76
	8	0.27	0.36	0.44	0.53	0.67
	9	0.24	0.32	0.40	0.47	0.59
	10	0.21	0.28	0.36	0.43	0.53
8,000	6	0.27	0.36	0.44	0.53	0.67
	7	0.23	0.31	0.38	0.46	0.57
	8	0.20	0.27	0.33	0.40	0.50
	9	0.18	0.24	0.30	0.36	0.44
	10	0.16	0.21	0.27	0.32	0.40

These values are 70 percent of the economic injury threshold.

Table 17. **Milk stage**, economic thresholds for the number of **stink bugs and leaf-footed bugs** per panicle.						
Crop Yield Potential (lb./Acre)	Value ($/100 lb.)	Control Cost ($/Acre)				
		$6	$8	$10	$12	$15
2,000	6	1.88	2.50	3.13	3.75	4.69
	7	1.61	2.15	2.68	3.22	4.02
	8	1.41	1.88	2.35	2.82	3.52
	9	1.25	1.67	2.09	2.50	3.13
	10	1.13	1.50	1.88	2.25	2.85
4,000	6	0.94	1.25	1.56	1.88	2.35
	7	0.80	1.07	1.34	1.61	2.01
	8	0.70	0.94	1.17	1.41	1.76
	9	0.63	0.83	1.04	1.25	1.56
	10	0.56	0.75	0.94	1.13	1.41
6,000	6	0.63	0.83	1.04	1.25	1.56
	7	0.54	0.72	0.89	1.07	1.34
	8	0.47	0.63	0.78	0.94	1.17
	9	0.42	0.56	0.70	0.83	1.04
	10	0.38	0.50	0.63	0.75	0.94
8,000	6	0.47	0.63	0.78	0.94	1.17
	7	0.40	0.54	0.67	0.80	1.01
	8	0.35	0.47	0.59	0.70	0.88
	9	0.31	0.42	0.52	0.63	0.78
	10	0.28	0.38	0.47	0.56	0.70

These values are 70 percent of the economic injury threshold.

Table 18. **Soft-dough** stage, economic thresholds for the number of **stink bugs and leaf-footed bugs** per panicle. Hard-dough threshold greater than 15 per panicle.						
Crop Yield Potential (lb./Acre)	Value ($/100 lb.)	Control Cost ($/Acre)				
		$6	$8	$10	$12	$15
2,000	6	3.20	4.26	5.33	6.39	7.99
	7	2.74	3.65	4.57	5.48	6.85
	8	2.40	3.20	4.00	4.80	5.99
	9	2.13	2.84	3.55	4.26	5.33
	10	1.92	2.56	3.20	3.84	4.80
4,000	6	1.60	2.13	2.66	3.20	4.00
	7	1.37	1.83	2.28	2.74	3.43
	8	1.20	1.60	2.00	2.40	3.00
	9	1.07	1.42	1.78	2.13	2.66
	10	0.96	1.28	1.60	1.92	2.40
6,000	6	1.07	1.42	1.78	2.13	2.66
	7	0.91	1.22	1.52	1.83	2.28
	8	0.80	1.07	1.33	1.60	2.00
	9	0.71	0.95	1.18	1.42	1.78
	10	0.64	0.85	1.07	1.28	1.60
8,000	6	0.80	1.07	1.33	1.60	2.00
	7	0.69	0.91	1.14	1.37	1.71
	8	0.60	0.80	1.00	1.20	1.50
	9	0.53	0.71	0.89	1.07	1.33
	10	0.48	0.64	0.80	0.96	1.20
These values are 70 percent of the economic injury threshold.						

Figure 32. False chinch bugs.

False chinch bugs and Lygus bugs

Description: The false chinch bug (*Nysius raphanus*) resembles the chinch bug but is uniformly gray to brown (Fig. 32). False chinch bugs are 1⁄10 inch long. Large numbers of these bugs occasionally migrate from wild hosts, such as wild mustard, to sorghum. However, these insects usually concentrate in small areas of a field.

Lygus bugs (*Lygus* spp.) are oval, tan- to greenish-colored insects that run and fly quickly when disturbed (Fig. 33). The adults can fly into sorghum fields during grain fill and feed on the developing kernels, potentially reducing grain yield and quality.

Figure 33. Lygus bug.

Damage: Similar to stink bugs, false chinch bugs and Lygus bugs feed on the developing kernels with sucking mouthparts, potentially reducing grain yield and quality. However, their damage potential is much lower than the stink bug.

Scouting and control: Sample for false chinch bugs and Lygus bugs using the beat-bucket method described for headworms.

Table 19. Action thresholds for the number of **false chinch bugs and Lygus bugs** per panicle.

Pest	Threshold
False chinch bugs	140 per head until the hard-dough stage. Do not treat beyond the soft-dough stage.
Lygus bugs	12 per head until the hard-dough stage. Do not treat beyond the soft-dough stage.

Insecticides: The only insecticide options for false chinch bugs and Lygus bugs are foliar insecticides. Insecticides targeting stink bugs will control false chinch bugs and Lygus bugs (Table H).

Thresholds: Comprehensive thresholds have not been developed for false chinch bugs or Lygus bugs. However, general action level guidelines are available (Table 19).

Figure 34. Borers that attack sorghum include (from top) Mexican rice borers, neotropical cornstalk borers, and European corn borers.

STALK-BORING INSECTS

Main stalk-boring insects

Description: A number of stalk-boring pests may be found infesting sorghum, including sugarcane borers (*Diatraea saccharalis*), southwestern corn borers (*Diatraea grandiosella*), European corn borers, (*Ostrina nubilalis*), Mexican rice borers (*Eoreuma loftini*), and neotropical borers (*Diatraea lineolata*).

These are all closely related insects that tunnel in the stalks of sorghum, corn, and other crops. The introduction of Bt corn has greatly reduced stem-boring pests to near elimination. Thus, the incidence of treatable infestations of southwestern corn borers and European corn borers are no longer common.

The moths of these pests are white to buff colored, and the females deposit clusters of flattened, elliptical- to oval-shaped eggs that overlap like fish scales in a shingle-like arrangement on the host plant leaves. The eggs hatch in 3 to 7 days.

The larval stage lasts about 25 days, and the pupal stage lasts about 10 days. There are two to three generations a year. The larvae are creamy white and about 1 inch long when fully grown. Most of the body segments have conspicuous round brown or black spots (Fig. 34). The spots on mature overwintering larvae are lighter or absent. Young larvae feed for a few days on the leaves or leaf axis. Older larvae tunnel into the sorghum stalks, boring up and down the pith of the stalk. Most of these borers pass the winter as fully grown larvae in cells inside the stalks that remain after the crop is harvested.

Stem-base and crown borers

Description

Lesser cornstalk borers: The lesser cornstalk borer biology and feeding behavior is different from the main stalk borers. The larvae of lesser cornstalk borers (*Elasmopalpus lignosellus*) attack roots and bore into the stems of young plants of peanuts, corn, sorghum, and other crops. The larvae are light bluish green with prominent transverse reddish-brown bands (Fig. 35). They feed in silken tunnels covered with soil particles. The larvae pupate in silken cocoons under crop debris.

Figure 35. Lesser cornstalk borer.

Figure 36. Sugarcane rootstock weevil.

Sugarcane rootstock weevils: The sugarcane rootstock weevil, *Apinocis (Anacentrinus) deplanatus*, is not a stem-boring caterpillar but a weevil. Therefore, they are very different from the other stem-boring pests of sorghum. The sugarcane weevil infests sorghum sporadically, especially during dry years and in fields where Johnsongrass is abundant. The adult weevil is dark brown or black, about ⅛ inch long and ¹⁄₁₆ inch wide (Fig. 36). It overwinters beneath plant residues on the ground. In early spring, the weevils infest wild grasses, such as Johnsongrass, and later move to sorghum. The female uses its mouthparts to make a small puncture at the base of the plant, where the egg is deposited and concealed. It lays about 16 eggs that hatch in 6 days. When fully grown, the larvae are white, legless grubs about ⅕ inch long. The larvae require 19 to 32 days to complete development. A generation is completed in about 40 days.

All stalk-boring pests

Damage: Borer-infested stalks may be reduced in diameter and yield less. Larval tunneling just below the grain head can cause it to break and fall. Because sorghum is typically planted at high seeding rates, it is not as affected by stem-boring pests as corn is, unless plant populations are low. Damage from stem borers can result in more plant tillering, leading to non-uniform heading and flowering which can make managing head-feeding pests more difficult. Stalk borers can also lead to intensified problems with stalk-rotting plant pathogens and lodging.

The lesser cornstalk borer is primarily a pest of young sorghum plants. The larvae bore into the stem base, killing the main growing point, resulting in a drought-stressed appearance, lodging, and subsequent tillering.

Adult sugarcane rootstalk weevils feed on young sorghum plants and create pinpoint holes in the leaves. The larvae cause the most damage as they tunnel into the sorghum stalk just above or below the soil surface. As a result of larval feeding, the plants appear drought stressed and may lodge.

Table 20. Action thresholds for the number of **stalk-boring insects**, including main stalk borers (e.g., sugarcane borers, southwestern corn borers, European corn borers, Mexican rice borers, and neotropical borers), stem-base borers, and crown borers (e.g., lesser cornstalk borers and sugarcane rootstock weevils).

Pest	Threshold
Main stalk borers	When 25% or more plants have shot-hole feeding damage from stalk-boring larvae and before the larvae have bored into the stalk.
Stem-base and crown borers	
Lesser-cornstalk borers	Rescue treatments are not effective. Must be controlled preventively.
Sugarcane rootstock weevils	When 25% or more plants have shot-hole feeding damage from weevil feeding and adult weevils are easily detectable.

Scouting: Check the plants carefully for stem borers. Look for small holes near the leaf axis, which indicate that a larva has entered the stalk. Once the larvae have entered the stalk, it must be split to see them. Inspect the leaves carefully—the eggs are hard to find. Clusters containing 10 to 20 individual eggs may be on the top or underside of leaves, depending on the borer species. Assess the abundance of eggs and small larvae before the larvae bore into stalks.

Control: Plant sorghum early because borers are typically more abundant in late-planted sorghum. In northern Texas regions, shredding stalks very close to the ground or plowing and disking stubble destroys overwintering larvae of the southwestern corn borer by exposing them to cold temperatures. This practice reduces borer abundance the next year.

Maintaining good soil moisture through irrigation and crop fertility will lessen the impact of stalk-boring pests.

Infestations of lesser cornstalk borers are usually more severe during dry periods and in sandy soils. They are often more severe in sorghum planted behind cereal grains and where conventional tillage is practiced.

To discourage the insect, adopt cultural practices that preserve moisture and increase organic matter in the soil. Early planting and rotation with non-host crops helps avoid damage from the lesser cornstalk borer.

Insecticides: Insecticidal control (Table I) is effective only if it is applied before larvae bore into stalks. Foliar insecticides are the only option for managing the sugarcane borer, southwestern corn borer, European corn borer, Mexican rice borer, and neotropical borer. Due to the difficulty of getting good insecticide coverage with foliar insecticides, they may only provide 50 percent control or less.

Preventive insecticides, such as insecticide seed treatments or insecticides applied at planting, are the best means to prevent infestations and damage from lesser cornstalk borers and sugarcane rootstalk weevils. Rescue treatments are not effective for lesser cornstalk borers. Sugarcane rootstalk weevils can be controlled with foliar applications of pyrethroids. See Table I for a list of insecticide options.

Thresholds: Because of the difficulty in sampling, low damage potential, and difficulty achieving effective control, curative insecticide recommendations are rarely justified. Additionally, no comprehensive thresholds have been developed for these pests, but general action thresholds are presented in Table 20.

INSECTICIDES

Insecticide labels change frequently. Always check labels before using.

Table A. Insecticides labeled for control of wireworms, fire ants, white grubs, and southern corn rootworms in grain sorghum (follow label directions).						
Active Ingredient	Insecticide	Mode of Action	Rate	Remarks	REI[1]	PHI[2]
Seed Treatment						
Clothianidin	Poncho 600, NipsIt Inside	4A	5.1–6.4 fl. oz./100 lb. seed	Fire ants and southern corn rootworms not listed on the label.	12H	—
Imidacloprid	Gaucho 600, generics	4A	6.4 fl. oz./100 lb. seed	Do not graze or harvest for forage within 45 days, and fooder or grain within 100 days of planting. White grubs and southern corn rootworms not listed on the label.	12H	45 days grazing
Thiamethoxam	Cruiser 5FS	4A	5.1–7.6 fl. oz./100 lb. seed	White grubs and southern corn rootworms not listed on the label.	12H	45 days
At-planting Treatment						
Terbufos	Counter 20G Lock n' Load or Smartbox	1B	5.2 oz./1,000 row ft., any row spacing (minimum 20-inch row)	At planting, banded application only. No more than 8.4 lb./A. Restricted use. Fire ants not listed on the label.	48H	Do not graze or harvest forage within 50 days, and fodder or grain within 100 days.

[1] REI = Restricted entry level
[2] PHI = Pre-harvest interval

Table B. Insecticides labeled for control of cutworms in grain sorgum (follow label directions).						
Active Ingredient	Insecticide	Mode of Action	Rate	Remarks	REI[1]	PHI[2]
At-planting Treatment						
Esfenvalerate	Asana XL, generics	3A	5.8–9.6 fl. oz.	May be applied by broadcast at or immediately before planting. Restricted use.	12H	21 days
Post-emergence Treatment						
Alpha-cypermethrin	Fastac	3A	1.3–3.8 fl. oz./A	Restricted use.	—	14 days
Beta-cyfluthrin	Baythroid XL	3A	1.0–1.3 fl. oz./A	Application must be made before cutworms bore into plant. Restricted use.	12H	14 days
Cyfluthrin	Tombstone	3A	1.0–1.3 fl. oz./A	Restricted use.	12H	14 days
Deltamethrin	Delta Gold 1 .5 EC	3A	1.0–1.5 fl. oz./A	To ensure good spray coverage, apply a minimum of 5 GPA by ground and 2 GPA by aircraft. Restricted use. **Danger–Poison.**	12H	14 days
Esfenvalerate	Asana XL	3A	5.8–9.6 fl. oz.	Restricted use.	12H	21 days
Gamma-cyhalothrin	Declare 1.25, Proaxis 0.5	3A	0.77–1.02 fl. oz./A 1.92–2.56 fl. oz./A	To ensure good spray coverage, apply a minimum of 2 GPA by aircraft. Restricted use.	24H	30 days
Lambda-cyhalothrin	Warrior II with Zeon, Karate with Zeon, generics	3A	0.96–1.28 fl. oz./A	To ensure good spray coverage, apply a minimum of 2 GPA by aircraft. Restricted use.	24H	30 days
Lambda-cyhalothrin + chlorantraniliprole	Besiege 1.25 SC	3A, 28	5.0–6.0 oz./A	Do not exceed total of 18 fl. oz./A/yr. Restricted use.	24H	30 days
Zeta-cypermethrin	Mustang Maxx	3A	1.28–4.0 fl. oz./A	Restricted use.	12H	14 days

[1] REI = Restricted entry level
[2] PHI = Pre-harvest interval

Table C. Insecticides labeled for control of aphids, including yellow sugarcane aphids, sorghum aphids, corn leaf aphids, and greenbugs (follow label directions).						
Active Ingredient	Insecticide	Mode of Action	Rate	Remarks	REI[1]	PHI[2]
Seed Treatment						
Clothianidin	Poncho 600, NipsIt Inside	4A	5.1–6.4 fl. oz./ 100 lb. seed	—	12H	—
Imidacloprid	Gaucho 600, generics	4A	6.4 fl. oz./ 100 lb. seed	Do not graze or harvest for forage within 45 days, and fodder or grain within 100 days of planting.	12H	45 days grazing
Thiamethoxam	Cruiser 5FS	4A	5.1–7.6 fl. oz./100 lb. seed	—	12H	45 days
At-planting Treatment						
Terbufos	Counter 20G Lock n' Load or Smartbox	1B	5.2 oz./1,000 row ft. for any row spacing (minimum 20-inch row spacing)	Aphid control on seeding sorghum only. At planting, banded or knifed-in. Do not place granules in direct contact with seed, as crop injury might occur. No more than 8.4 lb./A. Do not use banded applications for aphid control in West Texas. Restricted use.	48H	Do not graze or harvest forage within 50 days, or fodder or grain within 100 days.
Flupyradifurone	Sivanto Prime	4D	6.0–10.0 fl. oz.	In-furrow spray during planting. See 2(ee) label for reduced in-furrow rates.	4H	45 days
Post-emergence Treatment						
Afidopyropen	Sefina	9D	6.0 fl. oz./A	See supplemental label for sorghum.	12H	14 days for grain, 7 days for forage.
Alpha-cypermethrin	Fastac	3A	3.2–3.9 fl. oz./A	Not recommended for sorghum aphids. Restricted use. **Danger–Poison.**	12H	14 days
Dimethoate	Dimethoate 400, Dimethoate 4EC, Dimethoate 2.67	1B	0.5–1.0 pt./A 0.75–1.5 pt./A	Restricted use. Not recommended for sorghum aphids.	48H	28 days
Flupyradifurone	Sivanto Prime	4D	4.0–7.0 fl. oz./A	See 2(ee) label for reduced rates.	4H	21 days See 24(c) label for 14-day PHI for sorghum aphid.
Sulfoxaflor	Transform WG	4C	0.75–1.5 oz./A	—	24H	14 days for grain, 7 days for forage.

[1] REI = Restricted entry level
[2] PHI = Pre-harvest interval

Table D. Insecticides labeled for control of chinch bugs (follow label directions).						
Active Ingredient	Insecticide	Mode of Action	Rate	Remarks	REI[1]	PHI[2]
Seed Treatment						
Clothianidin	Poncho 600, NipsIt Inside	4A	5.1–6.4 fl. oz./ 100 lb. seed	—	12H	—
Imidacloprid	Gaucho 600, generics	4A	6.4 fl. oz./ 100 lb. seed	Early season suppression. Do not graze or harvest for forage within 45 days, and fodder or grain within 100 days of planting.	12H	45 days grazing
Thiamethoxam	Cruiser 5FS	4A	5.1–7.6 fl. oz./ 100 lb. seed	—	12H	45 days
In-furrow at Planting						
Terbufos	Counter 20G Lock n' Load or Smartbox	1B	5.2 oz./1,000 row ft. for any row spacing (minimum 20-inch row spacing)	At planting, banded or knifed-in. Do not place granules in direct contact with seed, as crop injury might occur. No more than 8.4 lb./A. Restricted use.	48H	Do not graze or harvest forage within 50 days, or fodder or grain within 100 days.
Post-emergence Treatment						
Carbaryl	Carbaryl 4L Sevin XLR Plus	1A	1–2 qt./A	For best results, use high gallonage ground application at the base of plants.	12H	21 days harvest, 14 days grazing.
Beta-cyfluthrin	Baythroid XL	3A	2.0–2.8 fl. oz./A	Restricted use.	12H	14 days
Cyfluthrin	Tombstone	3A	2.0–2.8 fl. oz./A	Use 20 to 30 GPA. Direct sprays toward infested areas. Restricted use.	12H	14 days
Deltamethrin	Delta Gold 1.5 EC	3A	1.3–1.9 fl. oz./A	Restricted use. **Danger–Poison.**	12H	14 days
Esfenvalerate	Asana XL, generics	3A	5.8–9.6 oz./A	Spray should be directed at base of plants. Restricted use.	12H	21 days
Gamma-cyhalothrin	Declare, Proaxis	3A	1.54 fl. oz./A 3.83 fl. oz./A	Restricted use.	24H	30 days
Lambda-cyhalothrin	Warrior II with Zeon, Karate with Zeon, generics	3A	1.92 fl. oz./A	Begin applications when bugs migrate from small grains or grass weeds to small sorghum. Direct spray to the base of sorghum plants. Repeat applications at 3- to 5-day intervals if needed. Restricted use.	24H	30 days
Lambda-cyhalothrin + chlorantraniliprole	Besiege 1.25 SC	3A, 28	10 fl. oz./A	Direct spray to the base of sorghum plants. Do not exceed total of 18 fl. oz./A per year. Restricted use.	24H	30 days
Zeta-cypermethrin	Mustang Maxx, generics	3A	3.2–4.0 fl. oz./A	Begin applications when bugs migrate from small grains to grass weeds to small sorghum. Direct spray to the base of sorghum plants. Repeat applications at 3- to 5-day intervals if needed. Restricted use.	12H	14 days

[1] REI = Restricted entry level
[2] PHI = Pre-harvest interval

Table E. Miticides labeled for control of two-spotted spider mites and Banks grass mites (follow label directions).						
Active Ingredient	Insecticide	Mode of Action	Rate	Remarks	REI[1]	PHI[2]
Post-emergence Treatment						
Hexythiazox	Onager 1.0 EC	10A	10–24 fl. oz./A	Apply Onager before mites build up. Use higher rates on moderate to high might infestations or for larger plants with a dense canopy. 15 to 20 GPA recommended for ground application. Chemigation is labeled. Do not apply more than once a year.	12H	30 days
Propargite	Comite II	12C	24–36 fl. oz./A	Apply only to dry foliage. Do not tank-mix with other products or use oil-based surfactants. Use at least 20 GPA for ground applications and 5 GPA for aerial application. Treating a test plot is recommended to check for phytotoxicity before treating a large area. Restricted use.	13 days	30 days for silage; 60 days for grain harvest.

[1] REI = Restricted entry level
[2] PHI = Pre-harvest interval

Table F. Insecticides labeled for control of sorghum midges in grain sorghum (follow label directions).						
Active Ingredient	Insecticide	Mode of Action	Rate	Remarks	REI[1]	PHI[2]
Post-emergence Treatment						
Alpha-cypermethrin	Fastac	3A	1.3–3.8 fl. oz./A	Restricted use. **Danger–Poison.**	12H	14 days
Beta-cyfluthrin	Baythroid XL	3A	1.0–1.3 fl. oz./A	Restricted use.	12H	14 days
Cyfluthrin	Tombstone	3A	1.0–1.3 fl. oz./A	Restricted use.		
Deltamethrin	Delta Gold 1.5 EC	3A	1.3–1.9 fl. oz./A	Restricted use. **Danger–Poison.**		
Esfenvalerate	Asana XL, generics	3A	2.9–5.8 fl. oz./A	Restricted use.		
Gamma-cyhalothrin	Declare 1.25, Proaxis 0.5	3A	0.77–1.02 fl. oz./A 1.92–2.56 fl. oz./A	Restricted use.		
Lambda-cyhalothrin	Warrior II with Zeon, Karate with Zeon, generics	3A	0.96–1.28 fl. oz./A	Restricted use.		
Lambda-cyhalothrin + chlorantraniliprole	Besiege	3A	5.0–6.0 fl. oz./A	Do not exceed total of 18 fl. oz./A per year. Restricted use.		
Spinosad	Blackhawk	3A, 28	1.5–3.3 fl. oz./A	See 2(ee) label for midges. For low to moderate midge infestations.		
Methomyl	Lannate LV, Lannate SP, generics	5	0.75–1.0 pt./A 0.25–0.5 lb./A	Do not use methomyl on sweet sorghum varieties. For SP, use a minimum of 10 GPA by ground or 2 GPA by air. Restricted use. **Danger–Poison.**	48H	14 days
Zeta-cypermethrin	Mustang Maxx, Respect	1A	1.28–4.0 fl. oz./A	Restricted use.	12H	14 days

[1] REI = Restricted entry level
[2] PHI = Pre-harvest interval

Table G. Suggested insecticides for control of the headworm complex in grain sorghum (follow label directions).						
Active Ingredient	Insecticide	Mode of Action	Rate	Remarks	REI[1]	PHI[2]
Post-emergence Treatment						
Alpha-cypermethrin	Fastac	3A	1.3–3.8 fl. oz./A	Restricted use. **Danger–Poison.**	12H	14 days
Beta-cyfluthrin	Baythroid XL	3A	1.3–2.8 fl. oz./A	First and second instar (< ¼ in. long). Restricted use.	12H	14 days
Carbaryl	Sevin XLR Plus	1A	1–2 qt./A	Bee caution: Do not apply this product to target crops or weeds in bloom.	12H	21 days
Chlorantraniliprole	Vantacor, Shenzi 400SC	28	1.2–2.5 fl. oz./A 1.7–3.8 fl. oz/A	—	4H	1 day
Deltamethrin	Delta Gold 1.5EC	3A	1.0–1.5 fl. oz./A	Apply at least 2 GPA by aircraft or 5 GPA by ground. Restricted use. **Danger–Poison.**	12H	14 days
Esfenvalerate	Asana XL, generics	3A	5.8–9.6 fl. oz./A	Used for earworms on heads only. Restricted use.	12H	21 days
Gamma-cyhalothrin	Declare 1.25, Proaxis 0.5	3A	1.02–1.54 fl. oz./A 2.56–3.84 fl. oz./A	Use higher rates for large larvae. Restricted use.	24H	30 days
*Hear*NPV	Heligen	31	0.7–1.4 fl. oz./A	Only effective on corn earworms. Use lower application rates when targeting larvae smaller than 0.3 inches long (first and second instar) and in mixtures with sprays for midge control (not ULV). Use higher application rates when targeting larvae larger than 0.3 inches long (third instar) or under high-pressure situations. Time applications when 50% of heads have reached 100 percent flowering for optimal control.	4H	0 days
Lambda-cyhalothrin	Warrior II with Zeon, Karate with Zeon, generics	3A	1.28–1.92 fl. oz./A	Restricted use.	24H	30 days
Lambda-cyhalothrin + chlorantraniliprole	Besiege 1.25 SC	3A, 28	6.0–10.0 oz./A	Use higher rate range for large larvae. Do not exceed a total of 18 fl. oz./A per year. Restricted use.	24H	30 days
Methomyl	Lannate LV, Lannate SP	1A	0.75–1.5 pt./A 0.25–0.05 lb./A	Do not use on sweet sorghum varieties. Restricted use. **Danger–Poison.**	48H	14 days
Novaluron	Diamond	15	6.0–12.0 fl. oz./A	Fall armyworms only. See label.	12H	7 days for forage, 14 days for grain and stover.
Spinosad	Blackhawk	5	1.7–3.3 fl. oz./A	Apply to coincide with peak egg hatch or small larvae. Use a higher rate range for heavy infestations, advanced growth stages of target pests, or difficult spray coverage situations.	4H	21 days
Zeta-cypermethrin	Mustang Maxx, generics	3A	1.76–4.0 fl. oz./A	Restricted use.	12H	14 days

[1] REI = Restricted entry level

[2] PHI = Pre-harvest interval

Resistance to pyrethroids (products with only mode of action 3A) in corn earworms has been reported from some areas. If resistance is present, applying pyrethroids can result in poor control of corn earworms, especially when the larvae are larger than 1/4 inch (second instar). Also, pyrethroids are not recommended for fall armyworms larger than 1/4 inch.

Prethroids are not recommended for sorghum webworms.

Table H. Insecticides labeled for control of stink bugs, leaf-footed bugs, false chinch bugs, and Lygus bugs in grain sorghum (follow label directions).						
Active Ingredient	Insecticide	Mode of Action	Rate	Remarks	REI[1]	PHI[2]
Post-emergence Treatment						
Alpha-cypermethrin	Fastac	3A	1.3–3.8 fl. oz./A	Restricted use. **Danger–Poison.**	12H	14 days
Beta-cyfluthrin	Baythroid XL	3A	1.3–2.8 fl. oz./A	First and second instar (< ¼ in. long). Restricted use.	12H	14 days
Cyfluthrin	Tombstone 2	3A	1.3–2.8 fl. oz./A	Restricted use.	12H	14 days
Deltamethrin	Delta Gold	3A	1.5–1.9 fl. oz./A	Not labeled for false chinch bugs. Restricted use. **Danger–Poison.**	12H	14 days
Gamma-cyhalothrin	Declare, Proaxis	3A	1.02–1.54 fl. oz./A 2.56–3.84 fl. oz./A	Use higher rates for large larvae. Restricted use.	24H	30 days
Lambda-cyhalothrin	Warrior II with Zeon, Karate with Zeon, generics	3A	1.28–1.92 fl. oz./A	Apply no more than 6 oz. of *lambda*-cyhalothrin-containing products once the crop has reached soft-dough stage. Not labeled for false chinch bugs. Restricted use.	24H	30 days
Lambda-cyhalothrin + chlorantraniliprole	Besiege 1.25 SC	3A, 28	6.0–10.0 oz./A	Do not exceed total of 18 fl. oz./A per year. Apply no more than 6 oz. of *lambda*-cyhalothrin-containing products once the crop has reached soft-dough stage. Not labeled for false chinch bugs. Restricted use.	24H	30 days
Zeta-cypermethrin	Mustang Maxx, generics	3A	1.76–4.0 fl. oz./A	Restricted use.	12H	14 days

[1] REI = Restricted entry level
[2] PHI = Pre-harvest interval

Table I. Suggested insecticides for control of stalk borers, including southwestern corn borers, European corn borers, Mexican rice borers, sugarcane borers, neotropical borers, lesser cornstalk borers, and sugarcane rootstock weevils in grain sorghum (follow label directions).

Active Ingredient	Insecticide	Mode of Action	Rate	Remarks	REI[1]	PHI[2]
Seed Treatment (active only on the lesser cornstalk borer and sugarcane rootstalk weevil)						
Clothianidin	Poncho 600, NipsIt Inside 5, NipsIt Inside 5 F	4A	5.1–6.4 fl. oz./100 lb. seed	Lesser cornstalk borers and sugarcane rootstalk weevils not listed on label.	12H	—
Imidacloprid	Gaucho 600, generics	4A	6.4 fl. oz./100 lb. seed	Lesser cornstalk borers and sugarcane rootstalk weevils not listed on label. Do not graze or harvest for forage within 45 days, and fodder or grain within 100 days of planting.	12H	45 days, grazing
Thiamethoxam	Cruiser 5FS	4A	5.1–7.6 fl. oz./100 lb. seed	Lesser cornstalk borers and sugarcane rootstalk weevils not listed on label.	12H	45 days
In-furrow at Planting (active only on the lesser cornstalk borer and sugarcane rootstalk weevil)						
Terbufos	Counter 20G, Lock n' Load, or Smartbox	1B	5.2 oz./1,000 row ft. for any row spacing (minimum 20-inch row spacing)	At planting, banded or knifed-in. Do not place granules in direct contact with seed, as crop injury might occur. No more than 8.4 lb./A. Restricted use. Lesser cornstalk borer and sugarcane rootstalk weevil not listed on label.	48H	Do not graze or harvest forage within 50 days, or fodder or grain within 100 days.
Post-emergence Treatment (not effective toward the lesser cornstalk borer)						
Alpha-cypermethrin	Fastac	3A	1.3–3.8 fl. oz./A	Restricted use. **Danger–Poison.** Mexican rice borers, sugarcane borers, neotropical borers, and sugarcane stock weevils not listed on label.	12H	14 days
Beta-cyfluthrin	Baythroid XL	3A	1.3–2.8 fl. oz./A	Restricted use.	12H	14 days
Carbaryl	Sevin XLR Plus	1A	1–2 qt/A	Bee caution: Do not apply this product to target crops or weeds in bloom. Only southwestern corn borer listed on label.	12H	21 days
Chlorantraniliprole	Vantacor Shenzi 400SC	28	1.2–2.5 fl. oz./A 1.7–3.8 fl. oz/A	Not effective on sugarcane rootstock weevils. Neotropical borers, sugarcane borers, and lesser cornstalk borers not listed on label.	4H	1 day
Deltamethrin	Delta Gold 1.5 EC	3A	1.0–1.5 fl. oz./A	Apply at least 2 GPA by aircraft or 5 GPA by ground. Restricted use. **Danger–Poison.** Neotropical borers and sugarcane rootstalk weevils are not listed on label.	12H	14 days
Gamma-cyhalothrin	Declare 1.25, Proaxis 0.5	3A	1.02–1.54 fl. oz./A 2.56–3.84 fl. oz./A	Restricted use. Neotropical borers and sugarcane rootstalk weevils not listed on label.	24H	30 days
Lambda-cyhalothrin	Warrior II with Zeon, Karate with Zeon, generics	3A	1.28–1.92 fl. oz./A	Restricted use. Neotropical borersand sugarcane rootstalk weevils not listed on label.	24H	30 days
Lambda-cyhalothrin + chlorantraniliprole	Besiege 1.25 SC	3A, 28	6.0–10.0 oz./A	Restricted use. Neotropical borers and sugarcane rootstalk weevils not listed on label.	24H	30 days
Spinosad	Blackhawk	5	1.7–3.3 fl. oz./A	Only southwestern corn borers listed on the label.	4H	21 days

[1] REI = Restricted entry level
[2] PHI = Pre-harvest interval
All insecticide applications must be made prior to the larvae boring into the stalk.
Insecticide labels for stalk borers do not list all borers that may be encountered, so verify the species and check the label before applying.

POLICY STATEMENT FOR PEST MANAGEMENT SUGGESTIONS

The information and suggestions in this publication reflect the opinions of Extension entomologists based on research and experience. However, it is impossible to eliminate all risk. Conditions or circumstances that are unforeseen or unexpected may result in less-than-satisfactory results, even when these suggestions are used. The Texas A&M AgriLife Extension Service will not assume responsibility of risks. The user of this publication shall assume such risks.

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 produced.

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 carefully follow the directions on the container label.

WORKER PROTECTION STANDARD

The Worker Protection Standard (WPS) is a set of federal regulations that applies to all pesticides used in agricultural plant production. If you employ anyone to produce a plant or plant product for sale and apply any type of pesticide to that crop, WPS applies to you. The regulations require that you protect your employees from pesticide exposure.

You must inform employees about exposure, protect them from exposure, and mitigate pesticide exposures that they may receive. WPS requirements appear in the "Directions for Use" section of the pesticide label. For more information, see the online Worker Protection Standard 40 CFR part 170, visit the website of the Texas Department of Agriculture's Pesticide Worker Protection Program, or contact the department at (512)463-7476 or pesticides@TexasAgriculture.gov.

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FIGURE CREDITS

3 (top) Click beetle, **21** (top) Banks grass mite (*Oligonychus pratensis*) (Banks), Frank Peairs, Colorado State University, Bugwood.org (CC BY 3.0 US)

3 (bottom) David Kerns, Texas A&M AgriLife Extension Service

3 (middle), **9, 15** (right), **16** (right and center), **22** (top), **24, 25, 26, 29** Pat Porter, Texas A&M AgriLife Extension Service

4 Monti Vandiver, formerly of Texas A&M AgriLife Extension Service

5 (from top) spotted cucumber beetle (*Diabrotica undecimpunctata*) Mannerheim, 1843, John Capinera, University of Florida, Bugwood.org (CC BY-NC 3.0 US)

7 Cutworms, loopers, owlet moths, and underwings, Clemson University – USDA Cooperative Extension Slide Series, Bugwood.org (CC BY 3.0 US)

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21 (bottom) Two-spotted spider mite females with egg, Gilles San Martin (CC BY-SA 2.0)

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27 Fall armyworm, Russ Ottens, University of Georgia, Bugwood.org (CC BY 3.0 US)

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33 Tarnished plant bug, Big Thicket National Preserve, Kountze, Texas, Judy Gallagher (CC BY 2.0)

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