

## SUNFLOWER INSECTS

Other Resources Available Through NDSU Extension Service:

Publications	E824	Biology and Integrated Pest Management of the Sunflower Beetle in North Dakota (2000)
	E821	Biology and Integrated Pest Management of the Sunflower Stem Weevil in the Great Plains (2002)
	E828	Banded Sunflower Moth (2006)
	A1331	Sunflower Production (2007)

### BANDED SUNFLOWER MOTH

Banded sunflower moths (BSM) were a major concern in recent seasons. Heavy infestations occurred in the north-central region of the state in 2006; large moth flights were observed and treated by producers.

BSM begin to emerge from the soil about mid-July. Peak activity normally occurs about the last week of July or the first week of August. Moths fly from last year's field to the current year's field. At this time moths congregate around field margins. The moths move to fields during the bud stage, with a preference for the mid-bud stage. Eggs are laid on the back of the bud and the outside of the bracts. The newly hatched larvae move from these sites to the face of the flower and begin feeding on bracts and florets.

Two distinct and separate sampling procedures can be used to estimate the field damage potential from the banded sunflower moth. The first samples for eggs and the second samples for the adult (moth) stage.

**Egg Sampling:**

The potential for banded sunflower moth damage is determined by counting eggs on the outer layer of floral bracts in the field. Because the eggs are very small a magnifier is needed to accurately count the small eggs. We recommend using a head-mounted 3.5X magnifier to leave both hands free for manipulating the bud being observed. Egg counts should be made when most of the plants in the field are at plant stage R3 (distinct bud elongated ¾ inch above the nearest leaf, yellow ray petals not visible). However, to avoid sampling bias, buds should be randomly selected without regard to plant stage. The egg sampling steps include: 1) Divide each side of the field into two sections, 2) Sample the center of each section at 20 feet into the field from the field edge, 3) Randomly select five buds, 4) From each bud, randomly select six bracts from the outer whorl and count the eggs on each bract, and 5) Average the egg counts from the five buds and then map the average egg counts from each site to a diagram of the field. Next, calculate the economic injury level. The economic injury level (EIL) is the density or number of insects expected to cause damage that is equal to the cost of control. For Banded sunflower moth, EIL is the number of eggs per 6 bracts and considers treatment cost (\$/acre), market price (\$/lb), and plant population per acre.

$$EIL = \frac{\text{Treatment Cost (\$)}}{\text{Market Price (\$) x Plant Population x 0.00078}}$$

An **ED Calculator** is available from the North Dakota State University Department of Entomology Web site for automatically calculating the egg EIL and Economic Distance (<http://www.ndsu.nodak.edu/entomology/ext.htm>). The economic distance is the distance from the field margin that an economic infestation is present based on the egg density. Please obtain a copy of 2006 **Extension Bulletin E823 'Banded Sunflower Moth'** for complete details for determining the EIL, economic distance and timing of treatments.

**Adult Moth Sampling during Day:**

Sampling sites should be at least 75 to 100 feet from the field margins. In monitoring a field, use the X pattern, counting moths on 20 plants per sampling site to obtain the total number of moths per 100 plants. Sampling should be conducted in the late bud stage (R3), usually during mid-July. If treatment is warranted, it should be applied at the R5.1 sunflower plant growth stage (when 10% of head area have disk flowers that are flowering or completed flowering).

During the day (late morning to early afternoon) the moths remain quiet, resting on upper or lower surfaces of the leaves of sunflower plants. When disturbed, they flutter from plant to plant. When sampling for moths during day, the decision to treat or not is based on comparing the mean number of adult moths in the field to the EIL for moths. The EIL is the number of moths per head that will, if not managed, result in seed damage with a value equal to the cost of treatment. Use the following formula based on treatment costs, plant population and market price to determine the adult moth EIL for day sampling.

$$EIL \text{ (moths per 100 plants)} = \left( \frac{\text{Treatment Cost (\$) / Market Price}}{\text{Plant Population}} \right) \times 582.9 - 0.7$$

The constants in the formula simplify the calculation and include the amount of loss attributable to each banded sunflower moth larva produced per moth.

**Chemical Control and Application Timing:** Chemical treatment is directed at the larval stage of the banded sunflower moth which is the actual damaging stage. Once the decision to treat has been made, it is critical to correctly time the spray application to get maximum control. The best sunflower plant stage to treat is the R5.1 growth stage, or when pollen shed is just beginning. This is the

time when most banded sunflower moth eggs have hatched and larvae are present, but before the head has seeds forming. At this time the larvae are beginning to feed on the disk flowers, are exposed on the head, and are susceptible to the insecticide treatment. On older plants where the seeds have started maturing, most larvae will be feeding within the seeds or under the protection of the florets and will be protected from the insecticide. By then, much of the feeding damage has already occurred. Application at an earlier growth stage may be warranted if monitoring reveals earlier than normal egg-laying activity.

The **banded sunflower moth**, **seed weevil** and the **Lygus bug** have all impacted quality of **confection sunflowers** the past three to four seasons. It is recommended at this time, that **sunflowers grown for these markets be treated a minimum of two times**, once at early flowering and again 5 to 7 days later. With this type of program, a window of protection should be provided to minimize impact from all three of these seed-damaging insect pests.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0155 - 0.022	2.0 - 2.8 fl oz	PHI = 30 days. Maximum of 8.4 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.5 - 0.75	1 - 1.5 pts	PHI = 42 days. Do not apply more than 6 pt per acre per season or make more than 3 applications per season. Maximum single application rate is 1.88 lb ai per acre for preplant incorporation and 1.41 lb ai per acre for postemergence broadcast treatment. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated area.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.37 - 0.74 + 0.007 - 0.013	19 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications or apply more than 114 fl oz per season or after bloom initiation. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated areas.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.013 - 0.044	2.0 - 2.8 fl oz	PHI and pre-grazing/foraging interval = 30 days. Do not apply more than 0.044 lb ai per acre per 7 day interval. Do not apply more than 0.131 lb ai per acre per season. Do not make more than 6 applications per season. Do not apply ULV. Minimum application volume is 10 GPA for ground and 2 GPA for air.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.018	1.0 - 1.5 fl oz	PHI = 21 days. Do not apply more than 3.8 fl oz per acre per season. Do not graze or feed treated sunflower foliage to livestock.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 28 days. Do not apply more than 0.2 lb ai per acre per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 45 days.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 45 days. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.09 lb ai per acre per season after bloom initiation. Do not apply as an ultra-low volume (ULV) spray. Minimum application volume when applying by air is 2 GPA.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.02 - 0.03	1.33 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.014 - 0.025	2.24 - 4 fl oz	PHI =30 days. Do not apply more than 0.125 lb ai per acre per season. Do not make more than 5 applications at maximum application rate per season. Do not make applications less than 7 days apart. Do not graze livestock in treated areas or cut treated crops for feed. Minimum application volume is 10 GPA by ground and 2 GPA by air. Tank-mix with an NIS, COC or MSO for improved residual.

*RUP* - Restricted use pesticide

## CUTWORMS

Most damage by cutworms occurs when plants are in the early stage of development. Damage consists of young plants being chewed off slightly below or at ground level. Some cutworm feeding injury may occur on foliage. Cutworms primarily feed at night. When checking fields for cutworms during the day, dig down into soil an inch or two around recently damaged plants; there you can find the gray to gray-brown larva.

### Threshold:

Treatment is warranted when one cutworm or more is found per square foot or there is a 25% to 30% stand reduction observed.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0065 - 0.0125	0.8 - 1.6 fl oz	PHI = 30 days. Maximum of 8.4 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>carbaryl</b> Sevin 20% Bait Sevin XLR	1 - 2	20 - 40 lbs 1.5 qts	Broadcast applications may be made with aerial or ground equipment. PHI = 60 days.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E  Lorsban 15 G <i>RUP</i>	PPI: 1 - 2  Foliar broadcast: 1	PPI: 2 - 4 pts  Foliar broadcast: 2 pts  8 oz/1,000 ft of row (band at planting)	If ground is dry, cloddy or crusty at time of treatment, worms may be protected from the spray and effectiveness may be reduced. If such conditions exist, shallow cultivation using a rotary hoe or equivalent equipment before or soon after treatment may improve control. PHI = 42 days. Do not apply more than 6 pt per acre per season or make more than 3 applications per season. Maximum single application rate is 1.88 lb ai per acre for preplant incorporation and 1.41 lb ai per acre for postemergence broadcast treatment. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated area.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.37 - 0.74 + 0.007 - 0.013	19 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications or apply more than 114 fl oz per season or after bloom initiation. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated areas.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.013 - 0.025	0.8 - 1.6 fl oz	PHI and pre-grazing/foraging interval = 30 days. Do not apply more than 0.044 lb ai per acre per 7 day interval. Do not apply more than 0.131 lb ai per acre per season. Do not make more than 6 applications per season. Do not apply ULV. Minimum application volume is 10 GPA for ground and 2 GPA for air.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.018	1.0 - 1.5 fl oz	PHI = 21days. Do not apply more than 3.8 fl oz per acre per season. Do not graze or feed treated sunflower foliage to livestock.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 28 days. Do not apply more than 0.2 lb ai per acre per season.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.0125	1.92 - 3.2 fl oz	PHI = 45 days.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 45 days. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.09 lb ai per acre per season after bloom initiation. Do not apply as an ultra-low volume (ULV) spray. Minimum application volume when applying by air is 2 GPA.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.015 - 0.025	1.0 - 1.67 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	
<b>zeta-cypermethrin</b> Mustang Max Pending 2010 <i>RUP</i>	0.025	4 oz	For control of cutworms in-furrow directly over the sunflower seed. Apply a 5-7 inch T-band at 5 GPA over the seed furrow.
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.014 - 0.025	2.24 - 4 fl oz	PHI =30 days. Do not apply more than 0.125 lb ai per acre per season. Do not make more than 5 applications at maximum application rate per season. Do not make applications less than 7 days apart. Do not graze livestock in treated areas or cut treated crops for feed.

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## GRASSHOPPERS

In the Northern Plains, grasshopper egg hatch normally begins in late April to early May. Most grasshoppers emerge from eggs deposited in uncultivated ground. Sunflower growers should expect to find grasshopper feeding first along field margins adjacent to these sites. Later infestations may develop when grasshopper adults migrate from harvested small grain fields.

### Threshold:

The threatening rating is considered the action threshold for grasshoppers. For example, grasshopper control is advised whenever 50 or more small nymphs per square yard can be found in adjacent, non-crop areas, or when 30 or more nymphs per square yard can be found within the field. When 20 or more adults per square yard are found in field margins or 8 to 14 adults per square yard are occurring in the crop, treatment would be justified. Since it is difficult to estimate the number of grasshoppers per square yard when population densities are high, pest managers can use four 180-degree sweeps with a 15-inch sweep net, which is equivalent to the number of adult (or nymph) grasshoppers per square yard.

Rating	Nymphs (young hoppers) per square yard		Adults per square yard	
	Margin	Field	Margin	Field
Light	25-35	15-23	10-20	3-7
Threatening	50-75	30-45	21-40	8-14
Severe	100-150	60-90	41-80	15-28
Very Severe	200+	120	80+	28+

Many of the grasshopper infestations in sunflowers will be the heaviest on the field margins. Treating these areas may lessen the total numbers of grasshoppers successfully entering a field.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0065 - 0.0125	2.0 - 2.8 fl oz	PHI = 30 days. Maximum of 8.4 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>carbaryl</b> Sevin	0.5 - 1.5	rate varies by formulation	PHI = 60 days. Do not allow animals to graze on treated crops.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.5	1 pt	PHI = 42 days. Do not apply more than 6 pt per acre per season or make more than 3 applications per season. Maximum single application rate is 1.88 lb ai per acre for preplant incorporation and 1.41 lb ai per acre for postemergence broadcast treatment. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated area.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.14 - 0.25 + 0.003 - 0.004	7 - 13 fl oz	PHI = 45 days. Do not make more than 3 applications or apply more than 114 fl oz per season or after bloom initiation. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated areas.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.031 - 0.044	2.0 - 2.8 fl oz	PHI and pre-grazing/foraging interval = 30 days. Do not apply more than 0.044 lb ai per acre per 7 day interval. Do not apply more than 0.131 lb ai per acre per season. Do not make more than 6 applications per season. Do not apply ULV. Minimum application volume is 10 GPA for ground and 2 GPA for air.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.018	1.0 - 1.5 fl oz	PHI = 21 days. Do not apply more than 3.8 fl oz per acre per season. Do not graze or feed treated sunflower foliage to livestock.
<b>esfenvalerate</b> Adjourn	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 28 days. Do not apply more than 0.2 lb ai per acre per season.
<b>esfenvalerate</b> Asana XL <i>RUP</i>	0.02 - 0.03 0.03 - 0.05	Low Rate: 3.9 - 5.8 fl oz  High Rate: 5.8-9.6 fl oz	PHI = 21 days. A <b>reduced rate</b> has been issued as a state 2 (ee) label. These lower rates are for control of first- and second-stage grasshoppers, ONLY. The reduced-rate application has a range of 3.9 - 5.8 fl oz. The higher rates are for control of grasshopper nymphs larger than 2 <sup>nd</sup> instar. Do not apply more than 0.2 lb ai/acre per season. Do not feed or graze livestock on treated fields. Apply with a minimum of 2 GPA for air and 10 GPA for ground applications.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 45 days. Proaxis may be used in bordering, non-crop areas that are not hayed or grazed.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 45 days. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.09 lb ai per acre per season after bloom initiation. Do not apply as an ultra-low volume (ULV) spray. Minimum application volume when applying by air is 2 GPA.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.02 - 0.03	1.33 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.014 - 0.025	2.24 - 4 fl oz	PHI = 30 days. Do not apply more than 0.125 lb ai per acre per season. Do not make more than 5 applications at maximum application rate per season. Do not make applications less than 7 days apart. Do not graze livestock in treated areas or cut treated crops for feed. Minimum application volume is 10 GPA by ground and 2 GPA by air. Tank-mix with an NIS, COC or MSO for improved residual.

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## LONG-HORNED SUNFLOWER STEM GIRDLER OR LONG-HORNED BEETLE

Adults appear in mid-June to early July in the southern Plains. Emergence continues through August with 50% emerged by mid-July in Texas. Eggs are laid 4-8 days after mating and eggs are deposited singly in leaf petioles. Approximately 50 eggs are laid per female with about one-third viable. Eggs hatch in 6-10 days. Larvae tunnel and feed in the petioles and stem pith and finally move to the base of the plant to overwinter. Larvae develop through 6 instars. In late summer, the mature larvae girdle the inside of the lower stalk or root crown, move below the girdle, and pack frass into the tunnels. Stalks often break at the point of girdling, leaving the larva protected in its frass packed tunnel during the winter. Larvae are cannibalistic and stalks usually harbor only a single larva even though several may have originally hatched in a stalk. There is one generation per year. Host plants include sunflower, soybean, ragweed, and cocklebur. Plant damage due to adult feeding appears to be insignificant, since the scars do not penetrate the cortex nor encircle the stalk. Larval feeding is apparent when stalks lodge at the point of the girdle, about 2.5 to 3.5 inches (7 to 9-cm) above the soil surface.

**Scouting Method:** None has been developed.

**Economic Threshold:** None established.

**Management:** In the southern Plains, later planting dates and fall or winter tillage have reduced sunflower infestations by this pest. Perennial sunflower species are resistant to stalk infestation, indicating the possibility of breeding cultivars resistant to the long-horned sunflower stem girdler. Chemical treatments on soybean and sunflower are ineffective against larvae and were determined to be impractical against adults because of the extended emergence period. When larvae are present in the stalks, plants do not always lodge. Utilizing lower plant populations that encourage thicker stalks may help to reduce damage from lodging. If fields are suspected to be infested, prompt harvesting will limit losses from lodging.

## LYGUS BUG (TARNISHED PLANT BUG)

Concerns have been raised during the past three seasons about damage to **confection sunflower seeds**. The damage has been named "kernel brown spot" because of the dark spot on the kernel. All evidence suggests the problem is due to feeding by lygus on the developing seed.

Lygus are noted for being a pest of seed production to many crops. Their feeding preference is meristematic tissue, embryonic tissue or new growth of any kind. Lygus insert their mouthparts into the host, start a "pre-digestion pump" to inject saliva and start digestion, then suck the fluid into the stomach. This is where the seed injury originates. The saliva is toxic to plant tissue, helping reduce the plant fluid into a digestible source. The result in sunflower seeds is the brown to black spot resulting from tissue death at that feeding site.

There is still much to learn about lygus and sunflowers in the region. In the meantime, to minimize the damage which result in a quality reduction, a general approach to protecting sunflower from lygus and other seed feeding insects is being recommended. Sunflower is susceptible to lygus damage during flowering, from anthesis through seed hardening. A number of insecticides labeled for controlling head feeding insects in sunflower are available. Of these, the organophosphate (Lorsban, Methyl Parathion, Parathion) and pyrethroid (Asana XL, Baythroid, Warrior) insecticides are labeled for control of lygus on numerous other crops. Lygus can be treated at the same time confection sunflower is treated for other insects, such as the seed weevil and banded sunflower moth.

### Treatment Guideline:

**Confection** Entomologists found that populations of adult Lygus bugs at levels of 1 per 9 heads could result in economic loss to the producer through the reduction of seed quality. As a result, two treatments are needed to sufficiently protect confection sunflower heads from insect feeding: one application at the onset of pollen shed, or approximately 10% bloom, followed by a second treatment 7 days later. This program should adequately control insects on confection sunflower throughout flowering, minimizing the potential feeding damage.

**Oilseed** sunflower are not believed to be at risk to damage from Lygus feeding at this time.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>chlorpyrifos</b> Lorsban 4E Lorsban Advanced <i>RUP</i>	0.5 - 1.0	1 - 2 pts	PHI = 42 days. Do not apply more than 6 pt per acre per season or make more than 3 applications per season. Maximum single application rate is 1.88 lb ai per acre for preplant incorporation and 1.41 lb ai per acre for postemergence broadcast treatment. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated area.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.51 - 0.74 + 0.009 - 0.013	26 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications or apply more than 114 fl oz per season or after bloom initiation. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated areas.

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## SUNFLOWER BEETLE

Sunflower beetles begin feeding shortly after they emerge from overwintering. Emergence starts in mid-May. Most feeding by the adults is concentrated on the true leaves. When beetles are numerous, as in 1994 and 1995, fields may be severely defoliated. Adults quickly begin laying pale yellow eggs singly on stems and the underside of leaves. Eggs hatch in about 8 days. The pale green, humpbacked larvae begin feeding, eating holes throughout the leaf. Larvae do not feed during the day, resting in the plant tops where they are easily observed.

### Threshold:

**Adults** . . . Treatment is recommended when scouting determines that an average of 1 to 2 beetles per plant can be found throughout the field.

**Larvae** . . . When an average of 10 to 15 larvae per plant is found, defoliation levels of 25% to 30% would be expected. Treatment is suggested when damage levels reach this point and most larvae are 1/4 inch in size.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0065 - 0.0125	0.8 - 1.6 fl oz	PHI = 30 days. Maximum of 8.4 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>carbaryl</b> Sevin	1.5 - 2	rate varies by formulation	PHI = 60 days. Do not allow livestock to graze on treated forage.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.5 - 0.75	1 - 1.5 pts	PHI = 42 days. Do not apply more than 6 pt per acre per season or make more than 3 applications per season. Maximum single application rate is 1.88 lb ai per acre for preplant incorporation and 1.41 lb ai per acre for postemergence broadcast treatment. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated area.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.37 - 0.74 + 0.007 - 0.013	19 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications or apply more than 114 fl oz per season or after bloom initiation. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated areas.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.013 - 0.025	0.8 - 1.6 fl oz	PHI and pre-grazing/foraging interval = 30 days. Do not apply more than 0.044 lb ai per acre per 7 day interval. Do not apply more than 0.131 lb ai per acre per season. Do not make more than 6 applications per season. Do not apply ULV. Minimum application volume is 10 GPA for ground and 2 GPA for air.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.018	1.0 - 1.5 fl oz	PHI = 21 days. Do not apply more than 3.8 fl oz per acre per season. Do not graze or feed treated sunflower foliage to livestock.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.0075 - 0.03	1.45 - 5.8 fl oz	PHI = 28 days. Do not apply more than 0.2 lb ai per acre per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.0125	1.92 - 3.2 fl oz	PHI = 45 days.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 45 days. Do not apply more than 0.12 lb ai (15.36 fl oz) per acre per season. Do not apply more than 0.09 lb ai (0.72 pt) per acre per season after bloom initiation. Do not apply as an ultra-low volume (ULV) spray. Minimum application volume when applying by air is 2 GPA.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.015 - 0.025	1.0 - 1.67 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	PHI = 45 days. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.09 lb ai per acre per season after bloom initiation. Do not apply as an ultra-low volume (ULV) spray. Minimum application volume when applying by air is 2 GPA.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
zeta-cypermethrin Mustang Max EC <i>RUP</i>	0.014 - 0.025	2.24 - 4 fl oz	PHI =30 days. Do not apply more than 0.125 lb ai per acre per season. Do not make more than 5 applications at maximum application rate per season. Do not make applications less than 7 days apart. Do not graze livestock in treated areas or cut treated crops for feed. Minimum application volume is 10 GPA by ground and 2 GPA by air. Tank-mix with an NIS, COC or MSO for improved residual.

*RUP* - Restricted use pesticide

## SUNFLOWER MIDGE

The midge is a small fly, 3/32 inch in length, that is tan colored. The midge emerges in early July. They prefer to lay eggs on developing buds 1 to 2 inches in diameter. The cream to yellowish-orange larvae feed on bract tissue at first and later on the flowers and seeds. When populations are low and feeding is confined to the bracts, damage results in little economic loss. At higher populations, seed production is reduced or prevented. This type of injury appears as twisted and gnarled flowers. Often, infestations will be limited to field margins. When populations are large, damage may extend into the field and significant field losses may be observed. Historically, infestations and losses have increased with increased sunflower production. Also, environmental conditions contribute to midge outbreaks. Good soil moisture in the month of June promotes survival and emergence of midge.

### Threshold:

There are no effective chemical controls currently recognized for this pest. The best management strategy has been **rotation** to crops other than sunflower in the vicinity of large infestations. Staggering **planting dates** to promote different budding periods between fields aids in reducing risk of damage to all fields in the same geographic areas. Sunflower hybrids have recently been evaluated for their tolerance to sunflower midge. **Selecting hybrids** for their ability to tolerate infestations should be considered when choosing seed for the upcoming season. The midge tolerance ratings for hybrids evaluated during 2008 are listed below.

Sunflower Midge, Sunflower Seed Maggot, and Sunflower Bud Moth Hybrid Trial 2009 - Mapleton, ND Larry D. Charlet, USDA, ARS, Northern Crop Science Laboratory, Fargo, ND Janet J. Knodel, Department of Entomology, NDSU, Fargo, ND							
Hybrid	Growth stage [R]	Head diameter (cm)	Sunflower Midge				
			Round Index	Necrosis Index (0-5)		Bracken Scale (0-5)	
				Hybrid mean	Relative mean	Hybrid mean	Relative mean
USDA Hybrid 894	6.1	18.4	0.034	1.84	1.44	0.64	1.52
Advanta Pacific F51122	6.0	15.8	0.017	2.65	2.07	0.55	1.31
Advanta Pacific F51137	6.0	15.7	0.018	1.95	1.52	0.50	1.19
Advanta Pacific F51139	6.0	16.2	0.016	0.80	0.63	0.15	0.36
Advanta Pacific F51311	6.0	16.5	0.014	1.35	1.05	0.35	0.83
Advanta Pacific AP461	6.0	13.4	0.027	2.05	1.60	0.50	1.19
Advanta Pacific AP464	6.0	17.2	0.028	1.65	1.29	0.45	1.07
Advanta Pacific AP443	6.0	15.5	0.030	2.25	1.76	0.85	2.02
CHS 09HRT-1	6.0	15.5	0.019	1.30	1.02	0.40	0.95
CHS 09HRT-2	6.0	16.0	0.025	2.30	1.80	0.75	1.79
CHS 09HRT-3	6.0	17.9	0.028	0.65	0.51	0.05	0.12
CHS 09HRT-4	6.0	17.3	0.028	1.35	1.05	0.25	0.60
CHS 09HRT-5	6.0	15.1	0.024	1.45	1.13	0.45	1.07
CHS 09HRT-6	6.0	17.0	0.020	2.30	1.80	0.80	1.90
CHS 09HRT-7	6.0	15.7	0.060	2.60	2.03	0.70	1.67
Croplan WF09-01	6.0	18.0	0.027	0.60	0.47	0.20	0.48
Croplan WF09-02	6.0	16.5	0.013	1.50	1.17	0.35	0.83
Croplan WF09-03	6.0	17.6	0.023	1.30	1.02	0.45	1.07
Croplan WF09-05	6.0	18.3	0.016	1.00	0.78	0.15	0.36

Sunflower Midge, Sunflower Seed Maggot, and Sunflower Bud Moth Hybrid Trial 2009 - Mapleton, ND Larry D. Charlet, USDA, ARS, Northern Crop Science Laboratory, Fargo, ND Janet J. Knodel, Department of Entomology, NDSU, Fargo, ND							
Hybrid	Growth stage [R]	Head diameter (cm)	Sunflower Midge				
			Round Index	Necrosis Index (0-5)		Bracken Scale (0-5)	
				Hybrid mean	Relative mean	Hybrid mean	Relative mean
Croplan WF09-06	6.0	15.4	0.014	1.25	0.98	0.25	0.60
Croplan WF09-07	6.0	17.7	0.025	2.30	1.80	0.60	1.43
Croplan WF09-09	6.0	16.1	0.029	1.40	1.09	0.30	0.71
Dahlgren 94EXCL	6.0	17.7	0.044	0.40	0.31	0.15	0.36
Dahlgren 9599	6.0	17.2	0.029	1.45	1.13	0.40	0.95
Interstate MH9001	6.0	16.7	0.014	0.50	0.39	0.20	0.48
Interstate MH9002	6.0	16.1	0.032	1.10	0.86	0.55	1.31
Mycogen M9560	6.0	14.7	0.020	0.80	0.63	0.40	0.95
Mycogen 8N288	6.0	18.0	0.022	0.80	0.63	0.40	0.95
Mycogen 8N433	6.0	16.5	0.043	0.70	0.55	0.45	1.07
Mycogen 8N270	6.0	14.9	0.020	1.30	1.02	0.45	1.07
Mycogen 8N358	6.0	16.4	0.040	1.30	1.02	0.25	0.60
Nidera LN 9992	6.0	18.7	0.032	1.10	0.86	0.30	0.71
Nidera KN 9035	6.0	19.0	0.033	1.50	1.17	0.50	1.19
Nidera LK 9987	6.0	16.9	0.021	2.15	1.68	0.80	1.90
Nidera JN 7381	6.0	16.2	0.013	1.35	1.05	0.35	0.83
PANNAR PEX 7803	6.0	15.3	0.033	2.25	1.76	0.70	1.67
PANNAR PEX 7904	6.0	17.5	0.024	1.45	1.13	0.45	1.07
PANNAR PEX 7404	6.0	19.8	0.022	1.65	1.29	0.45	1.07
PANNAR PAN 8466	6.0	18.9	0.025	0.40	0.31	0.20	0.48
PANNAR PAN 8579	6.0	15.6	0.042	1.05	0.82	0.45	1.07
Pioneer 63N82	6.0	16.7	0.024	1.50	1.17	0.55	1.31
ProSeed E-8	6.0	18.1	0.07	1.40	1.09	0.30	0.71
ProSeed 7001CL	6.0	16.8	0.031	1.15	0.90	0.30	0.71
ProSeed 9001CL	6.3	16.2	0.024	2.05	1.60	0.60	1.43
Red River 2215	6.2	17.7	0.026	0.70	0.55	0.25	0.60
Red River 2217	6.3	17.8	0.030	0.45	0.35	0.25	0.60
Seeds2000 4744	6.0	16.2	0.020	0.60	0.47	0.35	0.83
Seeds2000 9478	6.2	18.3	0.020	0.55	0.43	0.30	0.71
Seeds2000 4994	6.0	18.9	0.035	0.15	0.12	0.15	0.36
Seeds2000 9427	6.3	16.6	0.006	0.70	0.55	0.30	0.71
Seeds2000 5619	6.1	15.7	0.033	1.15	0.90	0.50	1.19
Seeds2000 6796	6.0	16.2	0.017	0.85	0.66	0.30	0.71
Seeds2000 4294	6.2	15.3	0.056	1.45	1.13	0.85	2.02
Seeds2000 3939	6.2	17.4	0.018	1.95	1.52	0.55	1.31
Seeds2000 3974	5.8	17.9	0.037	0.95	0.74	0.10	0.24
Seeds2000 4529	6.1	18.6	0.020	1.45	1.13	0.55	1.31
Seeds2000 4537	6.2	18.6	0.017	0.60	0.47	0.25	0.60
Seeds2000 4129	6.3	15.7	0.022	1.60	1.25	0.45	1.07
Seeds2000 4137	6.1	17.1	0.023	1.10	0.86	0.55	1.31
Seeds2000 9477	6.2	16.0	0.022	1.35	1.05	0.35	0.83
Tom Heaton XFG1	6.3	17.7	0.026	1.40	1.09	0.40	0.95
Tom Heaton XFG2	6.1	17.5	0.029	0.55	0.43	0.25	0.60
Tom Heaton XFG3	6.3	19.7	0.042	1.75	1.37	0.75	1.79

Sunflower Midge, Sunflower Seed Maggot, and Sunflower Bud Moth Hybrid Trial 2009 - Mapleton, ND Larry D. Charlet, USDA, ARS, Northern Crop Science Laboratory, Fargo, ND Janet J. Knodel, Department of Entomology, NDSU, Fargo, ND								
Hybrid	Growth stage [R]	Head diameter (cm)	Sunflower Midge					
			Round Index	Necrosis Index (0-5)		Bracken Scale (0-5)		
				Hybrid mean	Relative mean	Hybrid mean	Relative mean	
Tom Heaton XFG4	6.3	15.4	0.033	1.30	1.02	0.45	1.07	
Tom Heaton XFG5	6.3	17.3	0.031	0.60	0.47	0.30	0.71	
Tom Heaton XFG6	6.3	18.0	0.046	0.85	0.66	0.40	0.95	
Tom Heaton XFG7	6.2	17.6	0.085	1.10	0.86	0.65	1.55	
Triumph 8325	6.0	15.3	0.045	0.90	0.70	0.30	0.71	
Triumph 8330	6.1	17.3	0.028	0.90	0.70	0.30	0.71	
Triumph 8341	6.3	19.8	0.023	1.15	0.90	0.20	0.48	
Triumph 9342	6.0	19.4	0.035	0.45	0.35	0.25	0.60	
Triumph 9343	6.0	20.5	0.031	0.80	0.63	0.50	1.19	
Triumph 9420	6.0	15.1	0.020	1.70	1.33	0.60	1.43	
Triumph 9427	6.0	16.5	0.034	0.85	0.66	0.40	0.95	

**Plant growth stage** measurements and ratings taken on 28 August 2009; hybrids in single row plots randomized and replicated 4 times; 5 plants were evaluated per row (20 total per hybrid).  
**Round index** measures the head deviation from the expected round shape with larger values indicating a greater deviation from the round shape.  
**Necrosis index** measures the extent of necrosis at the base of the bracts caused by sunflower midge larval feeding and the range is 0 (no injury) to 5 (50% or more of each quadrant of the head with midge necrosis);  
**Relative necrosis index** is the hybrid mean divided by the trial mean. Values less than one indicated a rating less than the average of the trial.  
**Bracken scale** measures sunflower midge injury symptoms on a 0 (no injury) to 5 (head closed, no seeds present) scale; **Relative bracken scale** is the hybrid mean divided by the trial mean. Values less than one indicated a rating less than the average of the trial.  
**Seed maggot score** measures injury symptoms to the sunflower head on a 0 (no injury) to 5 (feeding damage extending through all quadrants of the head); **Relative seed maggot score** is the hybrid mean divided by the trial mean. Values less than one indicated a rating less than the average of the trial.  
**Sunflower bud moth** damage is the percentage of evaluated heads with visible damage caused by larval feeding injury.

## SUNFLOWER MOTH

The sunflower moth migrates to North Dakota from Southern states. Because of the migratory nature of the insect, it has not been a major problem in North Dakota in recent years. This grayish-tan moth moves into fields in early bloom. It deposits its eggs on the face of the flower. Damage is similar to that caused by the banded sunflower moth. Since female moths lay eggs on the face of sunflower heads, insecticide should be applied in early flowering (R5.1 - R5.3).

**Threshold:**

When 1 to 2 moths are found for every 5 plants inspected, treatments should be considered.

INSECTICIDE	DOSAGE IN LB A/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<i>Bacillus thuringiensis</i> For Organic Production	see specific labels for rate recommendations		No preharvest interval. Non-toxic to man or wildlife. Worker Restricted Entry Interval (REI) is 4 hours. Treat when larvae are young (early instars) before crop is damaged. Larvae must be actively feeding on treated, exposed plant surfaces. Under heavy pest population pressure, use the higher label rates, shorten the spray interval (3-14 days), and /or raise spray volume to improve spray coverage. Currently labeled are: Agree®, Biobit®, Condor G®, Dipel®, Javelin®, M-Peril®, MVP®.
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0155 - 0.022	2.0 - 2.8 fl oz	PHI = 30 days. Maximum of 8.4 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.5 - 0.75	1 - 1.5 pts	PHI = 42 days. Do not apply more than 6 pt per acre per season or make more than 3 applications per season. Maximum single application rate is 1.88 lb ai per acre for preplant incorporation and 1.41 lb ai per acre for postemergence broadcast treatment. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated area.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.37 - 0.74 + 0.007 - 0.013	19 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications or apply more than 114 fl oz per season or after bloom initiation. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated areas.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.013 - 0.044	2.0 - 2.8 fl oz	PHI and pre-grazing/foraging interval = 30 days. Do not apply more than 0.044 lb ai per acre per 7 day interval. Do not apply more than 0.131 lb ai per acre per season. Do not make more than 6 applications per season. Do not apply ULV. Minimum application volume is 10 GPA for ground and 2 GPA for air.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.018	1.0 - 1.5 fl oz	PHI = 21 days. Do not apply more than 3.8 fl oz per acre per season. Do not graze or feed treated sunflower foliage to livestock.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 28 days. Do not apply more than 0.2 lb ai per acre per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 45 days.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 45 days. Do not apply more than 0.12 lb ai (15.36 fl oz) per acre per season. Do not apply more than 0.09 lb ai (0.72 pt) per acre per season after bloom initiation. Do not apply as an ultra-low volume (ULV) spray. Minimum application volume when applying by air is 2 GPA.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.02 - 0.03	1.33 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	PHI = 45 days. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.09 lb ai per acre per season after bloom initiation. Do not apply as an ultra-low volume (ULV) spray. Minimum application volume when applying by air is 2 GPA.
<b>methyl parathion</b> <i>RUP</i>	1	2 pts	First application at onset of bloom. Make no more than 3 applications at 5 day intervals. PHI = 30 days. Do not feed seeds to birds. Do not enter treated fields within 48 hours.
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.014 - 0.025	2.24 - 4 fl oz	PHI = 30 days. Do not apply more than 0.125 lb ai per acre per season. Do not make more than 5 applications at maximum application rate per season. Do not make applications less than 7 days apart. Do not graze livestock in treated areas or cut treated crops for feed. Minimum application volume is 10 GPA by ground and 2 GPA by air. Tank-mix with an NIS, COC or MSO for improved residual.

*RUP* - Restricted use pesticide

## SUNFLOWER SEED WEEVIL

The red sunflower seed weevil begins to emerge in early July and continues until mid-August. Peak emergence occurs in late July. Start counting adult seed weevils when the yellow ray petals are just beginning to show. Counts should continue until the economic threshold level has been reached or most plants have reached 70% pollen shed. A plant that has reached 70% pollen shed has few seeds still suitable for red seed weevil egg laying. Fields where most plants are at the 70% pollen shed stage should no longer be susceptible to further significant damage.

When sampling, use the X pattern and begin counting at least 70 to 100 feet into the field to avoid field margin effects. Count the number of weevils on five plants at each site for a total of 25 plants. The ideal plant stage for treatment is when most individual plants are at 40% pollen shed. However, we recommend that treatment be considered when three out of 10 plants are just beginning to shed pollen.

**Threshold:**

**Oilseed Sunflower . . .** The threshold can be calculated using the following formula:

$$\text{Threshold (Weevils per head)} = \frac{\text{Cost of Insecticide Treatment}}{(\text{Market Price} \times 21.5) (0.00022 \times \text{Plant Population} + 0.18)}$$

*example for calculating threshold: Price for Oilseed Sunflowers = \$0.19*

Plant Population	Treatment Cost (\$)					
	6.00	7.00	8.00	9.00	10.00	11.00
17,000	3	3	4	4	4	5
18,000	3	3	3	4	4	5
19,000	2	3	3	4	4	5
20,000	2	3	3	4	4	4
21,000	2	3	3	3	4	4
22,000	2	3	3	3	4	4
23,000	2	2	3	3	4	4
24,000	2	2	3	3	3	4
25,000	2	2	3	3	3	4

Estimation of absolute red sunflower seed weevil adults when sampling using a commercial formulation of mosquito repellent.					
Number counted in the field	Absolute number	Number counted in the field	Absolute number	Number counted in the field	Absolute number
1	1.4	7	12.4	13	23.1
2	2.9	8	14.2	14	24.9
3	4.4	9	16.0	15	26.6
4	5.8	10	17.8	16	29.3
5	7.3	11	19.5	17	31.1
6	10.7	12	21.3	18	32.9

**Confection or Hulling Sunflower Market . . .** red sunflower seed weevil control on confection sunflower is based on a need to keep seed damage below 0.5% due to industry standards. Treatment is recommended when 1 to 2 weevils are found per plant.

The **banded moth**, **seed weevil** and the **Lygus bug** have all impacted quality of these sunflowers the past three to four seasons. It is recommended at this time that **sunflowers grown for these markets be treated a minimum of two times**, once at early flowering and again 5 to 7 days later. With this type of program, a window of protection should be provided to minimize impact from all three of these seed damaging insect pests.

Growers should plan treatment schedules early. When flowers begin blooming across the region, competition for access to aerial applicators increases.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
beta-cyfluthrin Baythroid XL  <i>RUP</i>	0.0155 - 0.022	2.0 - 2.8 fl oz	PHI = 30 days. Maximum of 8.4 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.5 - 0.75	1 - 1.5 pts	PHI = 42 days. Do not apply more than 6 pt per acre per season or make more than 3 applications per season. Maximum single application rate is 1.88 lb ai per acre for preplant incorporation and 1.41 lb ai per acre for postemergence broadcast treatment. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated area.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.37 - 0.74 + 0.007 - 0.013	19 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications or apply more than 114 fl oz per season or after bloom initiation. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated areas.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.013 - 0.044	2.0 - 2.8 fl oz	PHI and pre-grazing/foraging interval = 30 days. Do not apply more than 0.044 lb ai per acre per 7 day interval. Do not apply more than 0.131 lb ai per acre per season. Do not make more than 6 applications per season. Do not apply ULV. Minimum application volume is 10 GPA for ground and 2 GPA for air.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.018	1.0 - 1.5 fl oz	PHI = 21 days. Do not apply more than 3.8 fl oz per acre per season. Do not graze or feed treated sunflower foliage to livestock.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 28 days. Do not apply more than 0.2 lb ai per acre per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 45 days.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 45 days. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.09 lb ai per acre per season after bloom initiation. Do not apply as an ultra-low volume (ULV) spray. Minimum application volume when applying by air is 2 GPA.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.02 - 0.03	1.33 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	PHI = 45 days. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.09 lb ai per acre per season after bloom initiation. Do not apply as an ultra-low volume (ULV) spray. Minimum application volume when applying by air is 2 GPA.
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.014 - 0.025	2.24 - 4 fl oz	PHI = 30 days. Do not apply more than 0.125 lb ai per acre per season. Do not make more than 5 applications at maximum application rate per season. Do not make applications less than 7 days apart. Do not graze livestock in treated areas or cut treated crops for feed. Minimum application volume is 10 GPA by ground and 2 GPA by air. Tank-mix with an NIS, COC or MSO for improved residual.

*RUP* - Restricted use pesticide

## SUNFLOWER STEM WEEVIL

The sunflower stem weevil can cause serious stalk breakage. This occurs when 25 to 30 larvae are present in a stalk, weakening the stalk when larvae make their overwintering cells in the stalk's base. Breakage is most likely to occur during drought stress or high winds.

The sunflower stem weevil is 3/16 inch in length, and grayish-brown with varying shaped white spots on the wing covers. The weevils emerge in mid to late June. Eggs are deposited in epidermal tissue of the stem. If controls are directed at the adults in order to minimize egg laying, treatments should be initiated during the first few days in July. About 50% of the eggs will be deposited by this weevil by mid-July.

Scouting for these insects is difficult due to their size, coloration and habit of "playing dead." Examine 5 plants each at 5 locations and keep a record of the number of weevils found. Approach plants carefully to avoid alarming the weevils, causing them to drop to the ground. Scout from late June to mid-July.

**Threshold:**

Treat for sunflower stem weevils when scouting determines that an average of 1 adult per three plants is found.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0125 - 0.019	1.6 - 2.4 fl oz	PHI = 30 days. Maximum of 8.4 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>carbaryl</b> Sevin	1 - 2	rate varies by formulation	PHI = 60 days. Do not allow livestock to graze on treated forage.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.5 - 0.75	1 - 1.5 pts	PHI = 42 days. Do not apply more than 6 pt per acre per season or make more than 3 applications per season. Maximum single application rate is 1.88 lb ai per acre for preplant incorporation and 1.41 lb ai per acre for postemergence broadcast treatment. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated area.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.37 - 0.74 + 0.007 - 0.013	19 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications or apply more than 114 fl oz per season or after bloom initiation. Do not make a second application within 10 days of the first application. Do not allow meat or dairy animals to graze in treated areas.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.038	1.6 - 2.4 fl oz	PHI and pre-grazing/foraging interval = 30 days. Do not apply more than 0.044 lb ai per acre per 7 day interval. Do not apply more than 0.131 lb ai per acre per season. Do not make more than 6 applications per season. Do not apply ULV. Minimum application volume is 10 GPA for ground and 2 GPA for air.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.018	1.0 - 1.5 fl oz	PHI = 21 days. Do not apply more than 3.8 fl oz per acre per season. Do not graze or feed treated sunflower foliage to livestock.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 28 days. Do not apply more than 0.2 lb ai per acre per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 45 days.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 45 days. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.09 lb ai per acre per season after bloom initiation. Do not apply as an ultra-low volume (ULV) spray. Minimum application volume when applying by air is 2 GPA.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.02 - 0.03	1.33 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	PHI = 45 days. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.09 lb ai per acre per season after bloom initiation. Do not apply as an ultra-low volume (ULV) spray. Minimum application volume when applying by air is 2 GPA.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.014 - 0.025	2.24 - 4 fl oz	PHI =30 days. Do not apply more than 0.125 lb ai per acre per season. Do not make more than 5 applications at maximum application rate per season. Do not make applications less than 7 days apart. Do not graze livestock in treated areas or cut treated crops for feed. Minimum application volume is 10 GPA by ground and 2 GPA by air. Tank-mix with an NIS, COC or MSO for improved residual.

*RUP* - Restricted use pesticide

## WIREWORMS

To decide whether wireworms are a potential problem, refer to the discussion in the corn insects section. Cruiser and Gaucho 600 is labeled as commercial seed treatment and use decisions must be made at time of seed purchase. Please see the seed treatment section in the introduction for more information.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Dyna-Shield Imidacloprid 5	refer to recommended label rate	12.8 fl oz per cwt of seed	Apply as a seed treatment or for end-use at agricultural establishments (total slurry treater, farmer applied seed treater). Do not graze or feed livestock on treated area for 45 days after planting. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Gaucho 600	refer to recommended label rate		Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>thiamethoxam</b> Cruiser 5FS	refer to recommended label rate	0.25 mg ai per seed	Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>zeta-cypermethrin</b> Mustang Max Pending 2009 <i>RUP</i>	0.025	4 oz	For control of wireworm in-furrow directly over the sunflower seed. Apply a 5-7 inch T-band at 5 GPA over the seed furrow.