Sunflower Seed Weevil Management

E-817 (Revised), April 1997

Chengwang Peng, Research Associate of Entomology
Gary J. Brewer, Associate Professor of Entomology
Laurence D. Charlet, USDA-ARS, Research Entomologist
Phillip A. Glogoza, Extension Entomologist

Sunflower Seed Weevil Management

Two species of seed weevils are present on sunflower in the northern Great Plains. They are the red sunflower seed weevil (*Smicronyx fulvus* LeConte) (**Figure 1** 14KB color jpg) and the gray sunflower seed weevil (*Smicronyx sordidus* LeConte) (**Figure 2** 17KB color jpg). It is important to be able to distinguish the two species because different control strategies are needed for each weevil.

The adults of red sunflower seed weevil are 1/10 to 1/8 inch (2.5 to 3 mm) long and are reddish-brown. The adults of gray sunflower seed weevil are slightly larger and gray in color. The larvae of both species are small, cream-colored, legless and C-shaped in appearance.

Figure 1 (Left)
Red sunflower seed weevil,
Smicronyx fulvus.

Figure 2 (Right)
Gray sunflower seed weevil,
Smicronyx sordidus.

Red Sunflower Seed Weevil

Life cycle (Figures 3 and 4)

Red sunflower seed weevil begins to emerge from the soil in early July and continues until about mid-August. Peak emergence occurs in late July to early August.

Newly emerged adults feed on the bracts of sunflower buds. When the sunflower head begins to bloom, the adults feed on the pollen, and as the seeds begin to fill, lay eggs within the seed. Most of the egg deposition involves a single egg per seed, although research has revealed that 8 to 12 percent of seeds may have multiple eggs per seed.

The small, white, oval-shaped eggs hatch in approximately one week. Larvae consume the meat of the seed, causing the economic loss. The majority of the larvae drop to the ground from mid-August through September after completing larval development. They overwinter in the soil at a depth of about 6 inches. Larvae pupate the following year in mid to late June and the pupal period lasts about one week. In North Dakota, there is a single generation per year

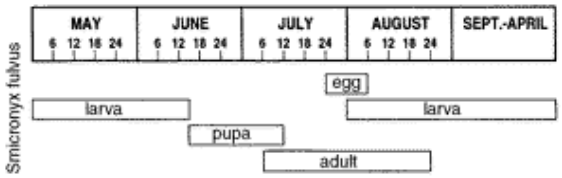

Figure 3. Approximate appearance of life stages of the red sunflower seed weevil.

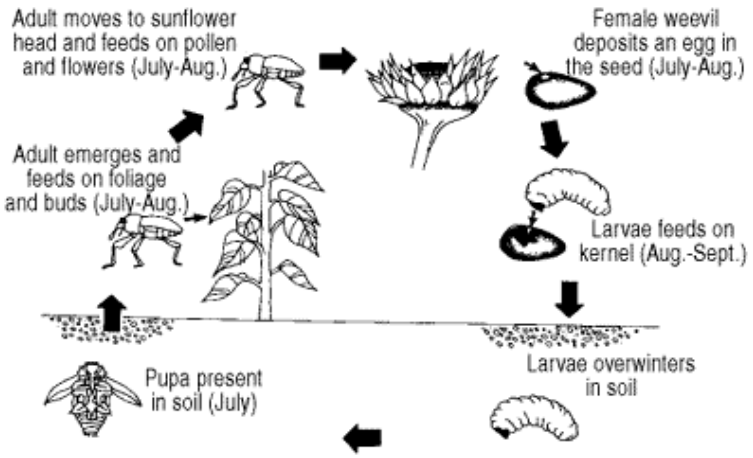

Figure 4. Life cycle of the red sunflower seed weevil.

How Sunflower is Damaged by the Red Sunflower Seed Weevil

Research reveals that most seeds are only partially consumed or destroyed by the larvae and that the damaged seeds have lower oil content than the undamaged seeds. The economic loss caused by the larval feeding includes the loss of both seed weight and oil content.

Larvae normally drop from the head to the soil after completing their development, but a small percentage may remain in the seed and be present at harvest. If larvae drop from the seed, an exit hole is present on the side of the seed. Growers with a seed weevil infestation are advised to delay harvest whenever possible. This allows most of the weevil larvae to leave the seeds so larvae will not be harvested along with the seeds. Larvae can cause heating and moisture problems in storage or in the stored seed.

Larvae remaining in the seed at harvest and bin filling time will not be controlled by fumigation until they complete development and emerge from the infested seeds. While control of emerged larvae is possible and does reduce potential heating problems caused by live larval activity, the problem of dead larvae in the bin will remain. For this reason, and the fact that larvae have already damaged the seed, the most economic time to initiate control is in the field when the adult weevils are active, but just before egg deposition begins.

Management Strategies

Cultural control

Cultural control methods such as tillage and planting date have been effective against red sunflower seed weevil. Fall or spring moldboard tillage in South Dakota reduced the overwintering larval populations and adult weevil emergence the following spring. Research in North Dakota revealed that planting sunflower in early to mid May will help reduce red sunflower seed weevil damage. However, early planting may increase damage by the banded sunflower moth and the sunflower stem weevil. Growers attempting to use planting dates to control any sunflower insect should be aware of all the insect pests they are likely to have, not just one species.

Trap cropping

Trap crop consists of a field margin planted to an early blooming sunflower that surrounds the remaining field area. Trap crops protect yield by concentrating and managing red sunflower seed weevils in a small part of a field. This allows for treating the trap area with an insecticide to control weevil adults. A trap crop works because seed weevils have a distinct preference for sunflower that is shedding pollen. If only a part of a field is in bloom, most weevils will be in that area of the field. When concentrated, they can be managed more easily and more economically than by treating the entire field.

Because sunflower is rotated to new fields each year, overwintering weevils emerging from the previous year's fields must find the current year's new fields. The early blooming trap margin will be more attractive to the searching adult weevils than the rest of the field. As the trap margin progresses past the flowering stage and the remaining part of the field begins to bloom, the trap effect decreases. The weevils then will begin to leave the margin and move into the field interior. It is important that controls be applied before the main portion of the field starts to bloom. Maximum effectiveness is obtained when controls are applied shortly before the interior of the field starts to flower.

In a trap crop only the field margin (about 10 percent of the field area) is treated, so the cost of control is much less than whole-field treatment. The result is equivalent yields while saving about 90 percent of the management costs.

Unfortunately, weather conditions may result in the early planted field margin and the remainder of the field flowering together. If that occurs, the field will need to be treated conventionally. The only loss will be in the extra management involved in planting the trap margin. Trap cropping is recommended in areas where economic populations of the red sunflower seed weevil are expected in oilseed sunflower fields.

Trap field design The goal in designing a trap field is to have the field margin flower in late July to early August and seven to 10 days before the rest of the field. At that time most weevil adults will already be in the fields and susceptible to treatment. Trap rows (16 rows or about the width of a single pass of an aerially applied insecticide) should be planted to an early maturing hybrid. A week to 10 days after the trap rows have been seeded, the rest of the field should be planted to a later season hybrid. This should allow the margin to start flowering ahead of the main portion of the field and allow enough time to decide whether treatment is needed. If the trap rows flower before late July, late emerging weevils arriving in the field after the trap rows are treated may pose an economic concern to the rest of the field.

Treatment decision When more than half of the plants in the trap rows are in the stage of just showing yellow ray petals (**R5.0**) to 30 percent of the head shedding pollen (**R5.3**) and the rest of the plants in the trap rows are in the bud stage, sample the plants for adult weevils (See the **Timing Insecticide Treatment** section for detailed description on plant stages) If the economic threshold is reached, treat the trap rows with an insecticide. Some weevils will be in the field interior and escape control when the trap rows are treated or other weevils may migrate into the field following treatment, so continue to sample for adult weevils in the field. If economic threshold levels are reached, the remaining portion of the field interior should also be treated.

Chemical Control

The use of insecticidal treatments is a management option ONLY when populations of the red sunflower seed weevil reach the economic threshold. To make a treatment decision, a grower needs to know three things. First, how many weevils will cause economic damage. Second, how many red sunflower seed weevils are in the field. Third, when should an insecticide treatment be initiated. The following sections answer those questions in detail.

Calculating Economic Thresholds for the Red Sunflower Seed Weevil

Oilseed sunflower

To decide whether to use an insecticide treatment to control red sunflower seed weevils, it is necessary to know the economic threshold. The economic threshold for red sunflower seed weevil depends on the following variables:

- the cost of insecticide treatment per acre;
- the market price of sunflower in dollars per pound;
- the plant population per acre.

The numbers shown in the formula are constants that simplify the calculation. They replace calculations for amount of seed consumed by one larva, the number of damaged seeds per each weevil sampled, and the oil content loss of the infested seeds. **Table 1** gives the economic thresholds for specific treatment costs, market price of sunflower, and plant population.

ECONOMIC THRESHOLD=

$$\frac{\text{Cost of Insecticide Treatment}}{(\text{Market Price} \times 21.5)\ (0.000022 \times \text{Plant Population} + 0.18)}$$

For example, assuming a treatment cost of $8.00 per acre, a sunflower market price of $0.10 per pound, and 18,000 sunflower plants per acre in the field, **Table 1** indicates an economic threshold of seven weevils per sunflower head. This is the number of weevils that will cause a dollar loss equal to the $8.00 per acre treatment cost. Spraying would not be economical if the number of weevils in the field, which is determined by scouting for the weevil adults based on the procedures described in the **Scouting Techniques** section, are less than seven per sunflower head.

Confection sunflower

The economic threshold for red sunflower seed weevil on confection sunflower is based on the need to keep seed damage below 3 to 4 percent due to industry standards. Assuming confection sunflower contains 800 seeds per head, the number of damaged seeds per head would therefore need to be kept below 24 to 32 to remain below the industry standard of 3 to 4 percent seed damage. Research on oilseed sunflower indicates that for each weevil sampled in the early bloom stage, 27 damaged seeds resulted. This suggests about one weevil per head as an economic threshold for red sunflower seed weevil on confection sunflower.

Table 1. Economic threshold (weevils per head) for red sunflower seed weevil.

Cost of spray ($/ACRE)	Market price ($/LB)	17	18	19	20	21	22	23	24	25
		Sunflower plants per acre (x1000)								
	0.07	10	9	9	9	8	8	8	8	7
	0.08	8	8	8	8	7	7	7	7	6
8.00	0.09	8	7	7	7	6	6	6	6	6
	0.10	7	7	6	6	6	6	5	5	5
	0.11	6	6	6	6	5	5	5	5	5
	0.12	6	5	5	5	5	5	5	4	4
	0.07	11	10	10	10	9	9	9	8	8
	0.08	9	9	9	8	8	8	8	7	7
9.00	0.09	8	8	8	8	7	7	7	7	6
	0.10	8	7	7	7	7	6	6	6	6
	0.11	7	7	6	6	6	6	6	5	5
	0.12	6	6	6	6	5	5	5	5	5
	0.07	12	12	11	11	10	10	10	9	9
	0.08	11	10	10	9	9	9	9	8	8
10.00	0.09	9	9	9	8	8	8	8	7	7
	0.10	8	8	8	8	7	7	7	7	6
	0.11	8	7	7	7	6	6	6	6	6
	0.12	7	7	7	6	6	6	6	6	5

Scouting Techniques

Growers should start counting adult red sunflower seed weevils when more than half of the plants in the field are in the stage of just showing yellow ray petals (**R5.0**) to 30 percent of the head shedding pollen (**R5.3**) and the rest of the plants in the field are still in the bud stage. Counts should continue until the economic threshold has been reached or most plants have reached 70 percent pollen shed (**R5.7**). A plant that has reached 70 percent pollen shed has very few seeds that are still at a stage of development suitable for red sunflower seed weevil oviposition. Therefore, when most plants are at the 70 percent pollen shed stage the field effectively is no longer susceptible to further damage. The following describes the sampling steps in deciding if the number of weevils in a field justifies control measures:

Step 1.

Before entering the field determine the economic threshold from **Table 1** or the formula previously given. Once the economic threshold is determined, find the corresponding ET columns from **Table 2**. The numbers in these columns represent the estimated total number of weevils and are used to make sampling and treatment decisions.

Step 2.

When sampling, choose four sampling sites with one site on each side of the field. The sampling sites should be at least 75 feet in from the edge of the field. Count the number of weevils on three plants at each site for a total of 12 plants. The key to accurate estimation of weevil populations in the field is representative sampling. Sunflower heads for weevil counts must be randomly selected without regard to plant stage.

For accurate checking of individual sunflower heads, spray the face of the heads with a commercial mosquito repellent containing diethyl toluamide (DEET). This will cause most of the weevils to move out of hiding spots. Then use **Table 3** to estimate the total number of weevils on the plant. Total the estimated number of weevils found on the 12 plants.

Step 3.

Use **Table 2** to compare the estimated total number of weevils for 12 plants with the numbers found in the columns under the economic threshold that was determined in step 1. If the total number of weevils found in your field is less than the number indicated in the `**Do not treat**' column, the current number of weevils will not cause an economic problem. If the total number of weevils found in your field is more than the number indicated in the `**Need to treat**' column, you need to treat with an insecticide. If the total number of weevils found in your field falls within the range of numbers indicated, you must sample two more sunflower heads.

If you need to continue sampling, take another two samples from the field and add the totals of all samples taken and compare the total to **Table 2** again. Additional samples should be spread throughout the field. If further samples are needed, take two more samples from the field.

If you have taken 54 samples (oilseed sunflower) or 38 samples (confection sunflower) and **Table 2** still indicates more samples are required, calculate the average number of weevils per head. If the average number of weevils is greater than the economic threshold, treat the field. Otherwise, do not treat the field.

Table 2. Total estimated number of weevils for specific number of samples that are used to make sampling and treatment decisions.

Total Number of Samples	Oilseed Sunflower				Confection Sunflower	
	ET is 5, 6, or 7		ET is 8, 9, or 10		ET is 1	
	Do not treat	Need to treat	Do not treat	Need to treat	Do not treat	Need to treat
12	8	134	--	206	6	14
14	19	145	--	222	8	16
16	31	157	16	238	10	18
18	43	169	32	254	11	20
20	55	181	47	269	13	21
22	67	193	63	285	15	23
24	78	204	79	301	16	25
26	90	216	95	317	18	27
28	102	228	111	333	20	28
30	114	240	127	249	22	30
32	125	252	142	364	23	32
34	137	263	158	380	25	33
36	149	275	174	396	27	35
38	161	287	190	412	29	37
40	173	299	206	428		
42	184	310	222	444		

44	196	322	237	459
46	208	334	253	475
48	220	346	269	491
50	231	358	285	507
52	243	369	301	523
54	255	381	317	539

ET = economic threshold

Table 3. Estimating the number of red sunflower seed weevil adults per flower head when sampling using a commercial formulation of mosquito repellent

Number counted on one head	Estimated number	Number counted on one head	Estimated number
1	1	13	23
2	3	14	25
3	4	15	27
4	6	16	29
5	7	17	31
6	10	18	33
7	12	19	35
8	14	20	37
9	16	25	46
10	18	30	56
11	20	35	65
12	21	40	75

Timing Insecticide Treatment

Sunflower plant stage is used to time insecticide treatment. Both bloom and flowering describe the sunflower plant when yellow ray petals are showing and pollen is being shed. It is important to distinguish between the percentage of the field in bloom from the percentage of individual plants in bloom. A field with 50 percent of the plants in bloom indicates that half of the plants are shedding pollen and the other half of the plants are in the bud stage. However, the individual plants in bloom will probably not all be at the same stage of bloom. Some plants may have just started to shed pollen and others may be at the end of pollen shed. A plant in the 40 percent bloom stage would have 40 percent of the head shedding pollen (**R5.4**). This would be a ring of opened florets comprising about 25 percent of the head radius. The remaining 60 percent of the florets would be unopened.

The ideal plant stage to treat is when most plants in the field are at 40 percent pollen shed (**R5.4**). However, we recommend that treatment be considered when more than half of the plants in the field are just beginning to show yellow ray petals (**R5.0**) to 30 percent of the head shedding pollen (**R5.3**) and the rest of the plants in the field are still in the bud stage. This difference between the ideal plant stage (**R5.4**) to treat and the earlier plant stage (just beginning pollen shed) is based, in part, on the fact that aerial applicators -- because of a busy schedule or adverse weather -- will not always be available to spray at the ideal stage of sunflower development. Considering treatment at the early bloom stage should allow growers a sufficient cushion of time to have their fields treated. Growers must be aware, however, that if weevil populations are high and/or spraying is done too early, a reinfestation may occur and a second insecticide application may be necessary.

Although insecticides applied to sunflower at the bud stage will kill weevils, treatments at that stage are not economical or effective because (1) seeds have not developed to a stage suitable for oviposition, (2) eggs within the weevil are not mature, and (3) adult weevil emergence is still continuing. Sunflower normally reaches the bud stage in late July at which time only about 30 percent of the weevils in the soil have pupated and emerged. Most weevils emerge from the soil by the first week of August. If growers were to spray bud stage sunflower in mid to late July, a second spray may be necessary as more weevils continue to emerge.

Gray Sunflower Seed Weevil

The biology of the gray sunflower seed weevil differs from that of the red sunflower seed weevil. The gray sunflower seed weevil lays eggs on sunflower in early to mid bud stages. This differs from the red sunflower seed weevil, which lays eggs on plants beginning at 40 percent pollen shed (**R5.4**). Also, the gray sunflower seed weevil does not lay as many eggs as the red sunflower seed weevil, so the economic threshold for the gray is higher than for the red sunflower seed weevil. The treatment strategies to control the red sunflower seed weevil will not control the gray sunflower seed weevil. Usually, populations of the gray sunflower seed weevil are too low to justify spraying oilseed sunflower fields. In confection sunflower, the low tolerance for insect damaged seed may justify treatment to prevent economic loss due to contamination. However, the hollow, brittle seeds that were infested by gray sunflower seed weevil larvae are often removed during the threshing and seed cleaning process. Even in confection sunflower, it is not likely that seed will be rejected because of gray sunflower seed weevil damage. If the decision to treat for the gray sunflower seed weevil is made, treatments would have to be applied at the early bud stage to prevent oviposition.

Insecticides Registered for Sunflower Seed Weevil Control

Insecticide	Dosage (actual toxicant) per acre	Actual product per acre	Remarks
Asana*	0.03 - 0.05 lb	5.8 - 9.6 oz	Do not apply within 28 days of harvest.
Baythroid*	0.044 lb	2.8 oz	Do not apply within 30 days of harvest.
Furadan 4F*	0.5 lb	1 pt	Do not reenter treated fields within 14 days of application without wearing proper protective clothing. Do not apply within 28 days of harvest.
Lorsban 4E	0.5 - 0.75 lb	1 - 1.5 pts	Do not apply within 42 days of harvest. Do not allow livestock to graze in treated areas.
Methyl parathion 4E*	1.0 lb	2 pts	Do not apply within 30 days of harvest. Do not feed seeds to birds. Do not reenter the fields within 48 hours after application. Fields must be sign posted.
6-3 parathion-methyl parathion*	1 lb	7/8 pt	Do not apply within 30 days of harvesting, pasturing, cutting or foraging. Do not feed seeds to birds. Do not reenter fields within 48 hours after application. Fields must be sign posted.
Scout X-Tra*	0.014 - 0.0164 lb	2.00 - 2.33 oz	Do not apply within 21 days of harvest.
Warrior*	0.02-0.03 lb	2.56 - 3.84 oz	Do not apply within 45 days of harvest.

* EPA has classified this insecticide as a restricted use pesticide.