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# The Sugarcane Aphid: Management Guidelines for Grain and Forage Sorghum in Texas

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The sugarcane aphid (SCA) is currently one of the most important insect pests of grain and forage sorghum in Texas. Until recently the SCA fed only on sugarcane in the US, but in 2013, it was found feeding on sorghum near Beaumont, TX. This sorghum-feeding SCA biotype developed because of a genetic change in the existing US population or was introduced into the US from elsewhere. In 2013, the sugarcane aphid was also found in sorghum in the Rio Grande Valley and the Texas Gulf Coast as well as in north Texas, southern Oklahoma, Louisiana, and Mississippi.

Sugarcane aphids survived the 2013 winter in south Texas and spread throughout much of Texas and 12 other southern states during the spring and summer of 2014. In 2015, the SCA spread through Texas into Oklahoma and Kansas, eventually infesting 17 states. This area encompasses 90 percent of the US sorghum acreage.

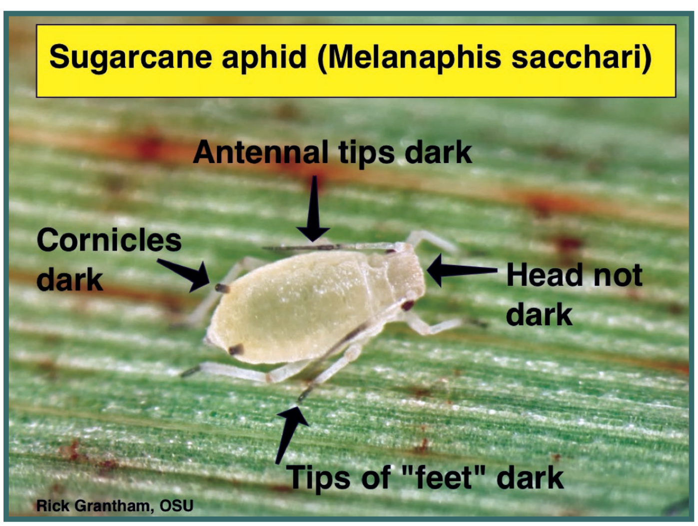


**Figure 1.** Sugarcane aphid

**Figure 2.** A colony of several hundred sugarcane aphids

This pest can be economically controlled to prevent crop loss and harvest difficulties associated with the honeydew it creates. However, to control SCA effectively, growers must assess infestations frequently and use that information to properly time any needed insecticide applications. SCA resistant hybrids are being developed and will play an important part in managing the sugarcane aphid. These resistant hybrids, along with selective insecticides and beneficial insects, are all important components of an integrated pest management program for sugarcane aphid.

## Identification and feeding habits

Sugarcane aphids are pale yellow, gray, or tan. The cornicles or "tailpipes," feet, and antennae are black (Fig. 1). The SCA feeds on the underside of sorghum leaves and though initial colonies consist of just a few aphids, they can eventually cover much of the lower leaf surface (Fig. 2). These aphids do not feed on the upper leaf surface. They produce large amounts of honeydew, which collects on the tops of leaves below, making them sticky and shiny. When scouting for aphids, the shiny honeydew can help you detect them. Sugarcane aphids can also move into the panicle.

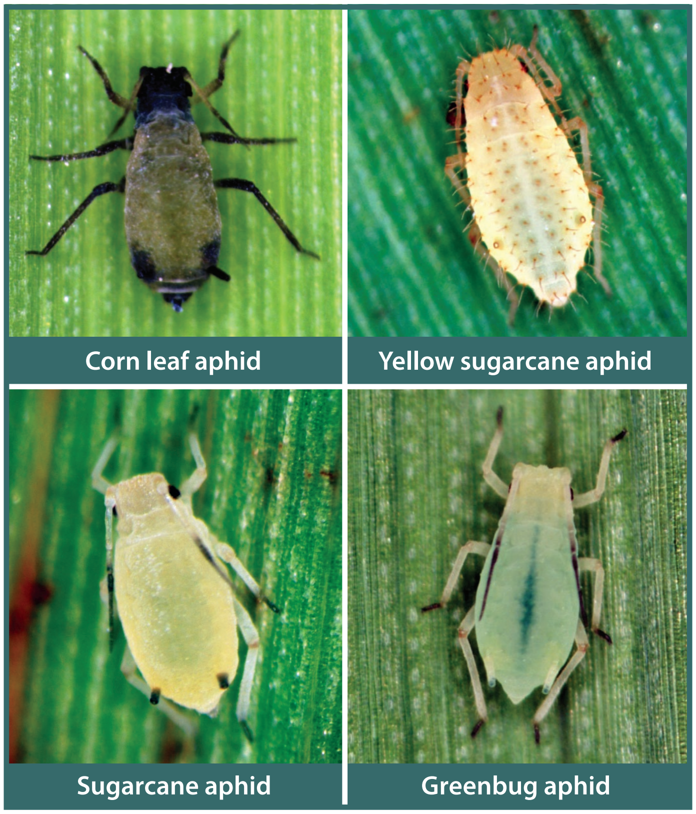


**Figure 3.** Aphid species that affect grain sorghum.

The greenbug is another aphid that feeds on the underside of sorghum leaves (Fig. 3). Unlike the sugarcane aphid however, it has a dark green stripe down its back. The corn leaf aphid is also found in sorghum, but it is dark green, feeds in the whorl of the sorghum plant, and is rarely a pest (Fig. 3). The yellow sugarcane aphid, which also feeds on sorghum, is bright yellow with rows of dark spots and many long hairs and does not produce honeydew (Fig.3).

## Life cycle

All SCA are females and give birth to live young (Fig 4). Immature aphids develop into adults in about five days and adults live for about four weeks. Aphid populations can increase rapidly during the summer. At Corpus Christi, an infestation of 50 SCA per leaf increased to 500 per leaf in 2 weeks. For this reason, once SCA are found, the field they are in should be monitored 1 to 2 times a week. This monitoring will help you determine if an infestation exceeds the treatment threshold and, if it does, when to consider applying an insecticide. Warm dry weather is optimal for aphid reproduction; under these conditions, it is advisable to scout infested fields twice a week.

**Figure 4.** Immature sugarcane aphids

During the winter, small colonies of SCA can be found on Johnsongrass and volunteer sorghum, which remain green throughout the winter in the Rio Grande Valley, the Gulf Coast of Texas, and in northern Mexico. Little is known about the SCA's ability to overwinter in north Texas. However, small colonies found in Hill County on Johnsongrass in late February, suggest that SCA can sometimes overwinter as far north as central Texas.

**Figure 5.** Winged sugarcane aphid

As SCA colonies become crowded and/or food quality declines, winged adults begin to appear (Fig. 5). These aphids are weak fliers, but the wind can carry them across long distances. It is believed that each spring, winds carry winged SCA from Mexico and south Texas to north Texas and then from field to field during the growing season.

## Host plants

Sugarcane aphids feed and reproduce on grain and forage sorghums, including Sudan grass, sorghum/Sudan hybrids, and Johnsongrass. All of these hosts are in the genus *Sorghum*. Laboratory tests show that SCA does not survive on wheat, oats, or on seedling foxtail millet or proso millet. Though hybrid pearl millet is not a species of Sorghum, small colonies of SCA are sometimes present but usually cause little damage. Hybrid pearl millet is a poor host of SCA. Winged SCA may be found on other crops, such as corn, but they establish only small colonies, if at all, and soon die out without damaging the crop. The sugarcane aphid also feeds on sugarcane in the Rio Grande Valley, but populations usually do not reach the numbers observed in sorghum.

## Damage

Sugarcane aphids feed by sucking plant sap, but there is no evidence of them injecting a toxin. Feeding causes leaves to turn yellow, purple, and then brown as the leaf tissue dies (Fig 6). Infestations on preboot sorghum can cause significant grain loss, but infestations present during grain development can also reduce yields. Large infestations can stunt the plant's growth and cause uneven panicle emergence from the boot. Infestations in forage sorghums also kill leaves, slow growth, and reduce forage yields.

The sticky leaves and stalks clog combines at harvest and reduce separation of the grain from the plants. Combines may require service time to wash off the honeydew and remove sorghum plants. Honeydew contamination can also gum up cutter bars and other machinery at harvest.

Honeydew contains primarily plant sugars and water and eventually dries to a harmless residue. However, a black sooty mold often grows on the honeydew on leaves. This mold inhibits light absorption needed for photosynthesis and may reduce the effectiveness of insecticides and harvest aid chemicals. Sorghum stressed by SCA feeding may be more susceptible to stalk rots, and lodging frequently occurs following heavy plant damage due to aphid feeding.

## Sampling SCA infestations in grain sorghum

Begin looking for sugarcane aphids when plants are in the four- to five-leaf stage. Mild winters increase the possibility of early infestations. The first-detection sampling plan detailed below is designed to determine if sugarcane aphids are present. This sampling does not require you to count aphids. If you find SCA, then you must begin the second sampling protocol to determine if the infestation has reached the action threshold. If it has, you should then apply insecticide to protect crop yield.

## First detection: Is the field at risk?

1. Once a week, walk at least 25 feet into the field and examine plants along 50 feet of row.
2. If honeydew is present, look for sugarcane aphids on the underside of a leaf above the honeydew.
3. Inspect the underside of leaves from the upper and lower canopy from 15 to 20 plants per location.
4. Sample each side of the field as well as sites near Johnsongrass and tall mutant plants.
5. Check at least four locations per field for a total of 60 to 80 plants.
6. If no sugarcane aphids are present, or only a few wingless or winged aphids are on upper leaves, then continue once-a-week scouting.

If sugarcane aphids are found on lower or mid-canopy leaves, begin twice-a-week scouting. Use one of the two thresholds below to determine if aphid densities exceed the treatment threshold and if an insecticide treatment is needed to protect yield.

## Making a treatment decision

Two action thresholds, the South-Central Texas economic threshold and the Texas High Plains grain sorghum action threshold, are presented below to help you determine when an insecticide treatment is needed to protect yield.

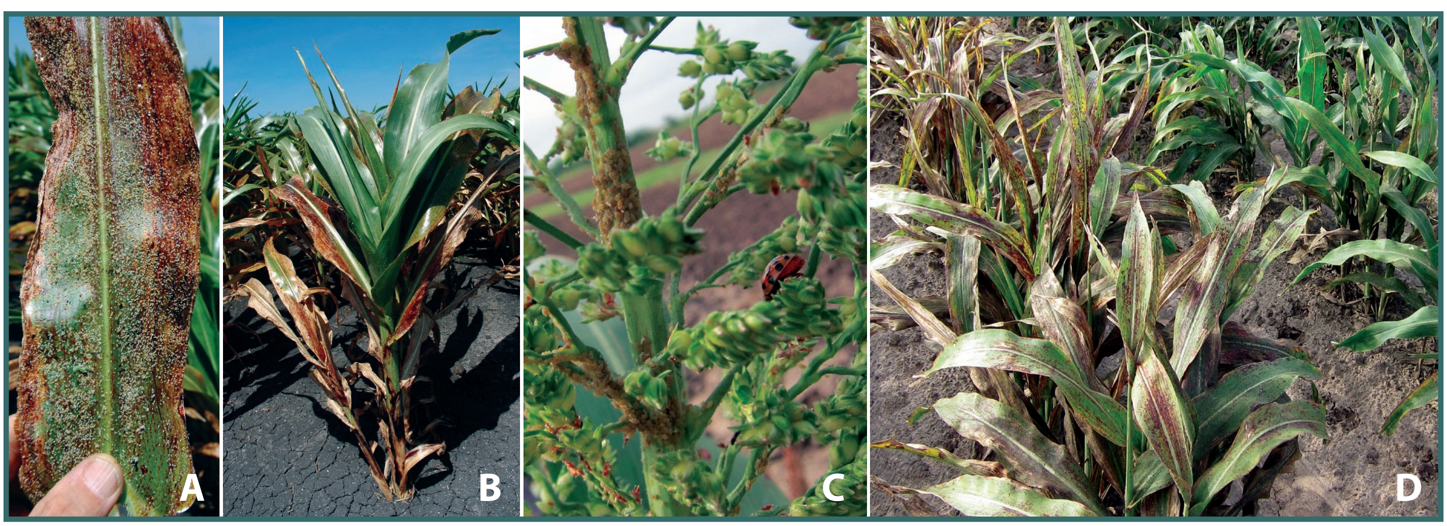

**Figure 6.** Sorghum leaf damaged by sugarcane aphid (A), plant damage and honeydew accumulation due to sugarcane aphid (B), sugarcane aphid feeding in the panicle (C), and research plot showing sugarcane aphid damage on a susceptible hybrid (left) and in the adjacent row a hybrid with some resistance to sugarcane aphid (D).

# South-Central Texas Economic Threshold

The South-Central Texas economic threshold is based on the number of aphids per leaf during the preboot (whorl) and boot stage.

## Field sampling protocol

Once sugarcane aphids are found in a field, use the following steps to assess the infestation.

1. Examine the underside of one completely green leaf from the lower canopy and the upper most leaf (or leaf below the flag leaf at boot to heading). Estimate and record the number of SCA per leaf[a].
2. Examine two leaves from each of five randomly selected plants for a total of 10 leaves per location.
3. Repeat at four locations for a total of 40 leaves per field.
4. Calculate the average number of aphids per leaf for the field (total aphids counted/total leaves inspected).

[a] Because counting exact numbers of aphids per leaf is impractical, the scouting sugarcane aphid estimation tool has been developed and is available at http://ccag.tamu.edu/sorghum-insect-pests/ under Quick Information Sheets and Guides.

## Economic threshold

1. If the field average is 50 to 125 sugarcane aphids per leaf (Fig. 7) or greater, apply an insecticide within four days and evaluate control after three to four days. Refer to insecticide labels for re-entry intervals. Continue to monitor SCA infestations until harvest to determine if a second insecticide application is necessary.

**Figure 7.** Leaf with 50 aphids/leaf

2. Consider treatment at 50 aphids per leaf if you are limited to once-a-week scouting or if the weather is warm and dry.
3. If the field average is less than the threshold level, continue scouting twice a week.

The economic threshold of 50 to 125 aphids per leaf is based on the potential yield loss if SCA is not controlled, the cost of control, and the expected market value of the crop. Economic thresholds for different control costs (insecticide and application) and the market value are shown in Table 1. For example, if the cost of control is 15 dollars per acre and the market value is 5 dollars per bushel, then the treatment threshold is an average of 70 or more SCA per leaf.

**Table 1. Economic thresholds for sugarcane aphid infestations. An insecticide treatment should be considered when the average number of sugarcane aphids per leaf exceeds the value in the table.**

| Market value of crop | Cost of control = \$12/acre | Cost of control = \$15/acre | Cost of control = \$20/acre |
|---|---|---|---|
| \$3.50/bushel, \$6.25/cwt | 75 | 100 | 125 |
| \$5.00/bushel, \$8.93/cwt | 50 | 70 | 100 |
| \$6.50/bushel, \$11.60/cwt | 50 | 50 | 70 |

These values are applicable to grain sorghum and infestations starting at or before boot stage. Infestations during grain fill can greatly reduce harvest efficiency due to honeydew contamination and can result in severe stalk lodging. During grain fill, monitor SCA infestations and damage to upper leaves and movement of aphids into the panicle to determine the need for an insecticide.

# Texas High Plains Action Threshold

The Texas High Plains action threshold uses aphid counts and percentage of plants infested with SCA to make a treatment decision. It varies with crop development and was used successfully in 2015 in west Texas and is appropriate for pre-boot (whorl) through flowering and grain-fill stages.

## Field sampling protocol

Once sugarcane aphids are found in a field, use the following protocol to assess the infestation.

1. Walk 25 feet into the field and examine the underside of green leaves from the lower canopy to the uppermost leaf for aphids. Watch for honeydew that indicates aphids on the leaf above.
2. Record the number of plants infested with any aphids. Also, record the number of uninfested plants.
3. Examine a minimum of 10 plants at four locations across the field. Calculate the percentage of plants infested (divide the number of plants with any

aphids by the total number of plants examined and multiply by 100).

4. If grain sorghum is in the whorl, boot or flowering-milk stage, estimate the number of aphids per leaf. At these growth stages, it is critical to treat before aphid numbers exceed 100 per leaf.

**Table 2. West Texas grain sorghum action threshold**

| Growth stage | Decision threshold specific to the sugarcane aphid |
|---|---|
| **Preboot** | 20% of plants with presence of aphids |
| **Boot** | 20% of plants infested with 50 aphids per leaf |
| **Flowering - milk** | 30% of plants infested with 50 aphids per leaf |
| **Soft dough** | 30% of plants infested, localized areas with heavy honeydew, and established aphid colonies |
| **Dough** | 30% of plants infested, localized areas with heavy honeydew, and established aphid colonies |
| **Black Layer** | • Heavy honeydew and established aphid colonies<br>• Treatment only for preventing harvest problems<br>• Important to observe preharvest intervals |

This threshold was revised from a threshold originally from Mississippi State University.

## Control options after first application

- Check fields for control after 4 to 7 days.
- If poor control and aphid colonies of 50 or more per leaf are still present, repeat application.
- If there was good control of the aphid, continue scouting fields twice a week for re-infestation or a rapid increase in aphid numbers.
- For whorl to early dough growth stages, use the **Grain Sorghum Action Threshold** for any second applications.
- From dough to late dough growth stages, a second application may be required when aphids are re-establishing, 40 to 50 percent of the total leaf area has aphid damage, and predator populations are not suppressing aphid populations.
- At black layer growth stage through harvest, an application may be required to prevent harvest problems.

## Insecticides

Sivanto 200SL insecticide has a Section 2(ee) label for use on grain and forage sorghum to control sugarcane aphid. Transform WG insecticide has a Section 18 Emergency Exemption label for control of sugarcane aphid in grain and forage sorghum in Texas. This label expires April 8, 2017. Information below is for educational purposes. Read and follow label directions.

**Table 3. Sivanto 200SL and Transform WG**

| | Sivanto 200SL | Transform WG |
|---|---|---|
| Use rate for sugarcane aphid | 4–7 oz / acre | 0.75–1.5 oz/acre |
| Minimum interval between applications | 7 days | 14 days |
| Minimum application volume | 10 GPA by ground<br>2 GPA by air | 5–10 GPA by ground.<br>3 GPA by air (5 recommended) |
| Pre-harvest interval | 21 days* for dried grain or straw or stover<br>7 days for grazing, forage, fodder or hay harvest | 14 days of grain or straw harvest or within 7 days of grazing or forage, fodder or hay harvest |
| Restricted entry | 4 hours | 24 hours |
| Restrictions | Sivanto is toxic to bees in laboratory studies via oral exposure, however, not toxic to bees through contact exposure, and field studies have shown no effects on honeybee colony development. | **Do not apply 3 days or less pre-bloom until after seed set.** Transform is highly toxic to bees exposed through contact during spraying and while droplets are still wet. Transform may be toxic to bees exposed to treated foliage for up to 3 hours following application. |

*Bayer CropScience has applied to EPA for a 24c label to reduce the grain sorghum PHI from 21 days to 14 days, therefor check current label.

Chlorpyrifos (Lorsban, Nufos), Dimethoate, and Malathion are also labeled for aphid control in sorghum. Although these products provide some control of SCA, university trials demonstrate that these products are not as effective as Sivanto and Transform.

Research on the Texas High Plains has shown that chemigation provides excellent control of sugarcane aphid. Refer to current Sivanto label to determine if chemigation has been added as an approved application method.

## Managing sugarcane aphids prior to harvest

Sugarcane aphid infestations present after panicle emergence can continue to produce large quantities of honeydew, which can interfere with harvest. Rain can help wash honeydew from leaves. Insecticides can also be applied at this time, but their use is limited by their preharvest restrictions.

Harvest aid chemicals such as glyphosate and sodium chlorate have been used to kill sorghum leaves to reduce SCA infestations prior to harvest. If, however, plants are slow to desiccate, SCA may have time to move up into the sorghum panicle and continue to feed, and produce honeydew. For this reason, you may need to use high rates of harvest aids that kill leaves quickly. Read and follow label directions for these products.

## Seed treatments

Insecticide seed treatments control aphids, including sugarcane aphid, and some other early-season insects for about 4 to 6 weeks after planting. These seed treatments include thiamethoxam (Cruiser), clothianidin (NIpsIt Inside, Poncho) and imidacloprid (Gaucho and others). The value of seed treatment for control of SCA will depend on how soon after planting the aphids infest the field.

## Managing SCA infestations in forage sorghum

Sugarcane aphids can cause extensive damage to forage sorghums, sudan grass, sorghum/sudan hybrids, and Johnsongrass meadows. Aphid infestations can kill leaves and increase stalk lodging. The honeydew contamination they cause can also plug harvest machinery.


**Figure 8.** Syrphid fly adult, larvae and pupa


**Figure 9.** Adult lady beetle *(Hippodamia convergens)* and lady beetle larva *(Cycloneda sanguinea)*

Treatment thresholds for SCA infestations of forage sorghums and Johnsongrass meadows have not been determined. Until they are, you can use the thresholds listed for grain sorghum when making treatment decisions. Forage sorghum should be monitored as described above at least weekly.

Controlling SCA with insecticides requires good coverage of the entire canopy, including lower leaves. Achieving this coverage may be difficult because forage sorghum has a dense canopy—especially if the crop is tall. Therefore, early harvest or grazing of infested fields may be the best option if you cannot achieve good insecticide coverage. If a second cutting is desired, the field should be scouted once a week after the harvest to determine if SCA have reinfested the field. If they have, scout the field twice per week to determine if an insecticide is needed to protect yield.

## Beneficial insects

Syrphid fly larvae, lady beetles, parasitic wasps, and green and brown lacewings feed on sugarcane aphids and can help suppress SCA infestations. Adult syrphid flies are small, about ¼ to ½ inch long and bright yellow and black, resembling a bee (Fig. 8). They are sometimes called hover flies because of their characteristic hovering. While the adult fly feeds only on nectar and honeydew, the maggot-like larvae feed on aphids. The larva is green, brown, or gray, lacks legs and has a tiny head at the small end of the tapered body (Fig. 8). Larvae move slowly among the aphid colony, sucking the juice from them. The adult and larval stages of several species of lady beetles also feed on SCA in sorghum (Fig 9).

Several species of parasitic wasps also attack sugarcane aphid (Fig. 10). These tiny wasps deposit their eggs into the sugarcane aphid and the egg hatches into a larva that feeds on and soon kills the host aphid. Once the larva has developed completely, it emerges from the dead aphid as an adult wasp. Aphids killed by parasites are called mummies. Parasitism by the *Aphelinus* wasp leaves a black or blue-black mummy. While these tiny parasitic wasps are difficult to see in the field, the mummies they leave behind show their impact.

**Figure 10.** An *Aphelinus* wasp parasitizing an aphid. The black or blue-black aphids, or mummies, have been killed by the *Aphelinus* larva feeding inside the sugarcane aphid (center). Aphid mummies showing the round exit hole from which the adult wasp emerged from the dead sugarcane aphid (far right).

**Figure 11.** Brown aphid mummies killed by the parasitic wasp, *Lysiphlebus testaceipes*. Note both sugarcane aphids and greenbugs present.

Another parasitic wasp, *Lysiphlebus testaceipes*, attacks greenbugs, corn leaf aphids and sugarcane aphids in sorghum—this wasp turns them into brown mummies (Fig 11). However, most sugarcane aphids are protected from *Lysiphlebus* because an internal bacterium prevents the immature parasitoid from developing.

## Sorghum hybrids that are resistant to SCA

Research studies and field observations demonstrate that some sorghum varieties show less leaf damage or host fewer SCA aphids than others. Resistant hybrids have genes that somewhat protect them against SCA damage or rapid population increases. Resistance, though, is a relative term—hybrids may be described as susceptible, moderately resistant, or resistant. In addition, resistance is not immunity and SCA can be present on and reduce the yield of resistant hybrids. Insecticide treatments will still be necessary if infestations exceed the economic threshold.

Resistance can be expressed as tolerance or antibiosis. Tolerant hybrids can withstand or recover from insect damage that would cause yield loss in a more susceptible hybrid. Resistance expressed as antibiosis means that the insect cannot survive or reproduce as well as it can on a susceptible hybrid—thus fewer aphids are present on the resistant hybrid. Hybrids with some resistance to SCA may keep an infestation from reaching the treatment threshold as quickly, thus providing more time for beneficial insects to have an impact. However, these hybrids must still be scouted to assess SCA infestation levels as described above. One strategy is to monitor the aphid population, and if the infestation reaches the threshold, consider plant damage when deciding whether to use an insecticide treatment.

Though breeding lines of highly resistant sorghum have been identified, it will take several years to move this genetic resistance into commercial hybrids. Seed companies have identified hybrids with some SCA resistance and a list of these is available from the National Sorghum Producers at: http://sorghumcheckoff.com/pest-management/. Ask your seed dealer about the availability of resistant grain sorghum hybrids.

**Table 4. Insecticides labeled for control of midge, headworm (corn earworm, fall armyworm) and stinkbugs in sorghum.**

| Active ingredient | Brand name | IRAC group[1] | Labeled for control of: Midge | Head worm[2] | Stinkbugs | Relative impact on aphid natural enemies[3] | Days to wait after application before harvest |
|---|---|---|---|---|---|---|---|
| cyfluthrin | Baythroid, Tombstone | 3a | Yes | Yes | Yes | High | 14 |
| esfenvalerate | Asana XL | 3 | Yes | Yes | No | High | 21 |
| lambda cyhalothrin | Karate Z, Warrior, Lambda-Cy | 3 | Yes | Yes | Yes | High | 30 |
| zeta-cypermethrin | Mustang Max | 3 | Yes | Yes | Yes | High | 14 |
| gamma-cyhalothrin | Declare | 3 | Yes | Yes | Yes | High | 30 |
| alpha-cypermethrin | Fastac | 3 | Yes | Yes | Yes | High | 14 |
| chlorpyrifos | Lorsban, Nufos and generics | 1B | Yes | Yes | No | High | 30 (1 pt)<br>60 (> 1 pt) |
| methomyl | Lannate | 1a | Yes | Yes | No | High | 14 |
| dimethoate | Dimethoate 400 | 1b | Yes | No | No | High | 28 |
| spinosad | Blackhawk | 5 | No | Yes | No | Low | 21 |
| flubendiamide | Belt | 28 | No | Yes | No | Low | 14 |
| chlorantraniliprole | Prevathon | 28 | No | Yes | No | Low | 1 |
| lambda-cyhalothrin plus chlorantraniliprole | Besiege | 3 and 28 | Yes | Yes | Yes | High | 30 |

[1] Groups refer to insecticides with similar modes of action. For example, Group 3 consists of pyrethroid insecticides while organophosphate insecticides are Group 1. Rotating between groups is an important method of slowing the development pest resistance to insecticides.
[2] Headworms include corn earworm and fall armyworm. Pyrethroids are often ineffective on larger FAW.
[3] Data on impact on aphid natural enemies is often lacking. Rating may be based on impact on honey bee only.

## Managing sorghum midge, headworms and stinkbugs when SCA is present

Sivanto and Transform are effective against SCA but are not labeled 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. It is important to preserve beneficial insects whenever possible.

When selecting insecticides to control midge, headworms, and stinkbugs when sugarcane aphids are also present in the field, consider the following:

1. Midge, headworms, and stinkbugs at treatment thresholds, present a certain threat to yield and profitability. While there is a risk of SCA outbreaks following use of some insecticides, crop yield should not be jeopardized solely to spare natural enemies.
2. For midge and stinkbug control, there are no labeled options that will not also reduce the number of beneficial insects (Table 4). If you apply an insecticide to control midge or stinkbugs, monitor sugarcane aphids frequently and be prepared to apply Sivanto or Transform if SCA numbers exceed the treatment threshold.
3. For corn earworm and fall armyworm control, methomyl and chlorpyrifos and all of the pyrethroid insecticides are broad-spectrum insecticides and are toxic to most natural enemies (Table 4). Prevathon and Belt are, by comparison, less toxic to natural enemies while still very effective on caterpillar pests such as corn earworm and fall armyworm. Besiege is a premix of the same active ingredient as Prevathon plus a pyrethroid, and hence is not as safe for beneficial insects as Prevathon alone. Spinosad, the active ingredient in Blackhawk, is much less toxic to many natural enemies than these other insecticides. Higher application rates and an insecticide's residual properties extend the time before natural enemies can repopulate a field.
4. Scout fields and base insecticide applications on pest counts of midge, headworms, and stinkbugs. Do not treat based solely on crop growth stage.
5. The economic threshold depends on the current value of the crop, the number of grain heads per acre, and the cost of control. These variables can be entered into calculators available on-line to determine the number of midge, headworms, or rice stinkbugs that should be controlled to avoid crop loss greater than the cost of control. These on-line calculators are available at: http://entomology.tamu.edu/extension/apps/.

## Additional resources

http://txscan.blogspot.com. Sign up to receive current information on sugarcane aphid provided by Texas AgriLife Extension Entomology

http://ccag.tamu.edu/sorghum-insect-pests/. A web site for research and Extension information on sugarcane aphid in south Texas.

## Photo credits

Fig. 1: Rick Grantham, Oklahoma State University Insect Diagnostic Lab, Stillwater. Fig. 2: Jourdan Bell, Texas A&M AgriLife Extension. Fig. 3: Aphids reared by Scott Armstrong, USDA–ARS Lab Stillwater, OK, and photographed by Rick Grantham. Fig. 4: Texas A&M AgriLife Extension Service. Fig. 5: Pat Porter, Texas A&M AgriLife Extension Service. Fig. 6: Texas A&M AgriLife Extension Service. Fig. 7: Allen Knutson, Texas A&M AgriLife Extension Service. Figs. 8, 9: Erin Maxon, Texas A&M University. Figs. 10, 11: Raul Villanueva and Pat Porter.

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