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Managing Insect Pests of TEXAS SUNFLOWERS

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Insect pests are often a major limiting factor in Texas sunflower production. Of the 50 insect species recorded on sunflowers in Texas, about 15 are considered potentially major pests. The sunflower moth is the major common pest of sunflowers. Stem weevils, seed weevils, stalk girdlers, and thistle caterpillars are occasional pests that can be quite serious when abundant.

Both oilseed and non-oilseed (confectionery) sunflowers are grown in Texas. The small, black seeds of oilseed sunflowers contain 38 to 50 percent oil. They are processed into sunflower oil and also used as bird feed. Confectionery sunflower seeds are usually large with black and white stripes. These are used for human consumption in a variety of food products.

Because the sunflower has a relatively short growing season, it is suitable primarily as a spring-planted crop or as a second crop after wheat. Sunflowers can be an alternative crop where plantings of other crops have been destroyed by wind, sand, rain, or hail. Drought tolerance makes sunflowers an attractive dryland crop and an option in areas with limited irrigation. Sunflowers also respond well under full irrigation.

Cultural practices that help reduce insect problems include crop rotation, modified planting dates, weed control, volunteer and wild sunflower control, and tillage. However, the judicious use of insecticides is often required for successful sunflower production in Texas. Producers should be able to identify the insect pests that reduce sunflower yield and know when those pests are most likely to occur during the growth of the plant. They should also understand pest biology and the control measures that are most effective.

Insect pests infesting the head

Sunflower moth

Lepidoptera: Pyralidae, *Homoeosoma electellum* (Hulst)

The sunflower moth—also called the "head moth"—is the single most important sunflower pest in Texas. Sunflower moth infestations are usually heaviest when early planted fields bloom during May and June, with another smaller moth flight possible later in the season, especially in the High Plains. The adult is a small, slender, silver- to buff-gray moth about ½ inch long (Figs. 1 and 2). It is most often seen resting on sunflower heads during the blooming period, especially in the early morning and early evening.

Figure I. Sunflower moths. *(Photo by Scott Russell)*

Figure 2. Sunflower moths. *(Photo by Scott Russell)*

Figure 3. Blooming sunflowers. *(Photo by Pat Porter)*

Moths are highly attracted to plants that are beginning to bloom. Nearly 80 percent of the eggs are laid on the plant within 4 to 7 days after buds begin to open during the late R4 growth stage (Fig. 3). The eggs hatch in 24 to 72 hours. Newly hatched larvae are yellow in color. For the first 5 to 6 days, they are relatively exposed as they feed on pollen and floral parts on the flower surface. Older larvae tunnel into the seeds and other head tissue. A single larva can destroy up to 12 seeds during the 15- to 19-day development period. Mature larvae are about ¾ inch long and brown with four yellowish-green to cream-colored longitudinal stripes (Fig. 4).

Figure 4. Sunflower moth larvae. *(Photo by Pat Porter)*

If larval feeding destroys florets before fertilization, a seed will not develop, and pops, or empty seed hulls, may occur. A head infested with sunflower moth larvae looks trashy and has webbing across the face of the head (Fig. 5). In addition to feeding damage, sunflower moth larvae predispose the sunflower head to *Rhizopus* head rot (Fig. 6). This disease can reduce yields up to 50 percent and lower seed oil content as well.

Figure 5. Sunflower moth larva and damage. *(Photo by Frank Peairs)*

Figure 6. Sunflower head rot disease symptoms as a result of sunflower moth larval damage. *(Photo by Monti Vandiver)*

In Texas, insecticidal control is based on the percentage bloom and the presence of moths in the field. The window for treatment is very narrow because sunflowers bloom rapidly once they begin.

Count any head as blooming when any of the ray flowers are opening and disk flowers are exposed—note the late R4 growth stage in Figure 3. The ray flowers are the yellow petals, while the disk flowers are the composite florets that produce seeds. Moths can lay eggs as soon as any part of the head is exposed. By the time plants reach R5.1, it is too late to make a control decision.

Research has shown that insecticides should be applied when 15 to 25 percent of plants are blooming and sunflower moths are found in the field. Unfortunately, blooming can progress so rapidly that by the time the producer gets spray equipment or an airplane on the field, it may be too late for an application to be completely effective. Follow these suggestions for effective sunflower moth control.

- At planting time, ensure that field conditions are favorable for uniform emergence across the field (e.g., good soil moisture, proper and consistent planting depth, etc.). A field where emergence is not uniform will have an extended blooming period that causes problems in the timing of insecticide application. Irrigating fields to supply

germination moisture can also cause up to a 2- to 3-day difference in blooming rate.

- At least 2 weeks before spraying, select and get a commitment from a custom applicator to be ready to spray. Decide which chemicals you will use so the applicator will have them on hand.
- Be ready to begin scouting as soon as you see the first blooming head in the field (late R4 stage). If you are a first-time grower, get assistance from those experienced in scouting for sunflower moths.

Besides the initial application, 1 to 2 additional insecticide applications at 5-day intervals may be needed when sunflower moth populations are moderate to heavy, and moths are still active. In more northern states, pheromone trap sampling from growth stages R3 to R5.1 indicates that fields are at a higher risk when more than four moths are captured per trap per night. However, treatment decisions should be made on the basis of scouting for adults at the time of bloom. Trap captures of fewer than four per night do not mean a field is safe from economic damage.

Banded sunflower moth

Lepidoptera: Tortricidae, *Cochylis hospes* (Walsingham)

The banded sunflower moth is about ¼ inch long and straw-colored with a brown triangular area near the middle of the forewing (Fig. 7). The eggs of the banded sunflower moth are white (Fig. 8). At first, larvae are off-white, but as they grow to about ½ inch long, they change to light pink, then to red or purple, and finally green (Fig. 9). Larvae feed on disk flowers until they reach the third instar, where they then begin to feed on seeds.

Figure 7. Banded sunflower moth. *(Photo by Larry Charlet, J. Knodel, and G. Brewer)*

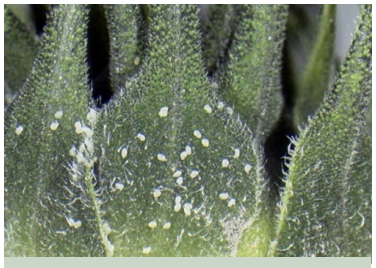

Figure 8. Banded sunflower moth eggs. *(Photo by Larry Charlet, J. Knodel, and G. Brewer)*

The action threshold is one moth per two plants during the late bud (R4) to early bloom stage (R5.2). Scouting should be done in the early morning or early evening.

Figure 9. Banded sunflower moth larvae. *(Photo by Larry Charlet, J. Knodel, and G. Brewer)*

Sunflower bud moth

Lepidoptera: Tortricidae, *Suleima helianthana* (Riley)

The appearance of deformed heads and black frass on heads or stalks indicates the presence of sunflower bud moths. The adult is a gray-brown moth with two dark bands on the wings. One band is across the middle of the wing, and the second is near the wingtip (Fig. 10). The wingspread is about ⅔ inch long. Larvae are white with a dark head capsule and about ⅜ inch long (Fig. 11).

Figure 10. Sunflower bud moth. *(Photo by Mark Dreiling)*

Figure 11. Sunflower bud moth. *(Photo by Pat Porter)*

Two generations of sunflower bud moths are produced each year. Moths lay eggs in the terminals of immature sunflowers, on the receptacle—or underside—of mature sunflower heads, or in leaf axils. Black frass surrounds the holes where larvae enter the sunflower plant. In Texas, infestations have been light, and feeding activity is restricted to the fleshy part of the head and stalk. Yield losses have been minimal and have only occurred when larvae burrow into small, unopened buds, thus preventing head formation.

Sunflower headclipping weevil

Coleoptera: Curculionidae, *Haplorhynchites aeneus* (Boheman)

Sunflower plants that are girdled about 1 to 2 inches below the head are likely to be infested with the headclipping weevil (Fig. 12). The adult is metallic black and about ¼ inch long with a long "snout." Females girdle just below the head and lay eggs in the girdled head (Fig. 13). The head then falls to the ground, where larvae develop and overwinter. Economic infestations of this insect have not been noted in Texas, although 2 to 3 percent of a crop is occasionally damaged. In Kansas, insecticide application is considered when 10 percent or more of the flower heads have been clipped, and weevils are still active.

Figure 12. Sunflower headclipping weevil. *(Photo by Whitney Cranshaw)*

Figure 13. Sunflower headclipping weevil damage. *(Photo by Pat Porter)*

Sunflower seed weevils

Coleoptera: *Curculionidae, Smicronyx* spp.

Two species of seed weevils have been detected in Texas. The red sunflower seed weevil, *Smicronyx fulvus,* is reddish brown and about ⅛ inch long (Fig. 14). The gray sunflower seed weevil, *Smicronyx sordidus,* is about ¼ inch long (Fig. 15). Adults may be present during the entire growing season.

Figure 14. Red sunflower seed weevil. *(Photo by Holly Davis)*

If adults emerge when sunflowers are in the bud stage, they will begin feeding between the bracts. As the sunflower matures, weevils begin feeding on pollen, and females deposit eggs individually into the developing seeds where larvae develop (Fig. 16). Mature larvae drop to the ground and overwinter in the soil. There is a single generation per year.

Figure 15. Gray sunflower seed weevil. *(Photo by Holly Davis)*

Figure 16. Gray sunflower seed weevil larva and damage to kernel. *(Photo by Frank Peairs)*

Seed weevils have the greatest economic impact on both confectionery and hybrid seed sunflowers. Economic infestations most often occur when sunflowers are blooming. The action threshold for the red sunflower seed weevil is 14 per head for oilseed sunflowers and 1 per head for confectionery. The gray sunflower seed weevil lays fewer eggs than the red sunflower seed weevil and probably has a higher action threshold. However, this has not been firmly established.

Insect pests infesting the stalk

Sunflower stem weevil

Coleoptera: Curculionidae, *Cylindrocopturus adspersus* (LeConte)

Stem weevils can occasionally cause losses in sunflowers. Adults are brown and white mottled and about 3/16 inch long (Fig. 17). There is a single generation per year. Adults feed on leaves but cause no economic damage. Eggs are deposited in sunflower stalks during a 2- to 5-week period after adults emerge. Young larvae burrow into the

Figure 17. Sunflower stem weevil adult. *(Photo by Frank Peairs)*

stalk, destroying pith and making the plant highly susceptible to lodging. Larvae overwinter in chambers at the base of the stalk. As many as 100 ¼-inch, creamy-white larvae have been found in a single stalk. The stem weevil can reduce yields by 50 percent. Evidence indicates that stem weevil damage predisposes plants to charcoal rot. In the Texas High Plains and Panhandle regions, crop rotation and planting delayed until after mid-June have prevented yield reduction from this pest. Non-rotated, early planted fields are most likely to be damaged. Double-crop sunflowers or those planted late seldom develop severe stem weevil infestations.

Apply insecticide to control stem weevils when two or more adults are found per plant from the third alternate leaf stage to the early bud stage. An infestation level of one adult weevil per three plants is considered an economic threshold in North Dakota.

The black sunflower stem weevil (*Apion occidentale* Fall) is black and about 1/10 inch long. Larvae are yellow and have been found among sunflower stem weevil larvae. This weevil causes very little damage.

Cocklebur weevil

Coleoptera: Curculionidae, *Rhodobaenus quinquepunctatus* (Say)

The adult weevil is ¼ to ⅜ inch long and is red with black spots (Fig. 18). The large larvae leave a ¼-inch tunnel in the pith as they burrow down to the roots. Oval feeding scars on the stalk and rather large larvae in the pith indicate the presence of this pest. Destroying stalks helps reduce this pest.

Figure 18. Cocklebur weevil. *(Photo by Salvador Vitanza)*

Girdlers (Longhorned beetles)

Coleoptera: Cerambycidae, *Mecas* spp., *Ataxia* spp., *Dectes* spp.

Several species of girdlers attack sunflowers. Adults of the *Mecas* spp. are ½ inch long and gray. The adult female makes two girdles about one-third of the way down the stalk, causing the upper stalk to die and fall to the ground. Eggs are deposited just beneath the stem surface and above the lower girdle. After hatching, the larvae, which are white and 1 inch long when mature, burrow down the pith to the roots, where they overwinter. Destroying stalks helps reduce this pest.

Another longhorned beetle, *Ataxia hubbardi*, does not overwinter in a dormant state. The larvae remain active and do not girdle the stalk. This species uses wild sunflowers and cockleburs as alternate hosts. There is no evidence that it causes significant damage, but the larvae can be confused with *Dectes texanus*, a species that can be much more damaging to sunflowers.

Figure 19. Longhorned beetle, *Dectes* sp. *(Photo by Salvador Vitanza)*

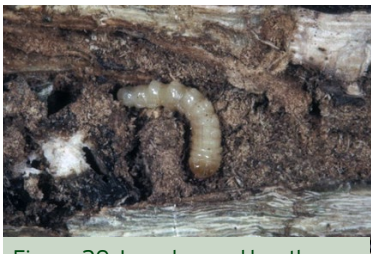

Figure 20. Longhorned beetle tunneling damage. *(Photo by Frank Peairs)*

Dectes texanus is an important pest of both sunflowers and soybeans in the Texas High Plains. The adult beetle is pale gray and about ⅜ inch long with antennae longer than the body (Fig. 19). Larvae are legless with a small brown head; they are ½ to ⅝ long when fully grown in the sunflower stem (Fig. 20). The larva overwinters at the base of sunflower and soybean stalks and in some weeds such as wild sunflowers, ragweed, and cockleburs. Adults have an extended emergence period during the growing season and are long-lived. After emerging, females lay eggs in leaf petioles. Hatching larvae tunnel in the stem and down to the base of the stalk when they start preparing to overwinter. The larvae girdle the stalk at or just above ground level, about 1 to 2 inches. Tunneling causes some yield loss, but the greatest loss is from the lodging caused by girdling. No insecticide recommendations are currently available. If infestations are observed, harvest as early as possible to limit yield losses (Fig. 21).

Producers may consider spraying a plant desiccant on heavily infested fields to hasten harvest. Do not plant continuous sunflowers or rotate behind soybeans. Destroy sunflower and soybean stalks to reduce the overwintering larval population.

Figure 21. Longhorned beetle girdling damage. *(Photo by J.P. Michaud)*

Insect pests infesting foliage

Sunflower beetle

Coleoptera: Chrysomelidae, *Zygogramma exclamationis* (Fabricius)

The adult sunflower beetle resembles the Colorado potato beetle (Fig.22). About ¼ inch long, it is yellow with brown stripes. It attacks early in the season, defoliating seedlings. The action threshold for seedling sunflowers is one adult per plant. On later growth stages, the yellowish, humped larvae hide in the bracts of the head during the day and feed on younger leaves at night, causing defoliation. The action threshold on later growth stages is 15 larvae per plant, with about 25 percent defoliation.

Figure 22. Sunflower beetle. *(Photo by Pat Porter)*

Thistle caterpillar (Painted lady butterfly)

Lepidoptera: Nymphalidae, *Vanessa cardui* (Linnaeus)

The butterfly has a wingspread of 2 inches (Fig. 23). The thistle caterpillar's upper wing surface is brown with red and orange mottling and white and black spots.

The thistle caterpillar, the larval stage of the painted lady butterfly, skeletonizes leaves and can cause significant defoliation. This colorful larva grows to 1¼ to 1½ inches long and has prominent spines on the body (Fig. 24). Larvae feed under the webbing of a curled leaf in the plant's terminal area. The action threshold is 25 percent defoliation, with most of the larvae less than 1¼ inches long.

Figure 23. Painted lady butterfly. *(Photo by Scott Russell)*

Figure 24. Thistle caterpillar, the larva of a painted lady butterfly. *(Photo by Pat Porter)*

Saltmarsh caterpillar (Woollybears)

Lepidoptera: Arctiidae, *Estigmene acrea* (Drury)

The saltmarsh caterpillar, a late-season pest, occasionally damages late-planted sunflowers. The very hairy caterpillar varies from yellow to brown to black and is often referred to as the "woollybear" (Fig. 25). The caterpillar can be as long as 2 inches and can cause economic damage by severe defoliation. The adult moth is white with black spots and has a wingspan of 1½ to 2 inches (Fig. 26). Keeping fields weed-free before and after planting will reduce problems with this pest.

Figure 25. Saltmarsh caterpillar (wollybear). *(Photo by Pat Porter)*

Figure 26. Saltmarsh caterpillar adult, tiger moth. *(Photo by Texas A&M University, Department of Entomology)*

Beet armyworm

Lepidoptera: Noctuidae, *Spodoptera exigua* (Hübner)

Heavy infestations of beet armyworms can cause severe defoliation. The beet armyworm can grow to be 1½ inches long and is variable in color. The immature beet armyworm is light green with thin, white stripes; more mature worms have green and black stripes. These armyworms can best be identified by the black spot on the side of the larva above the second pair of true legs.

Pupation occurs in the soil. The adult moth has a wingspread of 1 inch. Forewings are a grayish brown with a pale spot in the mid-front margin; the hind wings are white with a dark anterior margin. Controlling pigweed in and around sunflowers will reduce this pest.

Grasshoppers (many species)

Orthoptera

Heavy infestations of grasshoppers develop periodically and can cause economic damage to sunflowers. These insects can attack sunflowers at any time during the growing season. Early in the season, check for immature grasshoppers in crop margins. Controlling grasshoppers in crop margins can often prevent their movement into the crop. The presence of 11 or more grasshoppers per square yard in crop margins is likely to cause economic damage. See the Extension publication E-209, *Grasshoppers and Their Control*, for further information.

Cutworms

Lepidoptera: Noctuidae, several species.

The cutworms are stout-bodied, smooth caterpillars that can be 1 to 1½ inches long. They vary in color from dull gray to black and have stripes or spots. Damage to sunflowers occurs when plants are germinating and in the cotyledon growth stage. The feeding of older larvae will cut off plants at, below, or above the ground level, causing skips in the plant stand. Most cutworms feed mostly at night. During the day, larvae can be found at either end of the skip in the plant stand, resting under the soil surface near the base of a damaged plant. Treatment thresholds in Kansas are one or more larvae per square foot when most larvae are less than 1¼ inch long.

Soil insect pests damaging seeds or roots

Carrot beetle

Coleoptera: Scarabaeidae, *Tomarus gibbosus* (De Geer)

Occasionally, the carrot beetle can be very damaging to sunflowers in sandy soils of the Texas Rolling Plains (Fig. 27). The ½-inch-long, brown "June bug" adult feeds on the sunflower roots, causing stunting, wilting, and lodging. The larvae do not feed on sunflower roots. Carrot beetle infestations can often be detected by excavations near the base of the sunflower stalk. These excavations are made by skunks and other mammals foraging for the carrot beetles. Controlling pigweed in and around the sunflower field helps reduce this pest.

Figure 27. Carrot beetle. *(Photo by Billy Warrick)*

Sunflower root weevil

Coleoptera: Curculionidae, *Baris strenua* (LeConte)

The sunflower root weevil is about 1¼ inches long and dull black with a short, downward-projecting snout (Fig. 28). Adults first feed on foliage, causing little damage. They later congregate near the root zone of plants where they feed and lay eggs underneath the callus tissue that develops at adult feeding scars. Larvae feed near the area where they hatch, destroying root tissue and causing plants to wilt (Fig. 29). Plants will lodge if infestations are severe. An economic threshold has not been established, and in North Dakota, insecticide use has not been warranted for the control of this pest.

Figure 28. Sunflower root weevil. *(Photo by J.P. Michaud)*

Figure 29. Sunflower root weevil larva. *(Photo by Frank Peairs)*

Wireworm and false wireworm

Coleoptera: Elateridae and Tenebrionidae

Wireworm larvae are hard, smooth, yellow to dark brown, and are from ½ to 1½ inches long (Fig. 30). They overwinter in the soil as larvae and adults. The larval stage may last 2 to 6 years, depending on the species. Damage is most likely where sunflowers are planted into heavy residue, which adults are attracted to for depositing eggs. Larvae feed directly on seeds, preventing germination, or on young stems at the soil line. Seed treatments are effective on wireworm larvae, but because populations are sporadic, this method of control is not recommended unless a field has a history of problems. Generally, replanting sections impacted by these insects is the best option.

Figure 30. Wireworm.
(Photo by Holly Davis)

Protecting bees and other pollinators from insecticides

Pollination is vital in producing many seed crops. Sunflower hybrids are self-fertile and depend less on insect pollination than earlier, self-incompatible varieties. However, studies show that even self-compatible hybrids benefit from insect pollination. Seed set, seed oil percentage, seed yields, and oil yields increase when pollinators are present.

Many major insect pests attack sunflower crops during flowering. Applying insecticide to control pests may also harm pollinators. To minimize hazards to honeybees, communicate and cooperate with beekeepers, producers, and pesticide applicators.

Follow these guidelines to reduce bee losses:

- If practical, apply insecticide before moving bees into fields for pollination.
- Where insecticides are needed, use materials that are least toxic to bees.
- Make all applications when bees are not visiting the field. Evening or early morning treatments, between 7 p.m. and 6 a.m., generally are most satisfactory. Evening applications, after bees have left the field, are less hazardous than early morning.
- Use granular formulations or a spray rather than dusts.
- Where it is necessary to use one of the insecticides in Groups 1 and 2 in Table 7, notify the beekeeper so that arrangements can be made to protect the bees.
- Avoid drifting or spraying insecticide directly on bee colonies, as this generally results in heavy losses. On hot evenings, bees often cluster on the fronts of the hives. Pesticide drift or direct spray at this time generally kills many bees.

Chemical use precautions

Select products that provide effective, safe, and economical control. All listed materials are poisonous, but proper handling reduces the hazards associated with their use. Comply with the manufacturer's label directions for handling all toxic chemicals.

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

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

Pesticide drift: Avoid drift to nearby land and take precautions against contaminating ponds and streams.

Poisoning symptoms: Some symptoms of pesticide poisoning are headaches, nausea, cramps, diarrhea, weakness, blurred vision, and muscular twitching. If you notice any of these symptoms during or after handling any pesticide, consult a physician immediately.

Policy statement concerning chemical use

Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied, of similar products not mentioned. The Texas A&M AgriLife Extension Service assumes no responsibility for risks. Such risks shall be assumed by the user of this publication.

Pesticides must be registered and labeled for use by the Environmental Protection Agency and the Texas Department of Agriculture. The status of pesticide label clearances is subject to change and may have changed since this publication was printed.

The user is 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 pesticides from their property to that of others. Always read and follow the instructions on the product label carefully.

For further information about Texas sunflower production, consult educational resources from the National Sunflower Association at *http://www.sunflowernsa.com*.

Acknowledgment

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Table I. Insecticides grouped according to their relative hazards to honeybees

Insecticides	Remarks
Group I – Highly toxic *Beta*-cyfluthrin Carbaryl Chlorpyrifos Cyfluthrin Cyantraniliprole Deltamethrin Esfenvalerate *Gamma*-cyhalothrin *Lambda*-cyhalothrin Pyrethrum *Zeta*-cypermethrin	This group includes materials that kill bees on contact during application or for several days afterward. With some exceptions, remove bees from the area if these are used on plants the bees visit.
Group 2 – Moderately toxic	Do not apply these products when bees are working in the field. Apply in the late evening.
Group 3 – Relatively nontoxic Chlorantraniliprole *Bacillus thuringiensis*	Apply in late evening or early morning when bees are not foraging.

Table 2. Chemicals and trade names for products currently listed for control of insect pests in sunflowers

Chemical Name and Trade Name[1]	Rate/Acre	Pests listed on label (alphabetical)	REI[2] (Hours)	Grazing (Days)	PHI[3] (Days)	IRAC Class[4]	Signal word[5]
Bacillus thuringiensis Biobit HP, DiPel, and others	1.2–2.5 pint; 0.5–1.0 lb*	Banded sunflower moth, sunflower moth	4			IIA	Caution
***Beta*-cyfluthrin** Baythroid XL, Sultrus	0.8–2.8 oz	Banded sunflower moth, cutworms, grasshoppers, headclipping weevil, sunflower beetle, sunflower bud moth, sunflower moth, seed weevil, stem weevil (adult)	12	30	30	3A,	Caution – Warning
Carbaryl Sevin 4F, XLR Plus, Carbaryl 4L	1–1.5 quart	Cutworms, sunflower moth, sunflower beetle, stem weevil	12	30	30 - Forage 60 - Seed	1A	Caution
Chlorantraniliprole Coragen Prevathon	2.0–7.5 oz 8–20 oz	Banded sunflower moth, grasshoppers, sunflower moth	4		21	28	Caution
Chloropyrifos Chlorpyrifos 4E Lorsban Advanced, and many generics	1–4 pint*	Banded sunflower moth, cutworms, grasshoppers, seed weevil, sunflower beetle, sunflower moth, stem weevil, woollybear	24	Do not graze	42	1B	Warning
Chlorpyrifos + *Gamma*-cyhalothrin Bolton Cobalt	5–23 oz 7–39 oz	Banded sunflower moth, cutworms, grasshoppers, headclipping weevil (adult), seed weevil, sunflower beetle, sunflower moth, stem weevil, thistle caterpillar, woollybear		Do not graze	45	1B, 3A	Warning – Danger
chlorpyrifos + *Lambda*-cyhalothrin Cobalt Advanced	6–38 oz	Banded sunflower moth, cutworms, grasshoppers, headclipping weevil (adult), seed weevil, sunflower beetle, sunflower moth, stem weevil, thistle caterpillar, woollybear	24	Do not graze	45	1B, 3A	Warning
Chloropyrifos + zeta-cypermethrin Stallion	3.75–11.75 oz	Banded sunflower moth, cutworms, grasshoppers, headclipping weevil (adult), seed weevil (adult), sunflower beetle, sunflower moth, stem weevil (adult), thistle caterpillar, woollybear	24	Do not graze	42	1B, 3A	Warning
Cyantraniliprole Exirel	7.0–13.5 oz	Sunflower moth	12		7	28	Caution
Cyfluthrin Tombstone, Tombstone Helios	0.8–2.8 oz	Banded sunflower moth, cutworms, grasshoppers, headclipping weevil, seed weevil, sunflower beetle, sunflower bud moth, sunflower moth, stem weevil (adult)	12	30	30	3A	Warning – Danger

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Table 2 continued

Chemical Name and Trade Name[1]	Rate/Acre	Pests listed on label (alphabetical)	REI[2] (Hours)	Grazing (Days)	PHI[3] (Days)	IRAC Class[4]	Signal word[5]
Deltamethrin							
Delta Gold	1–1.5 oz	Banded sunflower moth, cutworms, grasshoppers, seed weevil, sunflower beetle, sunflower moth, stem weevil (adult)	12	Do not graze	21	3A	Danger
Esfenvalerate							
Asana XL, Zyrate, and many generics	1.45–9.6 oz*	Banded sunflower moth, cutworms, grasshoppers, seed weevil, sunflower beetle, sunflower moth, stem weevil	12		28	3A	Warning
***Gamma*-cyhalothrin**							
Declare Proaxis	0.77–1.54 oz 1.92–3.84 oz	Banded sunflower moth, cutworms, grasshoppers, headclipping weevil (adult), seed weevil (adult), sunflower beetle, sunflower moth, stem weevil (adult), thistle caterpillar, woollybear	24		45	3A	Caution
***Lambda*-cyhalothrin**							
Warrior II w/ Zeon Technology and many generics	0.96–1.92 oz*	Banded sunflower moth, cutworms, grasshoppers, headclipping weevil (adult), seed weevil (adult), sunflower beetle, sunflower moth, stem weevil (adult), thistle caterpillar, woollybear	24		45	3A	Warning
***Lambda*-cyhalothrin + chlorantraniliprole**							
Besiege	5–10 oz	Banded sunflower moth, cutworms, grasshoppers, headclipping weevil (adult), seed weevil (adult), sunflower beetle, sunflower moth, stem weevil (adult), thistle caterpillar, woollybear	24		45	3, 28	Warning
***Zeta*-cypermethrin**							
Mustang and Mustang MAXX	1.28–4.0 0z	Banded sunflower moth, cutworms, dectes stem borer, grasshoppers, headclipping weevil (adult), seed weevil (adult), sunflower beetle, sunflower moth, stem weevil (adult), thistle caterpillar, woollybear	12	Do not graze	30	3A	Warning

[1]Always refer to the insecticide label for all application instructions and specific use directions.
[2]REI – Re-entry interval is the length of time from application until workers can re-enter the area without protective clothing.
[3]PHI – Preharvest interval from last insecticide application.
[4]The Insecticide Resistance Action Committee (IRAC) groups insecticides based on their modes of action. It is important to rotate between insecticides from different IRAC groups to prevent resistance development.
[5]"Danger" means highly toxic. "Warning" means moderately toxic. "Caution" means low order of toxicity.
*Rates vary by product. Refer to the label.

Table 3. Stages of sunflower development

Stage	Description
VE Vegetative Emergence	The seedling has emerged, and the first leaf beyond the cotyledons is less than 4 cm long.
V (number) Vegetative Stages VI V2 V3 etc.	These are determined by counting the number of true leaves at least 4 cm in length, beginning as VI, V2, V3, V4, etc. If senescence of the lower leaves has occurred, count the leaf scars (excluding those where the cotyledons were attached) to determine the proper stage.
RI Reproductive Stages	The terminal bud forms a miniature floral head rather than a cluster of leaves. When viewed from directly above, the immature bracts have a many-pointed, star-like appearance.
R2	The immature bud elongates 0.5 to 2.0 cm above the nearest leaf attached to the stem. Disregard leaves attached directly to the back of the bud.
R3	The immature bud elongates more than 2.0 cm above the nearest leaf.
R4	The inflorescence begins to open. When viewed from above, immature ray flowers are visible.
R5 (decimal) R5.I R5.2 R5.3 etc.	This stage is the beginning of flowering. The stage can be divided into substages depending on the percent of the head area (disk flowers) that has completed or is in flowering. (E.g., R5.3 (30%), R5.8 (80%), etc.)
R6	Flowering is complete and the ray flowers are wilting.
R7	The back of the head has started to turn a pale yellow.
R8	The back of the head is yellow, but the bracts remain green.
R9	The bracts become yellow and brown. This stage is regarded as physiological maturity.

From Schneiter, A. A. and J. F. Miller, I98I. "Description of Sunflower Growth Stages." Crop Science 2I: 90I-903. A pictorial reference to developmental growth stages for sunflower is available at the national sunflower association Web site, http://www.sunflowernsa.com/growers/default.asp?contentID=302.

Table 4. Seasonal sunflower pest profile

The development of various sunflower pests is usually closely related to the seasonal development of the sunflower. Although the severity of insect problems cannot be predicted on a seasonal basis, producers should frequently determine plant development to aid them in predicting insect problems associated with various developmental stages of the sunflower.