

# WEED CONTROL

## The list of herbicides in this table

is adapted from the 2008 North Dakota Weed Control Guide, whose 2009 counterpart will be found online at [www.ag.ndsu.edu/weeds](http://www.ag.ndsu.edu/weeds). These labeled products and treatment recommendations are developed for North Dakota, and may vary in other states. See the product label for complete treatment details.

## ADDITIONAL HERBICIDE PRODUCT TREATMENT NOTES

Sunflower competes poorly with weeds because of slow early growth and minimal ground cover. Cultivation with a spike-tooth or coil spring harrow about 1 week after seeding but before sunflower emergence will kill weeds that emerge before sunflower. Harrow or rotary hoe when sunflower has at least 4 leaves. Cultivation will control weeds between the rows.

**Assert** (imazame-thabenz) at 0.6 to 0.8 pt/A applied POST controls wild mustard in sunflower up to 15 inches tall. Severe sunflower injury may occur when applied in high temperature and humidity. Sunflower variety, growth stage, weather conditions, humidity, spray

Preplant/ Preemerg Herbicides	Product/A (lb ai/A)	Weeds	When to Apply
<b>SUNFLOWER</b>			
Glyphosate	<b>1 to 3 pt of a 3 lb ae/gal conc.</b> (0.38 to 1.5 ae) <b>See Remarks.</b>	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.
<b>Gramoxone Inteon</b> <b>Gramoxone Max</b> (paraquat) <b>RUP</b>	<b>2 to 4 pt</b> <b>1.3 to 2.7 pt</b> (0.5 to 1)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.
<b>Aim</b> (carfentrazone)	<b>1/2 to 1 fl oz EW</b> (0.128 to 0.256 oz)	Small broadleaf weeds.	Preplant or anytime prior to crop emergence.
<b>Eptam</b> (EPTC)	<b>2.5 to 3.5 pt</b> (2 to 3)	Grass and some broadleaf weeds.	PPI.
<b>Eptam</b> (EPTC)	<b>4.5 to 5.25 pt EC</b> <b>20 to 22.55 lb 20G</b> (4 to 4.5)	Grass and some broadleaf weeds.	Fall PPI after Oct. 15.
<b>Prowl</b> <b>Prowl H2O</b> (pendimethalin)	<b>2.4 to 3.6 pt EC</b> <b>2.1 to 3 pt ACS</b> (1 to 1.5)	Grass and some broadleaf weeds.	PPI.
<b>Prowl</b> <b>Prowl H2O</b> (pendimethalin)	<b>3 to 3.6 pt EC</b> <b>2.7 to 3 pt ACS</b> (1.25 to 1.5)	Grass and some broadleaf weeds.	PRE - 30 days before to 1 day after seeding.
<b>Prowl</b> <b>Prowl H2O</b> (pendimethalin)	<b>2.4 to 4.25 pt</b> <b>2.1 to 3.7 pt ACS</b> (1 to 1.75)	Grass and some broadleaf weeds.	Fall: PPI when soil temperature is <45 F.
Trifluralin	<b>1 to 2 pt EC</b> <b>5 to 10 lb 10G</b> (0.5 to 1)	Grass and some broadleaf weeds.	PPI.
Trifluralin	<b>5 to 10 lb 10G</b> (0.5 to 1)	Grass and some broadleaf weeds.	Fall: PPI after September 1 or Spring.
<b>Sonalan</b> (ethalfluralin)	<b>1.5 to 3 pt EC</b> <b>5.5 to 11.5 lb 10G</b> (0.55 to 1.15)	Grass and some broadleaf weeds.	PPI. Spring. Fall: From October 1 to December 31.
<b>Sonalan</b> (ethalfluralin)	<b>7.5 to 11.5 lb 10G</b> (0.75 to 1.15)	Foxtail.	PPI. Spring. Fall: From October 1 to December 31.
<b>Dual Magnum</b> (s-metolachlor)	<b>1 to 2 pt</b> (0.95 to 1.9)	Grass and some broadleaf weeds.	PPI or PRE.
<b>Spartan</b> (sulfentrazone)	<b>3 to 8 fl oz F</b> (1.5 to 4 oz)	Small-seeded broadleaf weeds including kochia, pigweed, lambsquarters, nightshade, and biennial wormwood.	EPP, shallow PPI, PRE or fall.
<b>Spartan Charge (NEW for 2009; see label)</b>			

Remarks					
lb ae/gal	lb ai/gal		0.38 ae	0.57 ae	0.75 ae 1.125ae
3	4	=	16 fl oz	24 fl oz	32 fl oz 48 fl oz
4/4.17	5.4/5.1	=	12 fl oz	18 fl oz	24 fl oz 36 fl oz
4.5	5.5	=	11 fl oz	16 fl oz	22 fl oz 32 fl oz
5	6.1	=	10 fl oz	15 fl oz	20 fl oz 30 fl oz
Non-selective, non-residual, translocated, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use.					
Non-residual, contact, herbicides; thorough coverage required. • Apply with NIS at 0.25% v/v to small weeds. • Thorough coverage essential.					
Non-residual, contact, herbicides; thorough coverage required. • Apply with NIS at 0.25% v/v to small weeds. • Thorough coverage essential.					
No wild mustard control. • PPI immediately after application. • May be tank-mixed with Sonalan or trifluralin to increase spectrum of weeds controlled. • Consult label for rate range for specific tank mix.					
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No wild mustard and poor wild oat control. • Adjust rate according to soil type. • Refer to narrative for tank-mix options and rotational restrictions.					
No wild mustard and poor wild oat control. • Adjust rate according to soil type. • Refer to narrative for tank-mix options and rotational restrictions. • For use in no-till sunflower only.					
Keep spring tillage depth shallower than fall tillage.					
No wild mustard and poor wild oat control. • PPI within 24 hours after application. • May be tank-mixed with Eptam. • Refer to label for rotational restrictions.					
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No wild mustard and poor wild oat control. • Adjust rate according to soil type. • Use highest rate allowed for nightshade control. • Refer to label for rotational restrictions.					
For use in reduced or conservation tillage. Incorporate twice at 2 to 3 inches deep using a V-blade under-cutter or rotary hoe. For fall applications, incorporate once in the fall and once in the spring before seeding.					
No wild oat or wild mustard control. • PPI improves consistency of control. • Requires moisture for activation. • Adjust rate for soil type and OM. • Refer to label for additional information.					
Requires precipitation for activation. EPP applications up to 30 days prior to planting improves likelihood of activation by moisture. • Adjust rate to soil type. • Provide adequate furrow closure at planting. Temporary sunflower injury may occur in coarse, low organic matter soils with pH greater than 8.0. May give 6 to 8 weeks residual weed control. Refer to label for application information, crop rotation restrictions, and other information.					

volume, and additives may affect sunflower safety. Risk of injury should be considered when deciding if treatment is warranted. Do not apply to sunflower under drought or heat stress. Apply Assert when air temperature plus relative humidity is below 150. Sunflower damage may range from plant stunting to head deformation. Refer to label.

**Eptam (EPTC), Prowl/H2O (pendimethalin), Sonalan (ethalfuralin), and trifluralin** are PPI herbicides that can be applied spring or fall. Eptam must be incorporated immediately after application to prevent herbicide loss. Eptam may be applied in late fall before soil freeze-up at 4.5 pt 7E/A or 20 lb 20G/A on coarse textured soil and 5.25 pt 7E/A or 22.55 lb 20G/A on fine and medium textured soil. Eptam controls wild oat better than Prowl, Sonalan or trifluralin. Incorporation of pendimethalin is not essential but will improve weed control.

**Spartan (sulfentrazone)** at 3 to 6 fl oz/A applied EPP, shallow PPI, or PRE controls most annual small-seeded broadleaf weeds, such as ALS-resistant kochia, pigweed

species, common lambs-quarters, eastern black nightshade, annual smartweed, Russian thistle, and biennial wormwood. Sulfentrazone may partially control wild buckwheat, marshelder, wild mustard, common ragweed, hairy nightshade, and foxtail but provides no perennial weed control. Rate must be adjusted for soil texture, soil pH, and organic matter content. Herbicide solubility, activity, and phytotoxicity increases as soil pH increases. User must read and follow label for rate information to ensure adequate weed control while maintaining crop safety. Crop injury will be minimized and greater likelihood of activation by rainfall will result if applied up to 30 days prior to planting. Sunflower has good tolerance to Spartan on medium to fine textured soils with OM above 3%. Crop injury may occur on soils with low OM and soil pH greater than 7.5, especially on calcareous outcropping. Do not use on coarse textured soils with less than 1% organic matter. Close furrow at planting to reduce injury. Poor growing conditions at and following crop emergence, cold temperatures, soil compaction, or rate too high based

# WEED CONTROL

on soil type and OM may result in crop injury. NDSU research has shown that consistent control of susceptible broadleaf weeds and suppression of foxtail and marginally susceptible broadleaf weeds depends on at least 0.5 to 0.75 inch rainfall shortly after application and before weeds emerge. The approximate ranking of crops from most to least tolerant is soybean, flax, chickpea, mint, sunflower, potato, field pea, dry edible beans, safflower, crambe, canola, lentil, and sugarbeet. Spartan has a PPO inhibitor mode of action and will leave a residue in soil for more than one year. Refer to label for additional information.

## CLEARFIELD (IMIDAZOLINONE RESISTANT) SUNFLOWER

**Beyond** (imazamox) at 4 fl oz/A applied POST to Clearfield sunflower hybrids controls most annual grass and broadleaf weeds with limited crop rotation restrictions. Apply with NIS and UAN. MSO adjuvants are not restricted and will provide greater herbicide enhancement compared to NIS + UAN. However, MSO adjuvants

Preplant/Preemerge Herbicides	Product/A (lb ai/A)	Weeds	When to Apply
<b>Assert</b> (imazamethabenz)	<b>0.6 to 0.8 pt</b> (0.19 to 0.25)	Wild mustard.	POST. Sunflower: Less than 8 leaves or 15 inches. Mustard species including canola: Prior to bloom.
<b>Assure II Targa</b> (quizalofop)	<b>8 to 10 fl oz</b> (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Sunflower: Refer to PHI. Grass: Refer to label
<b>Poast</b> (sethoxydim)	<b>0.5 to 1.5 pt</b> (0.1 to 0.3)	Annual grasses.	POST. Sunflower: Refer to PHI. Grass: Refer to label
Clethodim	<b>4 to 8 fl oz</b> (1 to 2 oz)	Annual grasses and quackgrass.	POST. Sunflower: Refer to PHI. Grass: Refer to label
<b>Select Max</b> (clethodim)	<b>9 to 32 fl oz</b> (1.125 to 4 oz)	Annual grasses and quackgrass.	POST. Sunflower: Refer to PHI. Grass: Refer to label

## CLEARFIELD SUNFLOWER

<b>Beyond</b> (imazamox)	<b>4 fl oz</b> (0.5 oz)	Annual broadleaf weeds including wild mustard and black nightshade. No ALS-resistant kochia control.	EPOST. Sunflower: 2 to 8-leaf stage. Broadleaf weeds: Less than 3 inches tall. Grass weeds: Less than 4 to 5 leaves.
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## EXPRESS SUN SUNFLOWER

<b>Express</b> (tribenuron)	<b>0.25 to 0.5 oz</b> (0.188 to 0.38 oz)	Annual broadleaf weeds including wild mustard. Control or suppression of Canada thistle. No grass or ALS-resistant kochia control.	EPOST. Sunflower: 1-leaf stage but prior to bud formation. Broadleaf weeds: Less than 3 inches tall.
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## PREHARVEST DESICCANTS/LATE SEASON WEED CONTROL

<b>Gramoxone Inteon</b> <b>Gramoxone Max</b> (paraquat) <b>RUP</b>	<b>1.5 to 2 pt</b> <b>1 to 1.35 pt</b> (0.375 to 0.5)	Desiccant.	Backside of sunflower heads yellow and bracts turning brown. Seed moisture content under 35%.
<b>Drexel Defol</b> (sodium chlorate)	<b>1 to 2 gal of a 6 lb/gal conc.</b> (6 to 12)	Desiccant.	Backside of sunflower heads yellow and bracts turning brown. Seed moisture content under 35%.
<b>Roundup</b> (Glyphosate)	No more than 22 fl. oz. preharvest. See label for more details.	Labeled for late-season weed control.	Backside of sunflower heads yellow and bracts turning brown. Seed moisture content under 35%.

## Remarks

Sunflower injury may occur when applied at high temperature and humidity. • Refer to label for rotational restrictions. • Apply with NIS at 0.25% v/v.

Apply with oil adjuvant at 1% v/v but not less than 1 pt/A. Oil adjuvant at more than 1 qt/A is not needed. • See label for detailed adjuvant recommendations. • Refer to label for tank-mix options, possible grass antagonism with broadleaf herbicides, and avoiding reduced grass control. • Allow a 70 day PHI.

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**Apply only to Clearfield sunflower varieties.** • Apply with NIS at 0.25% v/v + UAN at 2.5% v/v. MSO and oil adjuvants are not prohibited but may increase activity of Beyond to cause temporary crop injury. • Can be applied following a labeled soil-applied grass herbicide. • Refer to label for weeds controlled, adjuvant use, tank-mix options, crop rotation restrictions and additional information.

**Apply only to Express Sun sunflower varieties.** • Apply with MSO-type oil adjuvants at 1% v/v. NIS or petroleum oil adjuvants are not prohibited. • Apply following a labeled soil-applied grass herbicide or with a registered POST grass herbicide. Sequential applications are allowed but observe a 14 day interval between applications and do not exceed 1 oz/A. Allow a 70 day PHI. Refer to label for weeds controlled and additional information.

For use on confectionery and oilseed varieties. • Apply with NIS. • Randomly sample 10 average heads for seed moisture. Allow a 7 day PHI.

For use on confectionery and oilseed varieties. Thorough coverage of plant is essential. Apply aerially at 5 to 10 gpa or by ground at 20 to 30 gpa.

Registered for late-season weed control in sunflower. Visual appearance of sunflower physiological maturity may vary by hybrid, particularly those with the 'stay green' characteristic.

may increase risk of temporary sunflower yellowing and stunting. Weed species that may not be controlled are wild buckwheat, ragweed, common lambsquarters (> 2 inches), biennial wormwood, Canada thistle, and ALS resistant kochia. Refer to the label for information on application and use restrictions.

## EXPRESS SUN (TRIBENURON RESISTANT) SUNFLOWER

**Express** (tribenuron) at 0.25 to 0.5 oz XP/A applied POST to Express Sun sunflower hybrids controls most broadleaf weeds and

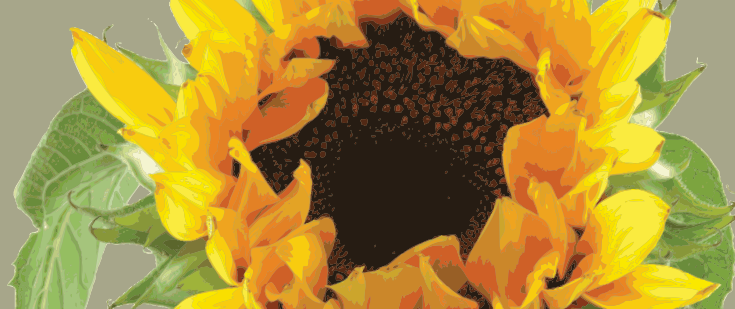
Canada thistle. Express does not control grasses or ALS resistant weeds. MSO adjuvants will enhance weed control more than other adjuvant types. Express may antagonize POST grass herbicides if applied together. The antagonism can be reduced or avoided by applying a higher rate of the grass herbicide or applying the grass herbicide 1 or more days before or 5 to 7 days after Express application. Do not apply any other ALS herbicide on Express Sun sunflower varieties, even other SU herbicides or severe sunflower injury or death will result. Refer to label for use directions and other information.



### Sunflower at about 30%-35% seed moisture.

Note backsides of sunflower heads are yellow and bracts are turning brown (about R9 sunflower stage, which is considered physiological maturity, although appearance may vary with 'stay green' hybrids). For the most accurate reading, have seed moisture tested.

# DISEASE CONTROL



## The following list of sunflower foliar sprays

is adapted from the 2009 North Dakota Fungicide Control Guide, which can be found online in its entirety at [www.ag.ndsu.edu/pubs/plantsci/pests/](http://www.ag.ndsu.edu/pubs/plantsci/pests/). These labeled products and treatment recommendations are developed for North Dakota, and may vary in other states. See product label for complete treatment details.

## SUNFLOWER SEED TREATMENTS

Seed treatments are done commercially by the seed companies. The treatments include a combination of an insecticide and fungicides, as follows:

- Cruiser Maxx® includes the fungicides Dynasty®, Maxim®4FS and Apron XL®, along with the insecticide Cruiser®.
- Idol® includes the fungicides Allegiance®, Idol™ and Vortex®, along with the insecticide Gaucho®.

Insects controlled include wireworm, flea beetle and suppression of sunflower beetle. Diseases controlled or suppressed include Downy Mildew, Pythium, Fusarium and Rhizoctonia.

## SUNFLOWER FOLIAR SPRAYS

Chemical (Fungicide Group)	Application <sup>1</sup>	Dosage <sup>2</sup>	Rust Control <sup>3</sup>	Remarks
Azoxystrobin Quadris, 22.9%	Spray or fungigation	6-15.5 fl oz/A	X	Apply prior to disease development. Also labeled for control of Alternaria leaf spot.
Pryaclostrobin Headline, 23.6%	Spray or fungigation	6-12 fl oz/A	X	Apply prior to disease development. Also labeled for control of Alternaria leaf spot, powdery mildew, Septoria leaf spot, and white rust. Maximum of 2 applications per season. PHI=21 days.
Tebuconazole Folicur®	Spray or fungigation	4-6 fl oz/A	X	Apply specific dosage of Folicur 3.6F at the earliest sign of infection (rust pustules developing) or when weather conditions are favorable for rust development. Apply higher rate to highly susceptible varieties and/or under severe conditions. Application may be repeated at 14 days if necessary to maintain control of the disease. Apply specified dosage in a minimum of 20 gallons of spray solution per acre by ground, or a minimum of 5 gallons of spray solution by air. Do not apply more than 16 fl. oz. of Folicur 3.6F per acre per season or within 50 days of harvest. For optimum disease control, the lowest labeled rate of a spray surfactant should be tank mixed with Folicur 3.6F.

<sup>1</sup>Spray = ground or aerial, Fungigation = application through sprinkler irrigation system.

<sup>2</sup>Dosage = Amount of formulated product to apply.

<sup>3</sup>X = Product labeled for crop and disease.

See fungicide resistance management statements in 2009 NDSU Fungicide Guide, [www.ag.ndsu.edu/pubs/plantsci/pests/](http://www.ag.ndsu.edu/pubs/plantsci/pests/)

## SOIL APPLIED BIOLOGICAL FUNGICIDES

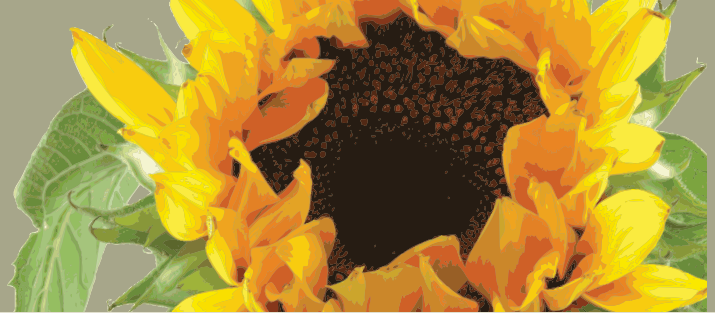
Organism	Application	Dosage <sup>1</sup>	Sclerotinia sclerotiorum (whitemold) Control <sup>2</sup>	Remarks
<i>Coniothyrium minitans</i> Contans WG, 5.3%	Soil Incorporation	1-2 lb/A depending on crop	X	Should be applied at least two months prior to a Sclerotinia disease outbreak. This will allow the active fungal ingredient to destroy sclerotia in the soil. Best applied before or at planting time at one lb/ac. Contans can be applied with Trifluralin, Prowl or Sonalan. Do not apply with starter fertilizers or ammonium sulfate. See label for further produce use and handling.

<sup>1</sup>Dosage = Amount of formulated product to apply.

<sup>2</sup>X = Product labeled for crop and disease.



# INSECT CONTROL



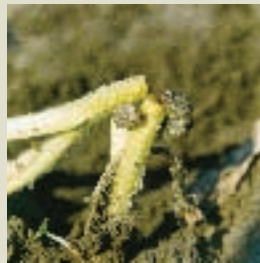
## Controlling Sunflower Insects

**Monitor sunflower insect development,** with particular attention to insects and fields that were problem areas last year. Scout fields, and if numbers reach economic thresholds, treat accordingly. Much of the information about the following insects that can be a problem in sunflower is courtesy of the North Dakota State University Extension Service and Kansas State University. Labeled products, product use rates, and application restrictions may vary by state. Some treatment products are restricted-use insecticides. All products should be used with close adherence to label instructions. See labeled products and treatment information for North Dakota online at [www.ag.ndsu.edu/crops/guides.html](http://www.ag.ndsu.edu/crops/guides.html).

### CUTWORMS

**Life Cycle:** Depending on the species, the adult lays eggs in the soil in the late summer. Eggs remain dormant until May/June.

**Damage:** Cutworms usually damage the young plants by cutting them off below or above the soil surface. This generally occurs in early emergence. They feed mostly at night, resting during the day below the soil surface near recently damaged plants.



**CUTWORMS**

### Economic Thresholds:

One larva per square foot or if stand reduction is at the lower end of optimum plant population.

### Scouting Method:

Check fields at least twice a week during early emergence, looking for cut-off plants or digging around a damaged plant to determine if cutworms are present.

**Management:** Most of the commercial insecticides labeled on sunflower include cutworm. This works well for surface-feeding cutworms. A number of producers in reduced tillage systems now calculate a cutworm insecticide treatment in their budgets. Control is done at emergence or just prior. Insecticide seed treatments are not labeled to control cutworms in sunflower.

### WIREWORMS

**Life Cycle:** The larvae overwinter in the soil and become active when soil temperatures reach 55 degrees. Adult females

emerge, mate and burrow back into the soil to lay eggs. They can re-emerge and go to other sites in the field to lay eggs. The egg laying soil preference can vary from light, well-drained soils to low spots where moisture levels are higher and clay is present. This often results in 'hot spot' infestations.

**Damage:** Wireworms feed on the developing roots of a seedling or a germinating seed. The seedling often dies before emergence or wilts shortly after emergence. Heavy damage can occur in field spots, requiring replanting of that area.

**Economic Thresholds:** See the scouting method below.

**Scouting Method:** Soil sampling (digging for the wireworm) is required to determine if this insect is present. NDSU suggests when digging soil samples, having 12 or more wireworms in 50 '3-inch by 3-inch' samples, is likely to result in damage.



**WIREWORMS**

**Management:** There are excellent insecticide seed treatments available that will eliminate wireworm damage. Most seed companies now sell only treated seed, with Cruiser® or Idol® primarily for wireworm control.

### PALESTRIPED FLEA BEETLES

**Life Cycle:** This insect's life cycle is not well understood. It appears that the adult overwinters in plant debris and emerges in the spring.

**Damage:** The flea beetle is a chewing insect and attacks the new cotyledons, causing them to wilt and die. The injured plants appear to be sand blasted. Heavy incidence will reduce plant stand.

**Economic Thresholds:** Control with an insecticide is recommended when 20% of the plant stand is injured or at risk of loss.

**Scouting Method:** The plant injury is easily recog-



**PALESTRIPED FLEA BEETLES**

nized at early emergence. Flea beetles move quickly and are difficult to count.

**Management:** Flea beetle damage has been eliminated by insecticide seed treatments such as Cruiser® and Idol®.

### STEM WEEVILS

**Life Cycle:** There is one generation of the sunflower stem weevil. Emergence is late May to early June in the High Plains and mid to late June in the Northern Plains. Eggs are deposited on the lower stem. Upon hatching, the larvae begin to feed in the pith area of stem; and in August they descend to the lower part of the stem and construct an overwintering chamber.

**Damage:** The stem weevil is often responsible for weakened stems and lodging. — especially in drought-affected sunflower. Under severe damage conditions, a significant yield loss can occur. This insect is also a vector for Phoma black stem and charcoal rot infections.

**Economic Thresholds:** One adult per three plants is the threshold level. Adults are difficult to scout. When disturbed, they drop to the ground and blend into the soil.

### Scouting Method:

The standard X pattern is recommended. The High Plains region recommends