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# North Dakota Field Crop Insect Management Guide

**For use in 2011 only**

Prepared by  
**Janet Knodel**  
Extension Entomologist

In cooperation with  
**Patrick Beauzay**  
**Mark Boetel**



## **On the Web:**

North Dakota State University Extension Service  
[www.ag.ndsu.edu](http://www.ag.ndsu.edu)

Insect Management Guide  
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Entomology Update  
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NDSU Crop and Pest Report  
[www.ag.ndsu.nodak.edu/aginfo/entomology/ndsucpr/index.htm](http://www.ag.ndsu.nodak.edu/aginfo/entomology/ndsucpr/index.htm)

# NDSU

**Extension Service**

North Dakota State University  
Fargo, North Dakota 58108

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# 2011 Field Crop Insect Management Guide

compiled by **Janet J. Knodel, Extension Entomologist,**  
*in cooperation with Patrick Beauzay and Mark Boetel*  
Department of Entomology - North Dakota State University

This is your reference copy of the 2011 edition of the NORTH DAKOTA INSECT MANAGEMENT GUIDE. The recommendations conform to the current federal and state laws and regulations relating to pesticidal chemicals at the time of printing. However, since pesticide recommendations are frequently subject to change, and inasmuch as this publication is revised only once each year, it is extremely important that you keep in contact with North Dakota State University for up-to-date information on possible changes in certain insecticide use patterns.

The Federal Insecticide, Fungicide and Rodenticide Act, as amended, makes it illegal to use any pesticides in a manner inconsistent with the label. Therefore, it is of the utmost importance that insecticide users READ, UNDERSTAND and FOLLOW all label directions and precautions.

Trade names have been used in some cases for simplicity and their usage does not imply endorsement of one product over another nor discrimination against any product by the North Dakota State University Extension Service. Some compounds have been omitted because they are not available, present unnecessary hazards to the user, or there is a lack of efficacy when compared to other available products.

## CAUTION!!!

The entomology staff at North Dakota State University believes that the recommendations in the guide are essentially accurate. However, since we do not exercise control over their use and the manner or conditions under which they are used, we assume no responsibility for personal injury, property damage or other types of loss resulting from the handling or use of the pesticides listed herein. PLEASE DISCARD ALL EARLIER EDITIONS OF THE NORTH DAKOTA INSECT MANAGEMENT GUIDE.

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## INSECTICIDE CONTROL RECOMMENDATIONS

The following recommendations include only the application of chemicals for the control of some of the important insect and mite pests. Keep in mind that the most effective and economical controls for many of these pests involve a complete program of cultural and mechanical as well as chemical operations.

For more complete information on any particular pest, consult reference material, such as textbooks, bulletins, circulars and leaflets covering the specific problem.

Some recommendations for the use of insecticides are given in terms of pounds or ounces of actual toxicant per acre or as percent of actual toxicant in the finished spray. This is necessary because of the wide variety of insecticide formulations and of equipment for applying them.

Insecticides usually are available as emulsifiable concentrates, wettable powders, dusts, granules or solutions. Each is designed for a specific method of application. For example, dusts are formulated to be applied dry; wettable powders are designed mainly for high gallonage pressure sprayers as used for spraying livestock; the emulsifiable concentrates, when diluted with water, form emulsions which may be used in low gallonage, low pressure sprayers. The job to be done and the equipment to be used will govern the type of formulation to recommend.

### Actual Toxicant Per Acre

Most applications to cereal and field crops are made in the form of sprays using emulsifiable concentrates or dusts. With dusts, it is relatively simple to determine the amount of dust to apply per acre. If the recommendation calls for 2

pounds of actual insecticide per acre and a 5 percent dust is used, then 40 pounds of the dust would have to be put on each acre to get 2 pounds of actual insecticide per acre.

When using emulsifiable concentrates, read the label on the container to determine the amount of actual toxicant, or active ingredient, per gallon. Generally, for 25 percent concentrates, there are 2 pounds of actual toxicant per gallon; for 45 percent concentrates, there are 4 pounds of actual toxicant per gallon, etc.

The following tables may be used for determining the amount of material to use per acre. It is important to calibrate sprayers so that applications will be made accurately. This will ensure effectiveness and will tend to avoid waste of chemicals and accumulations of possibly dangerous residues.

### Tolerance and Preharvest Intervals

A "tolerance" is the maximum amount of pesticide residue that may lawfully remain in or on food. Some pesticides, because of their chemical structure, leave no residue at all. Others are not harmful to humans when present in minute quantities. Still others are known to be harmful when present in food and so cannot be present even in minute quantities.

A preharvest interval is the time required between applications and harvest which will ensure conformance with the tolerance. The preharvest intervals established vary with the pesticide and the ultimate usage of it. In many instances, a pesticide cannot be used simply because it is not possible to adhere to the recommended preharvest interval.

## ABBREVIATIONS USED THROUGHOUT THIS DOCUMENT

A = acre	FM = flowable microencapsulated	RUP= Restricted Use Pesticide
AI = active ingredient	G = granular	sol = solution
bu = bushel	GPA= gallons per acre	SP = soluble powder
D = dust	gal = gallon	ST = Seed Treatment
EC = emulsifiable concentrate	lb = pound	sq ft = square feet
F = flowable	oz = ounce	T = tablespoon
fl = fluid	PHI = pre-harvest interval	t = teaspoon
fl oz = fluid ounce	pt = pint	ULV = ultra low volume
	qt = quart	WP = wettable powder

***North Dakota***  
**Pesticide Poison Information**  
**Toll - Free Number**  
**(800) 222 - 1222**

## INSECTICIDE CLASSES

Insecticides can be classified in a number of ways. The following table provides a listing of some common insecticide products used in North Dakota with their chemical classification designated.

Alternating the class of insecticide used for controlling insects can delay or even prevent resistance to those chemicals. Reliance on a single chemical or a group of

chemicals in the same class of insecticides could lead to development of resistance at a faster rate.

Resistance develops when survivors of a chemical application are able to pass on the genetic trait responsible for survival to their offspring. If a control failure occurs with a chemical, do not use it in a follow-up treatment, nor should a chemical from the same class be used (cross-resistance).

Trade Name	Active Ingredient	Insecticide Class <sup>1</sup>	Trade Name	Active Ingredient	Insecticide Class <sup>1</sup>
Abamectin E-AG	abamectin	M	Larvin	thiodicarb	C
Acephate	acephate	OP	Lattitude	imidacloprid	N
Actara	thiamethoxam	N	Leverage 360	imidacloprid + beta-cyfluthrin	N + P
Actellic	pirimiphos-methyl	OP	Lorsban	chlorpyrifos	OP
Adjourn	esfenvalerate	P	Lorsban Advanced	chlorpyrifos	OP
Admire Pro	imidacloprid	N	Malathion	malathion	OP
Advise	imidacloprid	N	Mana Alias	imidacloprid	N
Agrimek	abamectin	M	Margosan-O	azadirachtin	B
Ambush	permethrin	P	Marlate	methoxychlor	CH
Apistan	fluvalinate	P	Mavrik	fluvalinate	P
Arctic	permethrin	P	Mesurool	methiocarb	C
Assail	acetamiprid	N	Methyl Parathion	methyl parathion	OP
Asana XL	esfenvalerate	P	Mocap	ethoprop	OP
Attendant 600	imidacloprid	N	Monitor	methamidophos	OP
Avaunt	indoxacarb	O	Movento	spirotetramat	TA
Avicta 500FS	abamectin	M	Mustang Max	zeta-cypermethrin	P
Avicta Duo Corn	abamectin + thiamethoxam	M + N	Mustang Max EC	zeta-cypermethrin	P
Aztec	cyfluthrin + tebupirimiphos	P + OP	NipsIT Inside	clothianidin	N
<i>Bt</i>	<i>Bacillus thuringiensis</i>	M	Nolobait	<i>Nosema locustae</i>	M
Baythroid XL	beta-cyfluthrin	P	Nufarm Lambda-Cyhalothrin	lambda-cyhalothrin	P
Belay	clothianidin	N	Nuprid	imidacloprid	N
Beleaf	flonicamid	PC	Orthene	acephate	OP
Bifenture	bifenthrin	P	Parathion	ethyl parathion	OP
Bracket	acephate	O	PennCap-M	methyl parathion	OP
Brigade	bifenthrin	P	Permethrin	Permethrin	P
Brigadier	imidacloprid + bifenthrin	N + P	Perm-Up	Permethrin	P
Capture	bifenthrin	P	Platinum	thiamethoxam	N
Chlorpyrifos 4E AG	chlorpyrifos	OP	Poncho	clothianidin	N
Colbalt Advanced	chlorpyrifos + lambda-cyhalothrin	OP + P	Poncho Beta	clothianidin	N
Concur	imidacloprid	N	Pounce	permethrin	P
Counter	terbufos	OP	Proaxis	gamma-cyhalothrin	P
Coragen	chlorantraniliprole	AD	Prosper	clothianidin	N
Cruiser	thiamethoxam	N	Provado	imidacloprid	CN
Cygon	dimethoate	OP	Pydrin	fenvalerate	P
Danitol	fenpropathrin	P	Radiant SC	spinetoram	S
Delta Gold	deltamethrin	P	Regent	fipronil	PP
Di-Syston	disulfoton	OP	Reldan	chlorpyrifos-methyl	OP
Diacon II	methoprene	IGR	Respect	zeta-cypermethrin	P
Dibrom	naled	OP	Rimon	novaluron	IGR
Digon	dimethoate	OP	Sativa IM Max	imidacloprid	N
Dimethoate	dimethoate	OP	Sativa IM RTU	imidacloprid	N
Dimilin	diflubenzuron	IGR	Scourge	resmethrin	P
Dyna Shield	imidacloprid	N	Senator 600	imidacloprid	N
Imidacloprid 5					

Trade Name	Active Ingredient	Insecticide Class <sup>1</sup>	Trade Name	Active Ingredient	Insecticide Class <sup>1</sup>
Dipel	<i>Bacillus thuringiensis</i>	M	Sevin	carbaryl	C
Epi-mek	abamectin	M	Silencer	lambda-cyhalothrin	P
Endigo ZC	lambda-cyhalothrin + thiamethoxam	P + N	Sniper	bifenthrin	P
Enhance EW	imidacloprid	N	Stallion (pending	chlorpyrifos + zeta-	O + P
Fanfare	bifenthrin	P	Steward	Indoxacarb	O
Foothold Extra	imidacloprid	N	Storcide	chlorpyrifos-methyl + cyfluthrin	OP + P
Force	tefluthrin	P	Success	spinosad	S
Fortress	chlorethoxyfos	OP	Swagger	bifenthrin + imidacloprid	P + N
Fullfill	pymetrozine	PA	Temik	aldicarb	C
Furadan	carbofuran	C	Tempo	cyfluthrin	P
Gaucha 600	imidacloprid	N	Temprano	abamectin	M
Grizzly Z	lambda-cyhalothrin	P	Thimet	phorate	OP
Guthion	azinphos-methyl	OP	Tiguvon	fenthion	OP
Govern	chlorpyrifos	OP	Tombstone	cyfluthrin	P
Helix	thiamethoxam	N	Tombstone Helios	cyfluthrin	P
Hero	zeta-cypermethrin + bifenthrin	P	Tracer	spinosad	S
Imidan	phosmet	OP	Triumph	isazophos	OP
Inovate System	clothianidin	N	Tundra	bifenthrin	P
Intrepid	methoxyfenozide	IGR	Voliam Xpress	lambda-cyhalothrin + chlorantraniliprole	P + AD
Kaiso	lambda-cyhalothrin	P	Voliam Flexi	thiamethoxam + chlorantraniliprole	N + AD
Karate	lambda-cyhalothrin	P	Warbex	famphur	OP
Kelthane	dicofol	CH	Warhawk	chlorpyrifos	OP
Kryocide	cryolite	IC	Warrior II	lambda cyhalothrin	P
Lambda-Cy	lambda-cyhalothrin	P	Whirlwind	chlorpyrifos	OP
Lannate	methomyl	C	Yuma 4E	chlorpyrifos	OP

<sup>1</sup> AD=anthranilic diamide; B=botanical; C=carbamate; CD=cyclodiene; CH=chlorinated hydrocarbon; IC = inorganic compound, IGR=insect growth regulator; O = oxadiazine; OP=organophosphate; P=pyrethroid; PA=pyridine azomethines, PC = pyridine carboxamide, PP = phenylpyrazole; M=microbial; N=neonicotinoid; S=spinosyn; TA=tetramic acid.

## TOXICITY OF INSECTICIDES

All insecticides are classified as poisons, although there are considerable variations in the degree of toxicity to warm-blooded animals and fish. Toxicity refers to the degree to which a specific insecticide is poisonous to animals. Toxicity is classified as acute (severe) or chronic (long term) and it varies with the species, age, sex and method of administration to animals, nutritional state, and the type of insecticide formulation used.

Poisoning with insecticides may occur through the mouth and nose (oral) or through skin contact (dermal). Poisoning through the mouth usually requires less

insecticide to kill, although the greatest potential for occupational hazard in the use of insecticides is more closely associated with skin contamination.

The tests used to determine the toxicity of insecticides involve laboratory animals. Toxicity is expressed as LD<sub>50</sub>, which means the lethal dosage required to kill 50 percent of the test animal population. The amount of material needed to produce a lethal dose is expressed as milligrams of toxicant per kilogram of live animal weight (mg/kg).

CLASSIFICATION OF ACUTE ORAL TOXICITY FOR DIFFERENT CHEMICALS AND LETHAL DOSAGE FOR 150 POUND MAN			
Class	Signal Word	LD <sub>50</sub> , mg/kg	Lethal Dose For 150 Pound Man
Highly toxic	Danger / Poison	50 & below	few drops to 1 teaspoon
Moderately toxic	Warning	above 50 - 500	1 teaspoon to 1 ounce
Toxic	Caution	above 500 - 5,000	1 ounce to 1 pint or 1 pound
Non-toxic	Caution	above 5,000	1 pint to more than 1 quart

## THE EFFECT OF WATER PH ON INSECTICIDES

In recent years, another consideration in the application of insecticides is the pH of the water to be used for spraying. This is particularly important when organophosphate and carbamate insecticides such as Guthion, parathion, malathion, carbaryl and others are to be used. Experience in the Red River Valley area of North Dakota indicates that water with a pH of 8.0 - 8.2 or higher will cause rather rapid degradation of these insecticides while in solution. Buffering effects occur while the insecticide is in the spray solution, from mixing, through storage in the tank and continues until the water has evaporated from the spray droplet lying on the leaf.

### Half-Life\* of Some Insecticides At Different Water pH

Insecticide Product	Buffering Advised	Optimum pH	Half-Life for given pH						
			9.0	8.0	7.0	6.0	5.0	4.0	
Actara		7.0	Susceptible to alkaline hydrolysis in pH<9.0						
Actellic		7.0		12 days	35 days		7 days		
Admire		6.0	355 days		Fully stable at a pH of 5 and 7				
Ambush (permethrin)		7.0	Stable at pH 6.0 - 8.0						
Asana XL		7.0	Stable over a pH 5.0 - 9.0 range						
Di-Syston	•	5.0	7.2 hours			32 hours	60 hours		
Diazinon		7.0	29 days		70 days		14 days		
Dibrom	•	5.0	Hydrolyzed in 48 hours In pH > 7						
Dimethoate / Digon	•	5.0	48 min.			12 hours		20 hours	
Dipel (Bac.		6.0	Unstable in pH>8.0						
Furadan	•	5.0	78 hours			8 days			
Guthion	•	5.5	12 hours		10 days		17 days		
Imidan	•	5.0		4 hours	12 hours			13 days	
Lannate		6.5	stable in slightly acidic water						
Lindane			11 days		27 weeks				
Lorsban		7.0		1.5 days	35 days		63 days		
Malathion	•	5.0	5 hours	19 hours	3 days	8 days			
Monitor	•	5.5	Decomposes rapidly at pH > 7						
Orthene (acephate)		7.0	16 days		46 days		40 days		
Pounce (permethrin)		7.0	Stable at pH 6.0 - 8.0						
Provado		7.0	Stable over wide range of pH						
Reldan		7.0		3 days		38 days		10 days	
Sevin (carbaryl)	•	7.0	24 hours	2.5 days	12 days				
Spintor		7.0	Stable in pH from 6.0 to 11.0				12 hours		
Thiodan		6.5	some alkaline hydrolysis						
Vydate	•	5.0	3 hours		8 days		stable at 4.7 pH		
Warrior II		6.0	stable in pH 4.5 - 7.5						

\* Half-life is the time it takes for 50% of the chemical to decompose.

## REPORTING DAMAGE DUE TO PESTICIDE APPLICATIONS

Effective April 3, 2007

AN ACT to create and enact a new section to chapter 4-35 of the North Dakota Century Code, relating to notification of alleged pesticide damage; to repeal sections 4-35-21, 4-35-21.1, and 4-35-21.2 of the North Dakota Century Code, relating to reports of loss resulting from pesticide application; and to declare an emergency.

A new section to chapter 4-35 of the North Dakota Century Code is created and enacted as follows:

Pesticide application - Alleged property damage - Notification of applicator.

1. a. Before a person may file a civil action seeking reimbursement for property damage allegedly stemming from the application of a pesticide, the person shall notify by certified mail the pesticide applicator of the alleged damage within the earlier of:

(1) Twenty-eight days from the date the person first knew or should have known of the alleged damage; or

(2) Before twenty percent of the crop or field allegedly damaged is harvested or destroyed.

b. Subdivision a does not apply if the person seeking reimbursement for property damage was the applicator of the pesticide.

2. Upon notifying the applicator as required under subsection 1, the person seeking reimbursement for the alleged property damage shall permit the applicator and up to four representatives of the applicator to enter the person's property for the purpose of observing and examining the alleged damage. If the person fails to allow entry, the person is barred from asserting a claim against the applicator.

SECTION 2. REPEAL. Sections 4-35-21, 4-35-21.1, and 4-35-21.2 of the North Dakota Century Code are repealed.

SECTION 3. EMERGENCY. This Act is declared to be an emergency measure.

Further inquiries should be directed to:

**Department of Agriculture  
State Capitol Building  
Bismarck, North Dakota 58505  
Phone: 1-800-242-7535**

**North Dakota Department of Agriculture**  
<http://www.agdepartment.com>

## NORTH DAKOTA FIELD POSTING REQUIREMENTS

Effective July 1, 2004, North Dakota no longer has additional posting requirements for pesticides that are more demanding than federal labeling requirements. However, all pesticides that require posting on the label under the Environmental Protection Agency worker protection standard must be posted according to the Environmental Protection Agency worker protection standard.

## MANAGING INSECTICIDES TO PREVENT GROUNDWATER CONTAMINATION

The potential for insecticide movement into groundwater exists wherever insecticides are used, but the extent varies with the chemical nature of the insecticide, the soil and other factors such as volatilization (with subsequent loss to the atmosphere), decomposition, soil retention and transport by water. Volatilization and decomposition reduce the total amounts of insecticides available for downward movement, soil retention decreases the availability of the insecticide for downward movement, and transport by water relates to the movement of insecticides with soil water. In addition, small quantities of insecticides are removed from the land in agricultural products.

The amount of insecticide applied affects the potential for groundwater contamination. The potential movement to groundwater of relatively mobile water-soluble insecticides may be much increased where large amounts have entered the soil, such as areas used for fill stations, tank rinsing and equipment washing. In most areas, these practices should be carried out on concrete pads (or pads made from other impermeable material) and the liquid should be collected for disposal.

Organochlorines such as DDT and endrin were among the early synthetic organic insecticides. Low water solubility and a strong tendency to adsorb to soil have virtually precluded their appearance as groundwater contaminants resulting from agricultural applications.

Organophosphorus insecticides present a wide spectrum of both physiochemical properties and agricultural uses. They are generally less persistent than organochlorines and have been used to replace some organochlorine insecticides no longer registered in the United States. Breakdown in soil typically begins from reaction with water by natural and microbial hydrolysis. Examples of organophosphorus compounds include mevinphos, malathion and methyl parathion, listed in order of increasing persistence. This class of insecticides has not been detected in groundwater.

Three important members of the carbamate group are carbaryl, carbofuran and aldicarb. These are listed in order of increasing mobility, susceptibility to hydrolysis, and mammalian toxicity. Aldicarb (used also as a nematicide) is readily oxidized in soil. Aldicarb, aldicarb metabolites, and carbofuran have all been detected in groundwater.

Pyrethroids include natural products and the newer family of synthetic derivatives, e.g., permethrin, cypermethrin, esfenvalerate and lambda cyhalothrin. They are usually degraded quickly in soil and are unlikely to leach.

The following table gives the relative persistence and

mobility of insecticides used in North Dakota. Bear in mind that the persistence and mobility classification assigned to each insecticide is approximate because environmental variation will influence persistence and mobility. Whenever several insecticide options exist for the pest/site to be treated, this data will help pesticide users and advisors select the insecticide that presents the least potential for movement to groundwater. This is particularly true when insecticide applications are anticipated in areas with a high risk for groundwater contamination.

### Summary of Groundwater Contamination Potential As Influenced by Water, Pesticide and Soil Characteristics

	Low Risk	High Risk
<b>Pesticide Characteristics</b>		
water solubility	low solubility	high solubility
soil adsorption	highly adsorbed	poorly adsorbed
persistence	short half-life (a few days)	long half-life (several weeks)
<b>Soil Characteristics</b>		
texture	fine clay	coarse sand
organic matter	high O.M.	low O.M.
macropores	few, small	many, large
depth to groundwater	deep (20+ ft)	shallow (<10 ft)
<b>Water Volume</b>		
rain/irrigation	small volumes at infrequent intervals	large volumes at frequent intervals

### Relative Persistence and Mobility of Insecticides in Soils

Insecticide	Persistence <sup>a</sup>	Mobility <sup>b</sup>
acephate (Orthene)	M	VM
aldicarb (Temik)	M	MM
azinphos-methyl (Guthion)	N	NI
carbaryl (Sevin)	N	NI
carbofuran (Furadan)	M	MM
chlorpyrifos (Lorsban, Dursban)	N	NI
diazinon	M	SM
dimethoate (Digon)	N	MM
disulfoton (Di-Syston)	N	NI
endosulfan	N	NI
esfenvalerate (Asana)	M	I
fenvalerate (Pydrin)	M	I
fonofos (Dyfonate)	M	NM
malathion (Cythion)	N	NI
methomyl (Lannate)	N	SM
methyl parathion (Penncap-M)	N	I
methidathion (Supracide)	N	SM
monocrotophos (Azodrin)	N	MM
parathion	N	I
permethrin (Ambush, Pounce)	N	I
phorate (Thimet)	N	NI
phosphamidon (Dimecron)	N	MM
terbufos (Counter)	N	NI
tralomethrin (Scout)	M	I
trichlorfon (Dylox)	N	VM
trimethacarb (Broot)	M	NI

<sup>a</sup> P = persistent; M = moderately persistent; N = nonpersistent;

<sup>b</sup> VM = very mobile; MM = moderately mobile; SM = slightly mobile; NI = nearly immobile; I = immobile

### Summary of Suggested Pesticide Management Practices to Prevent Groundwater Contamination

Since site conditions, pest and crop patterns, and agricultural practices vary widely, specific recommendations for practices to reduce the risk of pesticide contamination must be specific and cannot be appropriate for all situations. However, measures to protect groundwater from pesticides generally involve the following objectives:

- Reduce the quantity of pesticide used (use the lowest effective rate).
- Use pesticides with less potential to leach.
- Use pesticides that are not persistent.
- Avoid pesticide application if conditions favor leaching.
- Prevent spills leading to a concentration of pesticide at a site which can leach to groundwater.
- Prevent back-siphoning or direct movement of pesticides down a well.

### Protecting Your Groundwater Through Farmstead Assessment:

There are numerous NDSU Extension circulars which address the issue of protecting groundwater from agricultural products. A listing and access to these circulars can be found on the Internet at:

<http://www.ext.nodak.edu/extpubs/watgrnd.htm>

## INSECTICIDE SEED TREATMENTS

Seed or planter box treatments are used on a wide variety of North Dakota crops for protection from a variety of soil and foliage feeding insects. The following tables highlight labeled crops and composition of common seed treatments. Always follow label directions. Protective clothing and equipment for mixing and handling are specified on the label. Mix thoroughly to ensure adequate protection. Treat only enough seed needed for immediate use. Do not store treated seed near feed or foodstuffs. Do not feed to livestock. Dispose of excess treated seed as specified on the label (usually burial).

**Slurry Seed Treatment:** Seed treatments may be applied as a slurry as seed is being augered into a drill, planter or truck. The treating equipment meters chemical into an auger conveyor where it is mixed with seed. The equipment is designed to mount to a truck bed, bin or transport augers and drill fill augers. Treaters consist of a metered pump, hoses and tank. The equipment is commonly used in bulk seed operations, providing uniform application of chemical to seed which enhances seed treatment performance.

**Planter-box Treatment:** Seed treatments should be thoroughly mixed with seed to ensure sufficient coverage. Recommendations for maximizing the effectiveness of planter-box seed treatments are as follows:

1. Fill box half full of seed.

2. Add half of required amount of product and mix thoroughly with paddle or stick.
3. Add remainder of seed to planter-box and the rest of product.
4. Mix well - thorough coverage is essential.
5. At end of day, clean planter population monitors.

### Inoculants in Combination with Seed Treatments:

Do not confuse seed inoculation with chemical seed treatment. Most seed disinfectants, including fungicides, are toxic to *Rhizobia* bacteria. Do not apply inoculum to seeds that are treated with a bactericide, such as streptomycin, unless you use a resistant strain of the *Rhizobia*. Although some *Rhizobia* species are slightly tolerant to certain chemical compounds, inoculating chemically treated legume seed requires special precautions. Check with the inoculum manufacturer regarding compatibility when considering combining products.

The following are some general guidelines when using seed treatments and inoculants:

- Insecticides are more toxic than fungicides, which are more toxic than herbicides.
- In-furrow inoculant applications are preferred when seed treatments have been used.
- If a seed treatment and inoculant are combined on the



seed, minimize exposure time; less than 4 hours is best. Some *Rhizobia* may be killed immediately; check compatibility charts prior to use. The 2005 Fungicide Guide also has information about fungicide seed treatment effects on inoculants.

- If liquid pesticides are used, apply first and allow to dry before inoculant is applied.

- Powder-based inoculants protect *Rhizobia* better than liquid-based inoculants.
- When using pre-treated seed, check with the inoculant formulator for comments on compatibility.

### Seed Treatments Approved by Crop

Seed Treatment	Corn	Wheat	Barley	Soybean	Sunflower	Dry Bean	Peas	Sugarbeet	Potato	Canola	Mustard	Lentils	Chickpeas	Safflowers	Flax
<b>Planter-Box Treatments</b>															
Assault 25	•			•											
Concur	•														
Enhance AW		•	•	•		•	•					•	•		
Latitude	•			•											
<b>Commercial Seed Treatments</b>															
Advise									•						
Attendant 600**	•	•	•	•		•	•			•	•	•	•		
Avicta Complete Beans				•											
Avicta Complete Corn	•														
Belay 2.13SC									•						
Cruiser 5FS*	•	•	•	•	•	•	•		•			•	•	•	•
CruiserMaxx*				•		•	•					•	•		
CruiserMaxx Cereals*		•	•												
CruiserMaxx Plus*				•											
CruiserMaxx Potatoes*									•						
CruiserMaxx Sugarbeets*								•							
Dyna-Shield Imidacloprid 5**	•	•	•	•	•			•		•	•			•	•
Foothold Extra		•	•												
Force ST *	•														
Gaicho 600*	•	•	•	•	•	•	•	•			•	•	•	•	•
Gaicho XT, Grande*		•	•												
Gaicho MZ									•						
Helix Lite *										•					
Helix XTra*										•					
Inovate System*				•				•		•					
Lorsban 30 *						•	•								
Lorsban 50SL*						•	•								
NipsIT Inside								•		•					
Poncho Beta*								•							
Poncho 600 *	•									•					
Profound *	<i>for commercial treatment of numerous vegetable seed types, refer to label for listing</i>														
Prosper FX*										•					
Regent TS*	•														
Raxil MD-W **		•	•												
Sativa IM Max		•	•												
Sativa IM RTU		•	•												
Senator 600**	•	•	•	•		•	•	•		•	•	•	•		

\*Available only through commercial seed treatment.

\*\*This product is for commercial or on-farm application.

## Insecticide/Fungicide Composition (% ai) of Seed Treatments

Seed Treatment	beta-cyfluthrin	Chlorpyrifos	Permethrin	Tefluthrin	Imidacloprid	Thiamethoxam	Clothianidin	Fipronil	Carboxin	Captan	Metaxyl	Tebuconazol	Difenoconazol	Mefanoxam	Ipconazole	Fludioxonil	Mancozeb	Trifloxystrobin	
	Insecticides								Fungicides										
Assault 25	-	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Attendant 600 FS**	-	-	-	-	48.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Belay 2.13SC**	-	-	-	-	-	-	23.6	-	-	-	-	-	-	-	-	-	-	-	-
Concur	-	-	-	-	25	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Cruiser 5FS *	-	-	-	-	-	47.6	-	-	-	-	-	-	-	-	-	-	-	-	-
CruiserMaxx *	-	-	-	-	-	22.61	-	-	-	-	-	-	-	1.70	-	1.12	-	-	-
CruiserMaxx Cereals*	-	-	-	-	-	2.8	-	-	-	-	-	-	3.36	0.56	-	-	-	-	-
CruiserMaxx Plus*	-	-	-	-	-	21.5	-	-	-	-	-	-	-	3.21	-	1.07	-	-	-
CruiserMaxx Potatoes *	-	-	-	-	-	28	-	-	-	-	-	-	-	-	-	7	-	-	-
CruiserMaxx Sugarbeets*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diazinon 50W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dyna-Shield Imidacloprid 5**	-	-	-	-	48.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Enhance AW	-	-	-	-	20	-	-	-	20	20	-	-	-	-	-	-	-	-	-
Foothold Extra	-	-	-	-	11.37	-	-	-	-	-	0.6	0.46	-	-	-	-	-	-	-
Force ST *	-	-	-	26.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GaUCHO Grande *	-	-	-	-	48.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GaUCHO XT	-	-	-	-	75	-	-	-	-	-	0.82	0.62	-	-	-	-	-	-	-
GaUCHO 600 *	-	-	-	-	48.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GaUCHO MZ	-	-	-	-	1.25	-	-	-	-	-	-	-	-	-	-	-	6	-	-
Helix Lite *	-	-	-	-	-	10.3	-	-	-	-	-	-	1.24	0.4	-	0.13	-	-	-
Helix Xtra *	-	-	-	-	-	20.7	-	-	-	-	-	-	1.25	0.4	-	0.13	-	-	-
Inovate*	-	-	-	-	-	-	47.8	-	-	-	-	-	-	-	-	-	-	-	-
Kernel Guard Supreme	-	-	10.4	-	-	-	-	-	14.4	-	-	-	-	-	-	-	-	-	-
Latitude	-	-	-	-	25	-	-	-	14	-	1	-	-	-	-	-	-	-	-
Lorsban 30 *	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lorsban 50SL*	-	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NipsIT Inside	-	-	-	-	-	-	47.8	-	-	-	1.65	-	-	-	1.03	-	-	-	-
Poncho Beta*	4.6	-	-	-	-	-	34.3	-	-	-	-	-	-	-	-	-	-	-	-
Poncho 600 *	-	-	-	-	-	-	48.0	-	-	-	-	-	-	-	-	-	-	-	-
Profound	-	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prosper FX*	-	-	-	-	-	-	21.7	-	3.81	-	0.41	-	-	-	-	-	-	-	9.5
Raxil MD-W**	-	-	-	-	1.5	-	-	-	-	-	0.62	0.461	-	-	-	-	-	-	-
Regent TS*	-	-	-	-	-	-	-	56	-	-	-	-	-	-	-	-	-	-	-
Sativa IM Max	-	-	-	-	11.37	-	-	-	-	-	0.6	0.46	-	-	-	-	-	-	-
Sativa IM RTU	-	-	-	-	1.6	-	-	-	-	-	0.6	0.47	-	-	-	-	-	-	-
Senator 600**	-	-	-	-	48.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-

\*Available only through commercial seed treatment.

\*\*This product is for commercial or on-farm application.

## BARLEY INSECTS

### Other Resources Available Through NDSU Extension Service:

Publications	E493	Aphid Management in Small Grains, Corn and Sorghum (1993)
	E830	The Armyworm and the Army Cutworm (2000)
	E1230	Cereal Leaf Beetle Management (2002)
	PP680	Wheat Stem Infesting Insects in North Dakota (1989)
	E1007	Biology and Management of Barley Thrips (1991)
	E272	Grasshopper Management (1997)
	E188	Wireworm Control (2001)

## APHID

### Small Grain Aphid descriptions:

**Greenbug** - pale green with darker stripe down back.

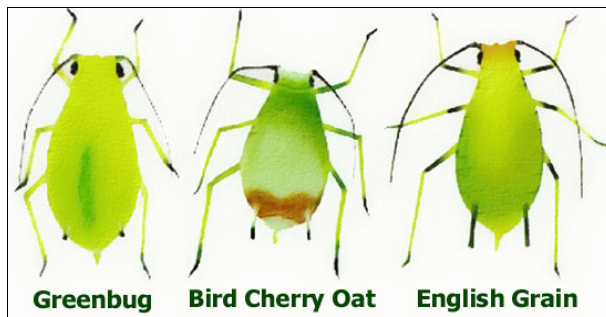
**Bird Cherry Oat Aphid** - olive green, brownish patch at the base of cornicles.

**English Grain Aphid** - bright green with long black cornicles.

The greenbug, English grain aphid and bird cherry oat aphids are the principle species that cause problems in North Dakota small grains. None of these aphids are known to overwinter in North Dakota; they migrate to the region from the South in late spring.

The greenbug is the most injurious because it injects a toxin with its saliva during feeding. The English grain aphid is the most common aphid seen in small grains. Its population grows rapidly

when feeding on wheat heads. The bird cherry oat aphid feeds primarily on leaves in the lower part of the small grain plant. These aphids transmit barley yellow dwarf virus. When aphid populations are high, the disease can spread through small grain fields. At greatest risk are later planted fields which attract migrating aphids that are moving from more mature fields.



### Thresholds for Small Grains: *English Grain, Bird Cherry Oat, Greenbug*

To protect small grains from yield loss due to aphid feeding, the treatment threshold is 85% stems with more than one aphid present or 12-15 aphid per stem, prior to complete heading. Field scouting should begin at stem elongation and continue up to the heading stage of wheat. Aphid populations at or above the thresholds during these growth stages will result in economic injury to plants.

The greatest risk of yield loss from aphids feeding on grains is in the vegetative to boot stages. Significant yield reductions after the onset of flowering could not be demonstrated in research published from South Dakota in 1997 (Voss et al., 1997. J of Economic Entomology 90: 1346-1350). Reasons for these conclusions were that: after heading the only major yield component aphids can affect is seed weight; aphids are unable to sustain the very large populations necessary to achieve significant impact on this factor. Other components of yield are determined earlier (number of spikelets - determined at jointing; number of seeds - determined at flowering).

### Russian Wheat Aphid (RWA):

15% to 20% of tillers infested up to flowering; 20+% infested tillers from flowering to early milk stage

**Note:** A tiller is infested whether it has one or several RWA present. RWA have only been found in southwest North Dakota during late summer; no economic damage has been reported. No RWA have been reported in North Dakota since the early '90s. Occasionally, RWA have overwintered during mild winters in Montana.

### Natural Controls:

Lady beetles, aphid lions, syrphid fly, and parasitic wasps play a major role in reducing aphid populations. When natural enemies are present in large numbers, and the crop is well developed, farmers are discouraged from spraying fields.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.014 - 0.019	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing interval = 3 days. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre per 3 day interval. Minimum application volume of 10 GPA by ground and 2 GPA by air.
<b>fenpropathrin</b> Danitol 2.4 EC <b>PENDING</b> <i>RUP</i>	0.2	10 2/3 fl oz	PHI = 14 days. Apply as a ground application in a minimum of 5 gallons of water per acre. Make a single application in the pre-boot stage. Do not exceed 0.2 lb ai per acre per season. PHI = 14 days.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate	0.8 - 2.4 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> Enhance AW	refer to recommended label rate	4 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. 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> Foothold Extra Sativa IM Max	refer to recommended label rate	3.4 - 5.0 fl oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. 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>lambda-cyhalothrin</b> Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Kaiso <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>malathion</b> Malathion 5	0.9	1.5 pts	PHI = 7 days. Do not apply below 60° F.
<b>malathion</b> Malathion 57EC	0.9 - 1.25	1.5 - 2 pts	
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225 - 0.45	12 - 24 fl oz	PHI = 7 days or feed treated forage within 10 days of application. Do not apply more than 6 pints (96 fl oz) per acre per season. Do not make more than 4 applications per crop per season.
<b>methomyl</b> Lannate SP <i>RUP</i>	N/A	0.25 - 0.5 lb	PHI = 7 days or feed treated forage within 10 days of application. Do not apply more than 2 lbs per acre per season. Do not make more than 4 applications per crop per season.
<b>methyl parathion</b> Cheminova Methyl 4EC <i>RUP</i>	0.25 - 0.75	8 - 24 fl oz	PHI = 15 days of harvest or grazing. To avoid injury to bees, do not apply during pollen shed if bees are visiting the areas to be treated during foraging hours. Do not enter treated fields within 48 hours after application.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 0.75	32 - 48 fl oz	
<b>thiamethoxam</b> Actara	0.06	4 oz	PHI = 21 days. Use minimum of 10 GPA by ground and 5 GPA by air. Minimum interval between applications = 7 days. Do not apply more than 0.12 lb ai (8 oz) per acre per season.

*RUP* - Restricted use pesticide

## ARMYWORMS

Armyworm outbreaks in North Dakota can occur when large migrations of moths from Southern states occur in late spring and early summer. Moths prefer to lay eggs in moist, shady areas where small grains or grasses have lodged or been damaged by hail or wind. Armyworms feed at night and hide under vegetation or in loose soil during the day. To scout for armyworms in grains, part the plants and inspect the soil for fecal pellets. If pellets or feeding damage is found, look for larvae under plant trash, soil clods or in soil cracks.

### Threshold for Small Grains:

Treat when 4 to 5 or more worms per square foot are present.

### Migrating Armyworms:

Treat a couple of swaths ahead of the infestation in the direction of movement to form a barrier strip.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.014 - 0.019	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing interval = 3 days. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre per 3 day interval. Minimum application volume of 10 GPA by ground and 2 GPA by air.
<b>lambda-cyhalothrin</b> Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Kaiso <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>malathion</b> Malathion 57EC	1.25	2 pts	PHI = 7 days. Do not apply below 60° F.
<b>malathion</b> Malathion 5	1.25	2 pts	
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225 - 0.45	12 - 24 fl oz	PHI = 7 days or feed treated forage within 10 days of application. Do not apply more than 6 pts (96 fl oz) per acre per season. Do not make more than 4 applications per crop per season.
<b>methomyl</b> Lannate SP <i>RUP</i>	N/A	0.25 - 0.5 lb	PHI = 7 days or feed treated forage within 10 days of application. Do not apply more than 2 lbs per acre per season. Do not make more than 4 applications per crop per season.
<b>methyl parathion</b> Cheminova Methyl 4EC <i>RUP</i>	0.25	8 fl oz	PHI = 15 days. Do not enter treated fields within 48 hours after methyl parathion application.
<b>methyl parathion</b> Methyl parathion 8EC <i>RUP</i>	0.5	8 fl oz	
<b>methyl parathion</b> Penncap-M <i>RUP</i>	0.5 - 0.75	2 - 3 pts	
<b>spinosad (microbial)</b> Entrust	0.05 - 0.1	1 - 2 oz	Do not apply more than 5.6 oz (0.28 lb a.i.) per acre per season. PHI = 21 days for grain and straw harvest or within 14 days of forage or hay harvest.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>spinosad (microbial)</b> Success	0.047 - 0.094	3 - 6 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest. Do not apply more than a total of 19 fl oz per acre per season.. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>spinosad (microbial)</b> Tracer	0.031 - 0.094	1 - 3 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest.
<b>spinetoram</b> Radiant SC	0.023 - 0.047	3 - 6 fl oz	PHI = 21 days for grain or straw harvest or within 3 days of forage, fodder or hay harvest. Do not apply more than 18 fl oz (0.141 lb ai spinetoram) per acre per year. Do not make more than 3 applications in one calendar year. Do not make applications less than 4 days apart.

*RUP* - Restricted use pesticide

## BARLEY THIRPS

Female barley thrips fly to barley from overwintering sites during mid to late May. Sampling for thrips should begin when the flag leaf is first visible and continue until the head is completely emerged from the boot. Sample at least 50 feet in from field margins. Most thrips can be found under the top two leaf sheaths. The dark brown to black thrips can be found by unrolling the leaf sheaths away from the stem. Insecticide treatments are only effective when applied before heading is complete.

**Threshold For Thrips:** *Treat when thrips are equal to or greater than the number calculated by*

$$\text{Threshold (Thrips/stem)} = \frac{\text{Cost of Control} \div \text{Expected \$ value per bushel}}{0.4}$$

Sampling plans based on this number can be prepared with the help of E-1007, **Biology and Management of Barley Thrips.**

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>fenprothrin</b> Danitol 2.4 EC <b>PENDING</b> <i>RUP</i>	0.2	10 2/3 fl oz	PHI = 14 days. Apply as a ground application in a minimum of 5 gallons of water per acre. Make a single application in the pre-boot stage. Do not exceed 0.2 lb ai per acre per season.
<b>methyl parathion</b> Cheminova Methyl 4EC <i>RUP</i>	0.25 - 0.375	8 - 12 fl oz	PHI = 15 days. Do not enter treated fields within 48 hours after methyl parathion application.

*RUP* - Restricted use pesticide

## CEREAL LEAF BEETLE

The cereal leaf beetle is an imported insect pest from Europe. This insect has just been found in **Williams and McKenzie counties of North Dakota**. It was first detected in Michigan in 1962, Utah in 1984, and Montana in 1989. The cereal leaf beetle is a serious pest of barley and wheat in Montana. Both adults and larvae of the cereal leaf beetle damage grain crops through their foliar feeding. The larvae are the most damaging stage and the target of control measures. Generally, the newer plant tissue is preferred with feeding occurring on the upper leaf surface causing characteristic elongated slits.

### Monitoring and Treatment Threshold:

The first sign of CLB activity in the spring is adult feeding damage on the plant foliage. While this is the first sign of adult activity, adults are not the target of control. Eggs and larvae are monitored by plant inspection since thresholds are expressed as egg and larvae numbers per plant or per stem. Examine 10 plants per location and select 1 location for every 10 acres of field. Count number of eggs and larvae per plant (small plants) or per stem (larger plants) and get an average number of eggs and larvae, based on the samples you have taken.

Boot stage is a critical point in plant development and impact of cereal leaf beetle feeding damage can be felt on both yield and grain quality. **Before boot stage**, the threshold is: three 3 eggs and larvae or more per plant (including all the tillers present before the emergence of the flag leaf). Larvae feeding in early growth stages can have a general impact on plant vigor. When the flag leaf emerges, feeding is generally restricted to the flag leaf which can significantly impact grain yield and quality. The threshold is decreased **at the boot stage** to: 1 larvae or more per flag leaf.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.008 - 0.014	1.0 - 1.8 fl oz	PHI = 30 days. Pre-grazing interval = 3 days. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre per 3 day interval. Minimum application volume of 10 GPA by ground and 2 GPA by air.
<b>diflubenzuron</b> Dimilin 2L <i>RUP</i>	0.0625	4 fl oz	PHI = 50 days for grain or straw, 15 days for hay, or 3 days for forage. Apply at egg laying. For use only west of US highway 281. Do not apply within 25 feet by ground or 150 feet by air of bodies of water. Applications must include a 25 foot vegetative buffer strip to limit runoff. Use 5 to 15 GPA total volume by ground, 3 to 5 GPA total volume by air. Do not exceed 4 fl oz per acre per season. Do not make more than 1 application per season.
<b>fenpropathrin</b> Danitol 2.4 EC <b>PENDING</b> <i>RUP</i>	0.2	10 2/3 fl oz	PHI = 14 days. Apply as a ground application in a minimum of 5 gallons of water per acre. Make a single application in the pre-boot stage. Do not exceed 0.2 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Kaiso <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>malathion</b> Malathion 5EC	0.6-1.25	1 - 2 pt	PHI = 7 days. Treatment is most effective at temperatures over 70° F.
<b>malathion</b> Fyfanon ULV	0.3-0.6	4 - 8 oz	
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225-0.45	0.75 - 1.5 pt 0.25 - 0.5 lbs	PHI = 7 days, or 10 day to graze. There is a 24-hour re-entry interval.
<b>methomyl</b> Lannate SP <i>RUP</i>	N/A	0.25 - 0.5 lb	PHI = 7 days or feed treated forage within 10 days of application. Do not apply more than 2 lbs per acre per season. Do not make more than 4 applications per crop per season.
<b>spinosad (microbial)</b> Entrust	0.025 - 0.1	0.5 - 2 oz	Do not apply more than 5.6 oz (0.28 lb a.i.) per acre per season. PHI = 21 days for grain and straw harvest or within 14 days of forage or hay harvest.
<b>spinosad (microbial)</b> Success	0.031 - 0.094	2 - 6 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest. Do not apply more than a total of 19 fl oz per acre per season.. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>spinosad (microbial)</b> Tracer	0.031 - 0.094	1 - 3 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest.
<b>spinetoram</b> Radiant SC	0.016 - 0.047	2 - 6 fl oz	PHI = 21 days for grain or straw harvest or within 3 days of forage, fodder or hay harvest. Do not apply more than 18 fl oz (0.141 lb ai spinetoram) per acre per year. Do not make more than 3 applications in one calendar year. Do not make applications less than 4 days apart.

*RUP - Restricted use pesticide*

## CUTWORMS

Several cutworm species affect regional crops. In western North Dakota, the pale western and the army cutworms are important pests of small grains. Eggs of pale western hatch in the spring and larvae feed underground. Eggs of the army cutworm hatch in the fall and spring feeding is above ground. In eastern North Dakota, the Dingy cutworm, *Feltia jaculifera*, overwinters as a partially grown larva and is one of the first cutworm species to cause problems during crop emergence from early to mid-May. The moth of the dingy cutworm is known to lay her eggs on sunflower heads from mid-July through September. Crops following sunflowers in rotation are at greatest risk of injury by this cutworm. Other cutworms, the red-backed, *Exoa ochregaster*, and the dark-sided, *Exoa messoria*, overwinter as eggs which hatch in mid to late May. Eggs are laid in the fall and survive in weedy, wet, and reduced-tillage areas. Feeding injury by these cutworms normally occurs in late May to early June.

### Management and Thresholds in Small Grains:

Treatment is recommended when cutworms number 4 to 5 per square foot.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.008 - 0.014	1.0 - 1.8 fl oz	PHI = 30 days. Pre-grazing interval = 3 days. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre per 3 day interval. Minimum application volume of 10 GPA by ground and 2 GPA by air.
<b>lambda-cyhalothrin</b> Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Kaiso <i>RUP</i>	0.015 - 0.025	1 - 1.67 fl oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	
<b>methyl parathion</b> Cheminova Methyl 4EC <i>RUP</i>	0.375 - 0.5	12 - 16 fl oz	PHI = 15 days

*RUP* - Restricted use pesticide

## GRASSHOPPERS

In the Northern Plains, grasshopper egg hatch normally begins in late April to early May. Peak hatch occurs about mid-June. Heavy infestations typically occur in areas of low rainfall or during drought years. Outbreaks are usually preceded by several years of hot, dry summers and warm falls. Cool, wet weather increases disease occurrence and delays development of grasshoppers, reducing the overall population.

### Cultural Control Methods:

- Early seeding** - Allows for early establishment and vigorous growth of plants.
- Crop rotation** - Avoid planting in areas of high egg deposits. Fields with late-maturing crops or green plant cover attract adults which then lay eggs.
- Tillage** - Summer fallow will act as a trap crop, attracting females for egg laying. Spring tillage of these sites will reduce successful emergence of nymphs.

**Grasshopper Thresholds: Infestation Ratings.** Threatening is considered the action threshold for grasshoppers. 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+

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.014 - 0.019	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing interval = 3 days. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre per 3 day interval. Minimum application volume of 10 GPA by ground and 2 GPA by air.
<b>diflubenzuron</b> Dimilin 2L <i>RUP</i>	0.031	2 fl oz	PHI = 50 days for grain or straw, 15 days for hay, or 3 days for forage harvest. For best results, apply when grasshoppers reach the 2 <sup>nd</sup> to 3 <sup>rd</sup> nymphal stage of development (not effective on adult grasshoppers). For use only west of US highway 281. Do not apply within 25 feet by ground or 150 feet by air of bodies of water. Applications must include a 25 foot vegetative buffer strip to limit runoff. Use 5 to 15 GPA total volume by ground, 3 to 5 GPA total volume by air. Do not exceed 4 fl oz per acre per season. Do not make more than 1 application per season.
<b>fenpropathrin</b> Danitol 2.4 EC <b>PENDING</b> <i>RUP</i>	0.2	10 2/3 fl oz	PHI = 14 days. Apply as a ground application in a minimum of 5 gallons of water per acre. Make a single application in the pre-boot stage. Do not exceed 0.2 lb ai per acre per season.
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate	1.2 - 2.4 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>lambda-cyhalothrin</b> Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Kaiso <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>malathion (ULV)</b>	0.48	8 fl oz/acre (95% concentrate)	Commercial aerial applicators only. PHI = 7 days.
<b>malathion</b> Malathion 57EC	0.9 - 25	1.5 - 2 pts	PHI = 7 days. No time limitation on grazing or straw for dairy or slaughter animals.
<b>malathion</b> Fyfanon ULV	0.6	8 oz	PHI = 7 days. Treatment is most effective at temperatures over 70° F.
<b>methyl parathion</b> Cheminova Methyl 4EC <i>RUP</i>	0.5	1 pt	PHI = 15 days. Do not enter fields for 48 hrs after application.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 0.75	2 - 3 pts	
<b>spinosad (microbial)</b> Entrust (suppression only)	0.05 - 0.1	1 - 2 oz	Do not apply more than 5.6 oz (0.28 lb a.i.) per acre per season. PHI = 21 days for grain and straw harvest or within 3 days of forage or hay harvest.
<b>spinosad (microbial)</b> Tracer (suppression only)	0.047 - 0.094	1.5 - 3 fl oz	Do not apply more than 9 fl oz (0.28 lb ai) per acre per season. PHI = 21 days of grain or straw harvest or within 3 days of forage or hay harvest.
<b>spinetoram</b> Radiant SC (suppression only)	0.023 - 0.047	3 - 6 fl oz	PHI = 21 days for grain or straw harvest or within 3 days of forage, fodder or hay harvest. Do not apply more than 18 fl oz (0.141 lb ai spinetoram) per acre per year. Do not make more than 3 applications in one calendar year. Do not make applications less than 4 days apart.

*RUP* - Restricted use pesticide

## WIREWORMS

Imidacloprid and thiamethoxam are now labeled as active ingredients for application to barley planting seed for wireworm management. Please refer to the seed treatment section in the introduction for more information.

**Caution:** Do not use treated seed for feed or food purposes. Prevent the contamination of commercial grain by thoroughly cleaning bins, grain augers and trucks that have been used to store, handle and/or home treat seed.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Gaucho 600	refer to recommended label rate	0.13 - 0.26 fl oz per cwt of seed	Follow all applicable directions, restrictions and precautions on the EPA registered label. Do not graze or feed livestock on treated areas for 45 days after planting.
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate	0.13 - 0.26 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> Enhance AW	refer to recommended label rate	4 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. 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> Foothold Extra Sativa IM Max	refer to recommended label rate	3.4 - 5.0 fl oz per cwt of seed	Apply prior to planting as a slurry treatment. Follow all applicable directions, restrictions and precautions on the EPA registered label. Do not graze or feed livestock on treated areas for 45 days after planting.
<b>imidacloprid</b> Sativa IM RTU	refer to recommended label rate	5 fl oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. 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>thiamethoxam</b> Cruiser 5FS, Cruiser MAXX Cereals	refer to recommended label rate		Follow all applicable directions, restrictions and precautions on the EPA registered label.

## BEAN INSECTS (DRY EDIBLE )

Other resources available through NDSU Extension Service:

Publications	A602	Dry Bean Production Handbook
	Extension Report #13	Dry Bean Grower Survey
	NCR Extension Pub #198	Recognition and Management of Dry Bean Production Problems

### LEAFHOPPERS

#### Leafhopper Management:

The adult is wedge-shaped and pale green in color. Adults are very active, jumping or flying when disturbed. Nymphs are wingless. Both adults and nymphs will run backwards or sideways rapidly. Large numbers of adults may appear early in the season. Nymphs usually complete their growth on the leaf where they hatched, feeding on the underside of the leaf. Damage by leafhoppers is referred to as hopper-burn. Foliage becomes dwarfed, crinkled, and curled. Small triangular brown areas appear at the tips of leaves, gradually spreading around the entire leaf margin.

#### Leafhopper Threshold:

The threshold for basing spray decisions is when an average of one leafhopper per trifoliate leaf is found. Do not let infestations and damage progress to the point that yellowing of foliage is easily detected.

### APHIDS

#### Aphid Management:

The bean aphid has not been a major pest in North Dakota, though it can be found. It is nearly black in color and 1/8 inch long. They feed along stems and the underside of leaves. Infestations may result in a buildup of honeydew on leaf surfaces, promoting the growth of a black "sooty" fungus. No economic threshold guidelines for control have been established for North Dakota.

#### Insecticides Registered for Leafhopper and Aphid Management in Dry Beans

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acephate</b> Acephate E 75 WP Acephate 75% Orthene Address Acephate 97UP	0.5 - 1	0.66 - 1.33 lbs	PHI = 14 days. Do not feed treated vines to livestock. Do not apply more than 2.67 lbs (2 lbs ai) per acre per season. Repeat at 3-7 day spray intervals for low - high rates (respectively) to maintain control.
<b>acephate</b> Orthene 97		0.5 - 1 lb (8 to 16 fl oz)	PHI = 14 days. Do not feed treated vines to livestock. Do not apply more than 2 1/8 lbs per acre per season. Repeat at 7-10 day spray intervals as necessary to maintain control.
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.025	3.2 fl oz for Pea aphid (suppression)	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
	0.0065 - 0.0125	0.8 - 1.6 fl oz for Leafhoppers	
<b>bifenthrin</b> Fanfare 2EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 14 days. Do not apply more than 0.2 lb active (12.8 fl oz) per acre per season. Do not make applications less than 7 days apart.
<b>bifenthrin</b> Brigade 2EC Sniper <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 14 days. Do not apply more than 0.3 lb active (19.2 fl oz) per acre per season to beans. Do not make applications less than 7 days apart.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 3 days. Do not apply more than 0.266 lb ai per acre per season. Do not make applications less than 5 days apart.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.050	3.2 fl oz for Pea aphid (suppression)	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
	0.013 - 0.025	0.8 - 1.6 fl oz for Leafhoppers	

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>dimethoate</b> Digon 400, Dimethoate 400 Dimethoate 2.67 EC	0.38 - 0.75	¾ - 1½ pt	No preharvest interval. Do not feed vines. To protect bees, do not apply if crop or weeds are in bloom. Do not enter treated fields without protective clothing until sprays have dried.
<b>disulfoton</b> Di-Syston G <i>RUP</i>	1	6 oz/1,000 ft of row any row spacing	Band treatment at planting only. Avoid direct contact with seed. Preharvest interval, 60 days.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not apply more than 0.2 lb a.i. per acre per season. Do not feed or graze livestock on treated vines.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. Do not graze or feed treated vines to livestock.
<b>imidacloprid</b> Attendant 600 Senator 600	refer to recommended label rate	1.6 - 3.2 fl oz per cwt of seed	Apply as a commercial seed treatment only. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Enhance AW	refer to recommended label rate	5 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. Do not graze or feed livestock on treated area for 60 days after planting. Follow all applicable directions, restrictions and precautions on the EPA registered label. For early season protection against aphid infestations.
<b>imidacloprid</b> Admire Pro	0.25 - 0.38	7.0 - 10.5 fl oz	PHI = 21 days. Maximum of 10.5 fl oz per acre per season. Apply using one of the following methods: 1) Chemigation into root zone, 2) In-furrow spray at planting directed on or below seed; 3) In a narrow (2" or less) surface band over seed-line during planting incorporating to a depth of 1 to 1.5' with sufficient irrigation within 24 hours following applications, 4) In a narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, or 5) As a post-seeding drench, transplant drench or hill drench.
<b>imidacloprid</b> Mana Alias 4F	0.25 - 0.38	8.0 - 12.0 fl oz	PHI = 21 days. Maximum amount allowed per season 12 fl oz/acre/season. Apply using one of the following methods: 1) Chemigation into root zone, 2) In-furrow spray at planting directed on or below seed; 3) In a narrow (2" or less) surface band over seed-line during planting incorporating to a depth of 1 to 1.5' with sufficient irrigation within 24 hours following applications, 4) In a narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, or 5) As a post-seeding drench, transplant drench or hill drench.
<b>imidacloprid</b> Mana Alias 4F	0.044	1.4 fl oz	PHI = 7 days. Minimum interval between applications = 5 days. Maximum of 4.2 fl oz per acre (0.13 lb ai per acre) allowed per crop season.
<b>imidacloprid</b> Nuprid 1.6F	0.048	3.8 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum amount allowed per season 10.5 fl oz/acre/season. May be applied through properly calibrated ground, aerial or chemigation application equipment. Not for use on crops grown for seed unless allowed by state-specific supplemental labeling.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Advise 2FL Nuprid 2F	0.25 - 0.38	16.0 - 24.0 fl oz	PHI = 21 days. Maximum amount allowed per season 24 fl oz/acre/season. Apply using one of the following methods: 1) Chemigation into root zone, 2) In-furrow spray at planting directed on or below seed; 3) In a narrow (2" or less) surface band over seed-line during planting incorporating to a depth of 1 to 1.5' with sufficient irrigation within 24 hours following applications, 4) In a narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, or 5) As a post-seeding drench, transplant drench or hill drench.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days for dried shelled legumes. Do not apply more than 0.12 lb ai per acre per season. Do not graze livestock in treated area or harvest vines for forage or hay.
<b>lambda-cyhalothrin</b> Kaiso <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.05 - 0.08	5.0 - 8.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>malathion</b> Malathion 57EC	1.25 - 1.56	2 - 2.5 pts	PHI = 1 day.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225 - 0.9	0.75 - 3 pts	PHI = 14 days from cutting. Do not apply more than 4.5 lb ai/acre per crop or make more than 10 applications per crop.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5	2 pts	PHI = 15 days. Read label for bee precautions. Do not enter treated fields within 48 hours after application.
<b>phorate</b> Thimet 20 G <i>RUP</i>	0.9 - 1.4 oz AI/1,000 ft of row	4.5 - 7.0 oz/1,000 ft of row - minimum 30-inch spacing	Band treatment at planting only. Avoid direct contact with seed. Preharvest interval, 60 days.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	Aphids 0.02 0- 0.025 Leafhoppers 0.017 - 0.025	Aphids 3.2 - 4 fl oz Leafhoppers 2.72 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

*RUP* - Restricted use pesticide

## ARMYWORMS

Armyworms are more of a problem in small grains and corn. Damage to dry beans can occur when their usual host plants become depleted. They are inactive during the day, resting under plant trash, clumps of grass or lodged plants. They feed at night by crawling up on plants and consuming foliage.

### Threshold:

Control of armyworms is recommended when 25% to 30% of the foliage is destroyed or if significant injury to pods is evident.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acephate</b> Acephate E 75 WP Acephate 75% Orthene Address Acephate 97UP	0.75 - 1	1 - 1.33 lbs	PHI = 14 days. Do not feed treated vines to livestock. Do not apply more than 2.67 lbs (2 lbs ai) per acre per season. Repeat at 3-7 day spray intervals for low - high rates (respectively) to maintain control.
<b>acephate</b> Orthene 97		0.75 - 1 lb (12 to 16 fl oz)	PHI = 14 days. Do not feed treated vines to livestock. Do not apply more than 2 1/8 lbs per acre per season. Repeat at 7-10 day spray intervals as necessary to maintain control.
<b>Bacillus thuringiensis ssp. kurstaki</b> DiPel DF (for organic production)		1 - 2 lb	No preharvest interval. 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.
<b>beta-cyfluthrin</b> Baythroid XL  <i>RUP</i>	0.019 - 0.025	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>bifenthrin</b> Fanfare 2EC  <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 14 days. Do not apply more than 0.2 lb active (12.8 fl oz) per acre per season. Do not make applications less than 7 days apart.
<b>bifenthrin</b> Brigade 2EC Sniper  <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 14 days. Do not apply more than 0.3 lb active (19.2 fl oz) per acre per season to beans. Do not make applications less than 7 days apart.
<b>bifenthrin</b> Capture LFR  <i>RUP</i>	0.04 - 0.08  0.0023 - 0.0046 lb active per 1000 linear feet of row	3.4 - 6.8 fl oz  0.2 - 0.39 fl oz per 1000 linear feet of row	Apply as a 5-7 inch band over the row on the soil surface, a 5-7 inch band over the open furrow (T-band), in-furrow with the seed, or broadcast over the entire acre on the soil surface. Do not apply more than 0.1 lb ai per acre per season as an at-plant application. Do not apply more than 0.3 lb ai per acre per season including at-plant plus foliar application of other bifenthrin products.
<b>bifenthrin + zeta-cypermethrin</b> Hero  <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 3 days. Do not apply more than 0.266 lb ai per acre per season. Do not make applications less than 5 days apart.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>carbaryl</b> Sevin	1 - 2	varies by formulation	No preharvest interval.
<b>cyfluthrin</b> Tombstone Tombstone Helios	0.038 - 0.050	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
	<i>RUP</i>		
<b>gamma-cyhalothrin</b> Proaxis	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. Do not graze or feed treated vines to livestock.
	<i>RUP</i>		
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 (1 <sup>st</sup> and 2 <sup>nd</sup> instars)	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
	<i>RUP</i>		
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days for dried shelled legumes. Do not apply more than 0.12 lb ai per acre per season. Do not graze livestock in treated area or harvest vines for forage or hay.
	<i>RUP</i>		
<b>lambda-cyhalothrin</b> Kaiso	0.02 - 0.03	1.33 - 2 fl oz	
	<i>RUP</i>		
<b>lambda-cyhalothrin</b> Warrior II	0.02 - 0.03	1.28 - 1.92 fl oz	
	<i>RUP</i>		
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
	<i>RUP</i>		
<b>methomyl</b> Lannate LV	0.45 - 0.9	1.5 - 3 pts	PHI = 14 days from cutting. Do not apply more than 4.5 lb ai/acre per crop or make more than 10 applications per crop.
	<i>RUP</i>		
<b>methoxyfenozide</b> Intrepid 2F	0.06-0.12	4-8 fl oz for early season applications	PHI = 7 days. Do not make applications less than 7 days apart. Do not make more than 4 applications per calendar year. Do not apply more than 64 fl oz per acre per calendar year.
	0.12-0.25	8-16 fl oz for mid- to late-season applications	
<b>spinosad (microbial)</b> Success	0.063 - 0.094	4 - 6 fl oz	PHI = 28 days. Do not apply more than a total of 12 fl oz per acre per season.. <b>For control of armyworms, corn borer, loopers, leafminers and thrips only.</b> Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>spinetoram</b> Radiant SC	0.031 - 0.063	4 - 8 fl oz	PHI = 28 days. Do not apply more than 12 fl oz (0.094 lb ai) spinetoram per acre per season. Do not make more than 6 applications per season. Do not make applications less than 4 days apart.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect	0.020 - 0.025   <i>RUP</i>	3.2 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

*RUP* - Restricted use pesticide

## BEAN LEAF BEETLE

This beetle can vary in color from yellow to reddish-brown, and may have three to four black spots and a black border on the wing covers. Adults emerge from overwintering, moving into bean fields as the seedlings emerge. The white larvae develop in the soil, feeding on the roots and nodules. New adults emerging in July feed on foliage and pods. The injury to pods results in secondary infections by fungi and bacteria, causing rotting and discoloration.

### Threshold:

Due to low incidence of this insect in North Dakota, no local control guidelines have been developed. University of Missouri entomologists suggest treatment when 40% to 70% of the bean plants show feeding injury on one or more of the pods/plant.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acephate</b> Acephate E 75 WP Acephate 75% Orthene Address Acephate 97UP	0.5 - 1	0.66 - 1.33 lbs	PHI = 14 days. Do not feed treated vines to livestock. Do not apply more than 2.67 lbs (2 lbs ai) per acre per season. Repeat at 3-7 day spray intervals for low - high rates (respectively) to maintain control.
<b>acephate</b> Orthene 97		0.5 - 1 lb (8 to 16 fl oz)	PHI = 14 days. Do not feed treated vines to livestock. Do not apply more than 2 1/8 lbs per acre per season. Repeat at 7-10 day spray intervals as necessary to maintain control.
<b>beta-cyfluthrin</b> Baythroid XL  <i>RUP</i>	0.019 - 0.025	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>bifenthrin</b> Fanfare 2EC  <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 14 days. Do not apply more than 0.2 lb active (12.8 fl oz) per acre per season. Do not make applications less than 7 days apart.
<b>bifenthrin</b> Brigade 2EC Sniper  <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 14 days. Do not apply more than 0.3 lb active (19.2 fl oz) per acre per season to beans. Do not make applications less than 7 days apart.
<b>bifenthrin + zeta-cypermethrin</b> Hero  <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 3 days. Do not apply more than 0.266 lb ai per acre per season. Do not make applications less than 5 days apart.
<b>carbaryl</b> Sevin	1	varies by formulation	No preharvest interval.



<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.038 - 0.050	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>dimethoate</b> Digon 400, Dimethoate 400, Dimethoate 2.67 EC	0.38 - 0.75	¾ - 1½ pt	No preharvest interval. Do not feed vines. To protect bees, do not apply if crop or weeds are in bloom. Do not enter treated fields without protective clothing until sprays have dried.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. Do not graze or feed treated vines to livestock.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	n applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days for dried shelled legumes. Do not apply more than 0.12 lb ai per acre per season. Do not graze livestock in treated area or harvest vines for forage or hay.
<b>lambda-cyhalothrin</b> Kaiso <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>imidacloprid</b> Attendant 600 Senator 600	refer to recommended label rate	1.6 - 3.2 fl oz per cwt of seed	Apply as a commercial seed treatment only. To suppress the spread of certain viruses by bean leaf beetle (control of overwintering population). Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Enhance AW	refer to recommended label rate	5 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. Do not graze or feed livestock on treated area for 60 days after planting. Follow all applicable directions, restrictions and precautions on the EPA registered label. For early season protection against bean leaf beetle infestations.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.017- 0.025	2.72 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## CUTWORMS

Most damage by cutworms occurs when bean 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 bean 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 3 feet of row and the larvae are small (<3/4 inch long).

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acephate</b> Acephate E 75 WP Acephate 75% Orthene Address Acephate 97UP	0.5 - 1	0.66 - 1.33 lbs	PHI = 14 days. Do not feed treated vines to livestock. Do not apply more than 2.67 lbs (2 lbs ai) per acre per season. Repeat at 3-7 day spray intervals for low - high rates (respectively) to maintain control.
<b>acephate</b> Orthene 97		0.5 - 1 lb (8 to 16 fl oz)	PHI = 14 days. Do not feed treated vines to livestock. Do not apply more than 2 1/8 lbs per acre per season. Repeat at 7-10 day spray intervals as necessary to maintain control.
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0065 - 0.0125	0.8 - 1.6 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>bifenthrin</b> Fanfare 2EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 14 days. Do not apply more than 0.2 lb active (12.8 fl oz) per acre per season. Do not make applications less than 7 days apart.
<b>bifenthrin</b> Brigade 2EC Sniper <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 14 days. Do not apply more than 0.3 lb active (19.2 fl oz) per acre per season to beans. Do not make applications less than 7 days apart.
<b>bifenthrin</b> Capture LFR <i>RUP</i>	0.04 - 0.08 0.0023 - 0.0046 lb active per 1000 linear feet of row	3.4 - 6.8 fl oz 0.20 - 0.39 fl oz per 1000 linear feet of row	Apply as a 5-7 inch band over the row on the soil surface (best for cutworm control), a 5-7 inch band over the open furrow (T-band), in-furrow with the seed, or broadcast over the entire acre on the soil surface. Do not apply more than 0.1 lb ai per acre per season as an at-plant application. Do not apply more than 0.3 lb ai per acre per season including at-plant plus foliar application of other bifenthrin products.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 3 days. Do not apply more than 0.266 lb ai per acre per season. Do not make applications less than 5 days apart.
<b>carbaryl</b> Sevin	1 - 2	varies by formulation	No preharvest interval.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.013 - 0.025	0.8 - 1.6 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not apply more than 0.2 lb a.i. per acre per season. Do not feed or graze livestock on treated vines.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.0125	1.92 - 3.2 fl oz	PHI = 21 days. Do not graze or feed treated vines to livestock.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days for dried shelled legumes. Do not apply more than 0.12 lb ai per acre per season. Do not graze livestock in treated area or harvest vines for forage or hay.
<b>lambda-cyhalothrin</b> Kaiso <i>RUP</i>	0.015 - 0.025	1 - 1.67 fl oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.05 - 0.08	5.0 - 8.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.45 - 0.9	1.5 pts	PHI = 14 days from cutting. Do not apply more than 4.5 lb ai/acre per crop or make more than 10 applications per crop.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.008- 0.025	1.28 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Use 4 fl oz per acre rate for in-furrow, band, or T-band treatments. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## FOLIAGE FEEDING CATERPILLARS

### Green Cloverworm, Cabbage Looper, Velvetbean Caterpillar, Thistle Caterpillar, and Alfalfa webworm

Populations of these caterpillars have been negligible in North Dakota and little treatment to control them has been required. The exception was the 2001 growing season when many of these caterpillars affected bean fields. Sampling for these insects is accomplished through the use of a drop cloth or a vertical beat sheet, placed between two rows of plants. The larvae are dislodged from the plants and counted on the cloth or collection tray to arrive at an estimate of the number per row feet.

**Green cloverworm:** These caterpillars are green with two narrow, white stripes down the side. When mature, the worms are 1 ¼ inches long. These caterpillars have only three pairs of fleshy prolegs on the abdomen, plus the pair on the back tip. When moving, the worms move by arching the middle of the body, or "looping." Young worms scrape leaf tissue, creating a transparent skin, or "window," on the leaf surface. Older clover worms eat holes in the leaves.

**Cabbage looper:** These caterpillars are light to dark green with lighter colored stripes, along the side and on the top, running the length of the body. When mature, the worms are 1 ½ inches long. These caterpillars have only two pairs of fleshy prolegs on the abdomen, plus the pair on the back tip. When moving, the caterpillars move by arching the middle of the body, or "looping." These worms feed on leaves on the interior and lower portion of the plant. As defoliation occurs, worms feed higher in the plant. Feeding injury is similar to the cloverworm.

**Velvetbean caterpillar:** This insect does not overwinter in the region, instead, moths migrate from Southern locations. These caterpillars have dark lines bordered by lighter colored, narrower lines running the length of the body. The background color ranges from a pale yellow-green to brown or black. These larvae have four pairs of fleshy prolegs to distinguish them from the cloverworm and the looper. Young velvetbean caterpillars feed on the underside of leaves in the upper portion of the plant. Older larvae consume the entire leaf, except for the leaf veins.

**Thistle caterpillar:** This insect is the larva of the butterfly known as the Painted Lady. This butterfly does not overwinter in the region, but migrates from Southern locations each spring. These caterpillars are brown to black in color with yellow stripes along each side of the body. They are covered with spiny-hairs that give the caterpillar a prickly appearance. Full grown larvae are about 1 ½ inches long. The caterpillars feed on the leaves, webbing them together at the feeding site.

**Alfalfa webworm:** These larvae are 1 inch when full grown. They are greenish to nearly black with a light stripe that runs down the middle of the back. There are three dark spots, each with hairs, on the side of each segment. These larvae feed for about 3+ weeks. Infestations are characterized by light webbing over the leaves. Beneath the web is where the larvae feed, consuming the leaves. These larvae move very rapidly, forward or backward, when disturbed.

**Threshold for foliage feeding caterpillars:**

Control of these different caterpillars is normally not warranted until greater than 30% of the foliage is destroyed. This usually requires an average infestation of 10 to 15 larvae per row foot.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acephate</b> Acephate E 75 WP Acephate 75% Orthene Address Acephate 97UP	0.5 - 1	0.66 - 1.33 lbs	PHI = 14 days. Do not feed treated vines to livestock. Do not apply more than 2.67 lbs (2 lbs ai) per acre per season. Repeat at 3-7 day spray intervals for low - high rates (respectively) to maintain control.
<b>acephate</b> Orthene 97		0.5 - 1 lb (8 to 16 fl oz)	PHI = 14 days. Do not feed treated vines to livestock. Do not apply more than 2 ½ lbs per acre per season. Repeat at 7-10 day spray intervals as necessary to maintain control.
<b>Bacillus thuringiensis ssp. kurstaki</b> DiPel DF (for organic production)		½ - 1 lb	No preharvest interval. 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.
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.019 - 0.025	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>bifenthrin</b> Fanfare 2EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 14 days. Do not apply more than 0.2 lb active (12.8 fl oz) per acre per season. Do not make applications less than 7 days apart.
<b>bifenthrin</b> Brigade 2EC Sniper <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 14 days. Do not apply more than 0.3 lb active (19.2 fl oz) per acre per season to beans. Do not make applications less than 7 days apart.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 3 days. Do not apply more than 0.266 lb ai per acre per season. Do not make applications less than 5 days apart.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.038 - 0.050	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not apply more than 0.2 lb a.i. per acre per season. Do not feed or graze livestock on treated vines.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. Do not graze or feed treated vines to livestock.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 21 days for dried shelled legumes. Do not apply more than 0.12 lb ai per acre per season. Do not graze livestock in treated area or harvest vines for forage or hay.
<b>lambda-cyhalothrin</b> Kaiso <i>RUP</i>	0.015 - 0.025	1 - 1.67 fl oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.05 - 0.09	5.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>malathion</b> Malathion ULV	0.6	8 fl oz	Preharvest interval 1 day.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5	2 pts	PHI = 15 days. Read label for bee precautions. Do not enter treated fields within 48 hours after application.
<b>spinosad (microbial)</b> Success	0.063 - 0.094	4 - 6 fl oz	PHI = 28 days. Do not apply more than a total of 12 fl oz per acre per season.. <b>For control of armyworms, corn borer, loopers, leafminers and thrips only.</b> Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>spinetoram</b> Radiant SC	0.031 - 0.063	4 - 8 fl oz	PHI = 28 days. Do not apply more than 12 fl oz (0.094 lb ai) spinetoram per acre per season. Do not make more than 6 applications per season. Do not make applications less than 4 days apart.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.017- 0.025	2.72 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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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. Bean growers should expect to find grasshoppers feeding first along bean field margins adjacent to these sites. Later infestations may develop when grasshopper adults migrate from harvested small grain fields. Grasshoppers will attack leaves and pods, creating holes. Due to these migrations, bean fields become sites for significant egg laying.

**Thresholds: Infestation Ratings:** Threatening is considered the action threshold for grasshoppers. 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+

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acephate</b> Acephate E 75 WP Acephate 75% Orthene Address Acephate 97UP	0.25 - 0.5	0.33 - 0.66 lbs	PHI = 14 days. Do not feed treated vines to livestock. Do not apply more than 2.67 lbs (2 lbs ai) per acre per season. Repeat at 3-7 day spray intervals for low - high rates (respectively) to maintain control.
<b>acephate</b> Orthene 97		0.25 - 0.5 lb (4 to 8 fl oz)	PHI = 14 days. Do not feed treated vines to livestock. Do not apply more than 2 1/8 lbs per acre per season. Repeat at 7-10 day spray intervals as necessary to maintain control.
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.019 - 0.025	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>bifenthrin</b> Fanfare 2EC <i>RUP</i>	0.025 - 0.10	1.6 - 6.4 fl oz	PHI = 14 days. Do not apply more than 0.2 lb active (12.8 fl oz) per acre per season. Do not make applications less than 7 days apart.
<b>bifenthrin</b> Brigade 2EC Sniper <i>RUP</i>	0.025 - 0.10	1.6 - 6.4 fl oz	PHI = 14 days. Do not apply more than 0.3 lb active (19.2 fl oz) per acre per season to beans. Do not make applications less than 7 days apart.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 3 days. Do not apply more than 0.266 lb ai per acre per season. Do not make applications less than 5 days apart.
<b>carbaryl</b> Sevin	1 - 1.5	rate varies by formulation	No preharvest interval. Treat when 8 or more grasshoppers per square yard occur in the field.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.038 - 0.050	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>esfenvalerate</b> Asana XL <i>RUP</i>	0.02 - 0.03	Low Rate: 3.9 - 5.8 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. Asana XL may be used in bordering, non-crop areas not hayed or grazed. The higher rates are for control of grasshopper nymphs larger than 2 <sup>nd</sup> instar.
	0.03 - 0.05	High Rate: 5.8-9.6 fl oz	
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. Do not graze or feed treated vines to livestock. Proaxis may be used in bordering, non-crop areas that are not hayed or grazed.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days for dried shelled legumes. Do not apply more than 0.12 lb ai per acre per season. Do not graze livestock in treated area or harvest vines for forage or hay.
<b>lambda-cyhalothrin</b> Kaiso <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.02 0- 0.025	3.2 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## SEEDCORN MAGGOT

Seed corn maggot attack bean seed, preventing sprouting or weakening seedlings. The yellowish white maggot is found burrowing in the seed or emerging stem. The adult flies emerge in spring when soil temperatures reach 50° F. They deposit eggs in soil where there is abundant organic matter and decaying crop residue, or on the seed or seedling. Seed corn maggots are usually most severe in wet, cold seasons and on high organic matter soils.

### Thresholds:

When conditions are wet and cool or planting into high crop residue conditions, seed treatments will provide the best defense against injury. Please see the seed treatment section in the introduction for more information.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>bifenthrin</b> Capture LFR <i>RUP</i>	0.04 - 0.08  0.0023 - 0.0046 pounds active per 1000 linear feet of row	3.4 - 6.8 fl oz  0.20 - 0.39 fl oz per 1000 linear feet of row	Do not apply more than 0.1 lb ai per acre per season as an at-plant application. Do not apply more than 0.3 pound active per acre per season including at-plant plus foliar applications of other bifenthrin products. Apply as a 5-7 inch band over the open furrow (T-band), or in-furrow with the seed.
<b>chlorpyrifos</b> Lorsban 30 F  Lorsban 50-SL		2.75 fl oz/100 lbs seed 2.0 fl oz/100 lbs seed	Product is applied as a slurry treatment. Lorsban treated seed must not be used for or mixed with food or animal feed, or processed for oil. <b>For Use by Commercial Seed Treaters Only.</b>
<b>phorate</b> Thimet 20 G <i>RUP</i>		4.5 - 7.0 oz/1,000 ft of row	Do not place granules in direct contact with seed. Do not feed bean foliage within 60 days of harvest.

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## WIREWORMS

Wireworms are most likely to be problems when dry beans follows pasture or grassland. Infestations often are found in coarse textured soils (sandy loam) where moisture is abundant, perhaps in low spots of fields.

### Thresholds:

There is no easy way to estimate wireworm infestations. Two methods are currently used.

**Soil Sampling** . . . Sample 20, well spaced, 1 square foot sites to a depth of 4 to 6 inches for every 40 acres being planted. If an average of 1 wireworm per square foot is found, treatment would be justified.

**Solar Baiting** . . . In September, establish bait stations for 2 to 3 weeks before freeze. Place bait stations randomly through the field, but representing all areas of the field. There should be 10 - 12 stations per 40 acre field. Place one cup wheat and one cup shelled corn in a 4- to 6-inch deep hole. Cover grain with soil and then an 18-inch square piece of clear plastic. Dig up the grain. If an average of one or more wireworm larvae are found per station, treatment would be justified.

**Seed Treatment** . . . Please the seed treatment section in the introduction for more information.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin</b> Capture LFR	0.04 - 0.08	3.4 - 6.8 fl oz	Do not apply more than 0.1 lb ai per acre per season as an at-plant application. Do not apply more than 0.3 pound active per acre per season including at-plant plus foliar applications of other bifenthrin products. Apply as a 5-7 inch band over the open furrow (T-band), or in-furrow with the seed.
<i>RUP</i>	0.0023 - 0.0046 pounds active per 1000 linear feet of row	0.20 - 0.39 fl oz per 1000 linear feet of row	
<b>imidacloprid</b> Attendant 600 Senator 600	refer to recommended label rate	1.6 - 3.2 fl oz per cwt of seed	Apply as a commercial seed treatment only. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Enhance AW	refer to recommended label rate	5 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. Do not graze or feed livestock on treated area for 60 days after planting. Follow all applicable directions, restrictions and precautions on the EPA registered label.

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# CANOLA INSECTS

Other Resources Available Through NDSU Extension Service:

Publications	E1234	Biology and Integrated Pest Management of the Crucifer Flea Beetle in Canola (2002)
	A1280	Canola Production Field Guide (2005)
	E1346	Diamondback Moth in Canola: Biology and Integrated Pest Management (2008)
	E1347	Bertha Armyworm in Canola: Biology and Integrated Pest Management (2008)

## BERTHA ARMYWORMS

The Bertha armyworm attacks many kinds of broadleaf plants, including canola, flax and beans. Areas of North Dakota where this insect may be found include the north-central counties of Bottineau, Rollette, Towner, and neighboring areas. The larvae are pale green when they first hatch. These larvae feed on the leaves. Older larvae reach a length of 3/4 to 1 inch and will be velvety brown to black with a yellowish band along each side of the body. As leaves dry, these larvae begin feeding on seeds and flowers which are more succulent. The greatest risk of crop injury occurs in August as the worms approach full growth. In Canada, where this insect is a more frequent pest, early seeded canola often has been swathed prior to the occurrence of significant feeding injury.

**Threshold:**

Thresholds would be 18 to 22 larvae per square yard, as long as leaf feeding is the extent of the damage observed.

Thresholds may be adjusted lower if larvae are found feeding on maturing seed pods.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b><i>Bacillus thuringiensis</i></b> 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>bifenthrin</b> Bifenture EC Brigade 2 EC Capture 2 EC Fanfare 2 EC Tundra <i>RUP</i>	0.033 - 0.04	2.1 - 2.6 fl oz	PHI = 35 days. Do not apply more than 5.12 fl oz per acre per season. Do not make applications less than 14 days apart. Apply a minimum of 2 gals. of finished spray per acre by air or in a minimum of 10 gals. per acre by ground. When applying by air, 1 to 2 quarts of emulsified oil may be substituted for 1 to 2 qts of water in the finished spray.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.009	0.8 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 7 days. Do not apply more than 1.5 fl oz (0.018 lb ai) per acre per season. Do not make applications less than 7 days apart.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.015	1.92 - 3.84 fl oz	PHI = 7 days. When applying by air, apply in a minimum of 2 gals water/acre.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Nufarm Lambda-Cyhalothrin 1EC Grizzly Z <i>RUP</i>	0.015 - 0.03	1.92 - 3.84 fl oz	PHI = 7 days. Do not apply more than 0.09 lb ai per acre per season. Avoid application when bees are actively foraging. When applying by air, apply in a minimum of 2 gals water/acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.015 - 0.03	1.0 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.03	0.96 - 1.92	
<b>tebufenozide</b> Confirm 2F	0.12 - 0.25	8 - 16 fl oz	PHI = 14 days. Do not apply more than 64 fl oz (1 lb ai) per acre per season. Apply in a minimum of 10 GPA by ground and 5 GPA by air.

Canola

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.025	4 fl oz	PHI = 7 days. Do not apply more than 0.15 lb ai per acre per season. Do not make applications less than 7 days apart.

## CUTWORMS

Most damage by cutworms occurs during seedling stage. Army cutworm feeding as early as late April has caused problems in recent years for canola growers in southwestern North Dakota. Cutworm 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 canola 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 3 feet of row and the larvae are small (<3/4 inch long).

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin</b> Bifenture EC Brigade 2 EC Capture 2 EC Fanfare 2 EC Tundra <i>RUP</i>	0.033 - 0.04	2.1 - 2.6 fl oz	PHI = 35 days. Do not apply more than 5.12 fl oz per acre per season. Do not make applications less than 14 days apart. Apply a minimum of 2 gals. of finished spray per acre by air or in a minimum of 10 gals. per acre by ground. When applying by air, 1 to 2 quarts of emulsified oil may be substituted for 1 to 2 qts of water in the finished spray.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.009	0.8 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 7 days. Do not apply more than 1.5 fl oz (0.018 lb ai) per acre per season. Do not make applications less than 7 days apart.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.015	1.92 - 3.84 fl oz	PHI = 7 days. When applying by air, apply in a minimum of 2 gals water/acre.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Nufarm Lambda- Cyhalothrin 1EC Grizzly Z <i>RUP</i>	0.015 - 0.03	1.92 - 3.84 fl oz	PHI = 7 days. Do not apply more than 0.09 lb ai per acre per season. Avoid application when bees are actively foraging. When applying by air, apply in a minimum of 2 gals water/acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.015 - 0.03	1.0 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.03	0.96 - 1.92	
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.025	4 fl oz	PHI = 7 days. Do not apply more than 0.15 lb ai per acre per season. Do not make applications less than 7 days apart.

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## DIAMONDBACK MOTH

Diamondback moths move to canola, rapeseed and other mustard hosts in late spring and early summer. The first eggs are laid on the lower leaves. The small, greenish larvae make tiny, irregular holes in the leaves. Moths of later generations lay eggs higher on the plant. These hatching larvae feed first on leaves, moving later to buds, flowers and developing seedpods. Foliar damage by diamondback moth larvae looks bad, but significant yield losses are not common. Damage would be much worse when plants are under drought or heat stress.

### Threshold:

Treat when larval counts reach 25 to 30 per square foot, or 1 to 2 larvae per plant, and there is significant evidence of damage to flowers and/or pods.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin</b> Bifenture EC Brigade 2 EC Capture 2 EC Fanfare 2 EC Tundra <i>RUP</i>	0.033 - 0.04	2.1 - 2.6 fl oz	PHI = 35 days. Do not apply more than 5.12 fl oz per acre per season. Do not make applications less than 14 days apart. Apply a minimum of 2 gals. of finished spray per acre by air or in a minimum of 10 gals. per acre by ground. When applying by air, 1 to 2 quarts of emulsified oil may be substituted for 1 to 2 qts of water in the finished spray.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.009	0.8 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 7 days. Do not apply more than 1.5 fl oz (0.018 lb ai) per acre per season. Do not make applications less than 7 days apart.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.015	1.92 - 3.84 fl oz	PHI = 7 days. When applying by air, apply in a minimum of 2 gals water/acre.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.03	1.92 - 3.84 fl oz	PHI = 7 days. Do not apply more than 0.09 lb ai per acre per season. Avoid application when bees are actively foraging. When applying by air, apply in a minimum of 2 gals water/acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.015 - 0.03	1.0 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.03	0.96 - 1.92	
<b>methyl parathion</b> <i>RUP</i>	0.5	1 pt	PHI = 28 days. Apply using a minimum of 3 GPA. Do not enter treated fields within 48 hours after application. Do not make more than 2 applications per season.
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.025	4 fl oz	PHI = 7 days. Do not apply more than 0.15 lb ai per acre per season. Do not make applications less than 7 days apart.

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## FLEA BEETLES

Flea beetles are the most serious pest of canola in North Dakota. The adult beetles feed on the emerging cotyledon and first true leaves of the young plant. Feeding injury can result in plant death and significant stand loss, especially during hot, dry weather.

Flea beetles overwinter as adults. They become active when temperatures reach 58° F. The beetles fly to canola, rapeseed and other mustards, moving into fields just as the seedlings emerge. The feeding injury appears as holes or small pits in the cotyledons and leaves. Injury can range from a few shot holes to destruction of the entire plant. Flea beetles feed most actively when the weather is sunny, warm and dry. Beetle activity is less when weather conditions are cool and damp. When warm, dry conditions exist and feeding injury is occurring, the plant can be stressed quickly. Cool, damp conditions can reduce the feeding intensity of the beetles and aid plant growth to the point where they can withstand the feeding damage. Once the crop is beyond the seedling stage and the first true leaves are fully expanded, serious damage usually does not occur. By mid-June, adult beetles decrease in number.

### Flea Beetle Management:

**Early Planting** . . . The early planting and establishment of canola can prevent significant injury to young plants by flea beetles migrating to fields after the first true leaves are fully expanded.

**Seed Treatment** . . . Gaucho®, Helix®, Poncho® and Prosper® are for use by commercial seed treaters.

**Foliar Treatment** . . . Fields should be checked daily for the presence of flea beetles while canola plants are at risk. The treatment threshold is when injury is approaching 25% and beetles are present. Foliar treatments must be made quickly. The weakness of foliar control strategies is the inability to cover large number of acres quickly when feeding pressure is high, and residual protection by the insecticides is short, allowing for reinfestation to occur.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin</b> Bifenture EC Brigade 2 EC Capture 2 EC Fanfare 2 EC Tundra <i>RUP</i>	0.033 - 0.04	2.1 - 2.6 fl oz	PHI = 35 days. Do not apply more than 5.12 fl oz per acre per season. Do not make applications less than 14 days apart. Apply a minimum of 2 gals. of finished spray per acre by air or in a minimum of 10 gals. per acre by ground. When applying by air, 1 to 2 quarts of emulsified oil may be substituted for 1 to 2 qts of water in the finished spray.
<b>clothianidin</b> NipsIT INSIDE (seed treatment)	refer to recommended label rate	10.23 fl oz per 100 lbs seed	Application to seed by commercial seed treatment equipment utilizing standard liquid or slurry treaters is necessary. Tank mixtures with other seed treatment products should be pretested to evaluate compatibility and assure proper physical compatibility.
<b>clothianidin</b> Poncho  Prosper (fungicide premix)		3.84 - 10.23 fl oz per 100 lbs of seed  19.2 - 25.6 fl oz per 100 lbs of seed	For use in commercial seed treaters only. Not for use in hopper-box, slurry-box or other seed treatment applications at, or immediately before, planting. Provides protection from flea beetle feeding injury. Rates can be varied depending on assessment of flea beetle risk based on population size observed.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.009	0.8 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 7 days. Do not apply more than 1.5 fl oz (0.018 lb ai) per acre per season. Do not make applications less than 7 days apart.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.015	1.92 - 3.84 fl oz	PHI = 7 days. When applying by air, apply in a minimum of 2 gals water/acre.
<b>imidacloprid</b> Gaucho 600		10.24 - 25.6 fl oz per hundredweight of seed	Primarily for use in commercial seed treaters. Canola seed may be treated as an end-use seed treatment on agricultural establishments at, or immediately before planting, using a liquid or slurry treatment device. Provides protection from flea beetle feeding injury. Rates can be varied depending on assessment of flea beetle risk based on population size observed.
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate		Apply as a commercial seed treatment or for end-use at agricultural establishments (total slurry treater, farmer applied seed treater). To provide early season protection of seedlings against injury by aphids, flea beetles and wireworms. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.03	1.92 - 3.84 fl oz	PHI = 7 days. Do not apply more than 0.09 lb ai per acre per season. Avoid application when bees are actively foraging. When applying by air, apply in a minimum of 2 gals water/acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.015 - 0.03	1.0 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.03	0.96 - 1.92	
<b>methyl parathion</b> <i>RUP</i>	0.5	1 pt	PHI = 28 days. Apply using a minimum of 3 GPA. Do not enter treated fields within 48 hours after application. Do not make more than 2 applications per season.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>thiamethoxam</b> Helix (10.3 % active)  Helix Xtra (20.7% active)		23 fl oz per hundredweight of seed	For use in commercial seed treaters only. The formulations vary by the concentration of insecticide. Provides protection from flea beetle feeding injury. Helix contains 3 fungicides to protect against seed-borne blackleg, seed-borne <i>Alternaria</i> , and the seedling disease complex disease. There is a 30 day plant-back restriction.
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.025	4 fl oz	PHI = 7 days. Do not apply more than 0.15 lb ai per acre per season. Do not make applications less than 7 days apart.

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## GRASSHOPPERS

### Thresholds:

Grasshopper control is advised whenever 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. (For more information on infestation ratings, see the discussion under Grasshoppers in Small Grain Insects).

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin</b> Bifenture EC Brigade 2 EC Capture 2 EC Fanfare 2 EC Tundra <i>RUP</i>	0.033 - 0.04	2.1 - 2.6 fl oz	PHI = 35 days. Do not apply more than 5.12 fl oz per acre per season. Do not make applications less than 14 days apart. Apply a minimum of 2 gals. of finished spray per acre by air or in a minimum of 10 gals. per acre by ground. When applying by air, 1 to 2 quarts of emulsified oil may be substituted for 1 to 2 qts of water in the finished spray.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.009	0.8 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 7 days. Do not apply more than 1.5 fl oz (0.018 lb ai) per acre per season. Do not make applications less than 7 days apart.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.015	1.92 - 3.84 fl oz	PHI = 7 days. When applying by air, apply in a minimum of 2 gals water/acre.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.03	1.92 - 3.84 fl oz	PHI = 7 days. Do not apply more than 0.09 lb ai per acre per season. Avoid application when bees are actively foraging. When applying by air, apply in a minimum of 2 gals water/acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.015 - 0.03	1.0 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.03	0.96 - 1.92	
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.025	4 fl oz	PHI = 7 days. Do not apply more than 0.15 lb ai per acre per season. Do not make applications less than 7 days apart.

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## LYGUS BUGS (TARNISHED PLANT BUGS)

Lygus bugs are comprised of several species belonging to the genus *Lygus*. The tarnished plant bug, *Lygus lineolaris*, is one of the more common species and is known to feed on over 200 host plants. Adult Lygus bugs are about ¼ inch in length, and pale green, light brown, or dark brown with a distinctive triangular marking on its back. Lygus bugs overwinter as adults in weedy areas and move into canola fields throughout the season. Adults lay eggs in the stems, leaves, and flowers of host plants, and then die. Immature nymphs hatch from these eggs. These nymphs are small, green, and sometimes confused with aphids; although Lygus nymphs are very active and move rapidly when disturbed, while aphids do not. Several generations occur each year with the second generation occurring in late July to early August. Hot dry weather favors the buildup of Lygus populations and increases the risk of

damage to the canola crop. Both immature and adult Lygus bugs feed on growing points, buds, flowers, and green pods. Lygus bugs inject a toxic saliva with their piercing sucking mouthparts during feeding, causing blasting of flowers or buds and shriveled seeds. Blasted flowers turn white within 24 hours and quickly fall to the ground. The small seeds or damaged seeds are lost during harvest.

**Thresholds:**

Scout for Lygus bugs from just prior to bud formation until seeds within the pod have become firm. Lygus populations can increase suddenly. For example, when an alfalfa (preferred host) is cut, Lygus will migrate quickly into nearby canola fields and often in high numbers. Use a 15-inch sweep net and make 10 180-degree sweeps at several sampling sites. The economic thresholds developed in Canada are: 15 Lygus bugs per 10 sweeps from bud stage through petal drop, and 20 Lygus bugs per 10 sweeps after petal drop. If soil moisture is good, canola plants usually can compensate for Lygus bug feeding injury to plants in the bud and flowering stages. However, if populations are high, control during the early pod ripening stage is usually the most economical.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin</b> Bifenture EC Brigade 2 EC Capture 2 EC Fanfare 2 EC Tundra <i>RUP</i>	0.033 - 0.04	2.1 - 2.6 fl oz	PHI = 35 days. Do not apply more than 5.12 fl oz per acre per season. Do not make applications less than 14 days apart. Apply a minimum of 2 gals. of finished spray per acre by air or in a minimum of 10 gals. per acre by ground. When applying by air, 1 to 2 quarts of emulsified oil may be substituted for 1 to 2 qts of water in the finished spray.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.009	0.8 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 7 days. Do not apply more than 1.5 fl oz (0.018 lb ai) per acre per season. Do not make applications less than 7 days apart.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.015	1.92 - 3.84 fl oz	PHI = 7 days. When applying by air, apply in a minimum of 2 gals water/acre.
<b>imidacloprid</b> Dyna-Shield Imidacloprid 5 Senator 600 <b>(for suppression of second generation Lygus bugs)</b>	refer to recommended label rate		Apply as a commercial seed treatment or for end-use at agricultural establishments (total slurry treater, farmer applied seed treater). To provide early season protection of seedlings against injury by aphids, flea beetles and wireworms. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.03	1.92 - 3.84 fl oz	PHI = 7 days. Do not apply more than 0.09 lb ai per acre per season. Avoid application when bees are actively foraging. When applying by air, apply in a minimum of 2 gals water/acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.015 - 0.03	1.0 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.03	0.96 - 1.92	
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.025	4 fl oz	PHI = 7 days. Do not apply more than 0.15 lb ai per acre per season. Do not make applications less than 7 days apart.

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# CARROTS

## ASTER LEAFHOPPER

The aster leafhopper can be a serious pest of carrots, potatoes and other vegetables. Feeding injury by the aster leafhopper is usually not the concern. It is the insect's ability to transmit Aster Yellows, a mycoplasma-induced disease. Aster Yellows can also affect wheat (symptoms resemble barley yellow dwarf).

The aster leafhopper is light green. The head is marked with black spots arranged in pairs (which accounts for the other common name of **Sixspotted leafhopper**). The aster leafhopper overwinters as an egg in the northern states. These eggs are hatching sometime in June. However, by late May and early June, adult leafhoppers are migrating into the region from areas to the south. In southern Minnesota and Wisconsin, the migrant adults are monitored for Aster Yellows infectivity levels. This information is useful for determining the population levels where growers need to control aster leafhopper to minimize infection and losses.

### Thresholds:

Sampling for leafhopper adults is done with a sweep net. When monitoring a field, estimate the population based on the average number of leafhoppers per 100 sweeps. In Wisconsin, based on a 2.5% infectivity level, control of aster leafhopper in carrots is currently recommended when sweep net sampling finds 20 leafhoppers per 100 sweeps for susceptible carrot varieties, or 40 per 100 sweeps for resistant carrot varieties.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL  <i>RUP</i>	0.0125 - 0.022	1.6 - 2.8 fl oz	PHI = 0 days. A total of 14.0 fl oz per acre may be made per season. Allow at least 7 days between applications. Due to potential injury to bee, do not apply to crops being grown for seed.
<b>carbaryl</b> Sevin	0.5 - 0.75	rate varies by formulation	PHI = 0 days.
<b>esfenvalerate</b> Asana XL  <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Apply as needed for control, but do not exceed 0.5 lb ai/acre per season. For aerial application apply in a minimum of 5 gals water per acre.
<b>imidacloprid</b> Admire Pro	see label	0.31 - 0.74 fl oz/ 1,000 feet of row  4.4 - 10.5 fl oz/A	PHI = 21 days. Apply in-furrow (rate per 1,000 row feet) or shanked-in. Or, apply in a narrow band (2 inches or less) directly below (1 to 2 inches) seed depth during planting.
<b>imidacloprid</b> Advise 2FL Nuprid 2F	see label	10 - 24 fl oz or 0.7 - 1.7 fl oz / 1,000 row-feet	PHI = 21 days. Maximum amount allowed per season 24 fl oz/acre/season. Maximum number of applications per crop season = 1. Apply using one of the following methods: 1) Chemigation into root zone, 2) In-furrow spray 1 to 2 inches below seed depth during planting, or 3) In a narrow (2 inches or less) band directly (1-2 inches) below the eventual seed row in a bedding operation 14 or fewer days before planting. Not for use on crops grown for seed unless allowed by state-specific labeling. Tops or greens may be utilized for food or feed.
<b>imidacloprid</b> Nuprid 1.6F	0.044	3.5 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum amount allowed per season 15.5 fl oz/acre/season. May be applied through properly calibrated ground, aerial or chemigation application equipment. Not for use on crops grown for seed unless allowed by state-specific labeling.
<b>imidacloprid</b> Senator 600	refer to recommended label rate	6.4 fl oz per cwt of seed	Apply as a commercial seed treatment only. Follow all applicable directions, restrictions and precautions on the EPA registered label. Controls wireworms and seed corn maggots.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360  <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Do not apply more than 8.3 fl oz per acre per season (0.065 lb ai beta-cyfluthrin, 0.13 lb ai imidacloprid).
<b>malathion</b> Malathion 57 EC		2.5 pts.	PHI = 7 days.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>methomyl</b> Lannate LV <i>RUP</i>	0.4 - 0.9	1.5 - 3 pts	PHI = 1 days. Do not make more than 10 applications per crop. Do not apply more than 6.3 lbs. ai/acre/crop.
<b>thiamethoxam</b> Platinum 2SC	0.08 - 0.188	5.0 - 12.0 fl oz	Also controls aphids and flea beetles. Apply at seeding or within 24 hours of seeding, using one of the following methods: 1) in-furrow spray at the seeding or as a narrow surface band above the seedline during planting. For surface-banded applications, incorporate to the seeding depth with sufficient sprinkle or drip irrigation within 24 hours; 2) immediately after seeding using sufficient water volume to ensure incorporation into the seed zone; 3) in trickle or drip irrigation water. For planting systems where multiple rows are planted on beds, apply Platinum according to one of the above methods. Do not exceed a total of 12 fl oz per acre per season.
<b>thiamethoxam</b> Platinum 75SG	0.08 - 0.188	1.7 - 4.01 oz	

*RUP* - Restricted use pesticide

## WIREWORMS

Wireworms, although often serious pests of cereal grains in the seedling stage, seldom damage carrots. Cruiser and Gaucho are 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.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>imidacloprid</b> Gaucho 600	refer to recommended label rate		Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Dyna-Shield Imidacloprid 5	refer to recommended label rate	6.4 fl oz per cwt of seed	Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Senator 600	refer to recommended label rate	6.4 fl oz per cwt of seed	Follow all applicable directions, restrictions and precautions on the EPA registered label.



## CHICKPEA / GARBANZO BEAN

Chickpea stems, leaves and seed pods are covered with small, hairlike glandular structures that secrete malic and oxalic acids. The secretions discourage insects from feeding on the plants. Therefore, insect problems on chickpeas have been minimal and insecticide applications generally have not been necessary. Several viral diseases that are transmitted by aphids have occasionally been reported in chickpea fields from the states of Washington and Idaho. Potential insect pests of chickpea include seedcorn maggots, armyworms, aphids, cutworms, grasshoppers, lygus bugs and wireworms.

### Insecticides approved for control of insect pests in Chickpea

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <span style="float: right;"><i>RUP</i></span>	0.0125 - 0.025	1.6 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock. Label includes plant bugs, grasshoppers, and other insect pests. For pea aphid, use high rate of 3.2 fl oz/acre for pest suppression only.
<b>bifenthrin + zeta-cypermethrin</b> Hero <span style="float: right;"><i>RUP</i></span>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 3 days. Do not apply more than 0.266 lb ai per acre per season. Do not make applications less than 5 days apart. Except Lygus bugs and wireworms.
<b>cyfluthrin</b> Tombstone Tombstone Helios <span style="float: right;"><i>RUP</i></span>	0.025 - 0.050	1.6 - 3.2 fl oz	PHI = 7 days. Do not apply more than 0.05 lb ai per acre per 14 day interval. Do not apply more than 0.1 lb ai per acre per season.
<b>dimethoate</b> Digon 400 Dimethoate 400	0.25 - 0.5	0.5 - 1 pt	Labeled for aphid control. Peas may be harvested mechanically on day of application. Do not feed treated plants to livestock. Label includes aphids, grasshoppers, leafhoppers and lygus bugs.
<b>esfenvalerate</b> Asana XL <span style="float: right;"><i>RUP</i></span>	0.02 - 0.03	Low Rate: 3.9 - 5.8 fl oz	PHI = 21 days. The 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>GRASSHOPPER ONLY</b>	0.03 - 0.05	High Rate: 5.8-9.6 fl oz	
<b>esfenvalerate</b> Adjourn Asana XL <span style="float: right;"><i>RUP</i></span>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. 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 <span style="float: right;"><i>RUP</i></span>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. Label includes aphid, grasshopper, cutworm and others. Proaxis may be used to control grasshoppers in bordering, non-crop areas that are not hayed or grazed.
<b>imidacloprid</b> Attendant 600 Senator 600	refer to recommended label rate	1.6 - 3.2 fl oz per cwt of seed	Apply as a commercial seed treatment. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Enhance AW	refer to recommended label rate	5 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. Do not graze or feed livestock on treated area for 60 days after planting. Follow all applicable directions, restrictions and precautions on the EPA registered label. For early season control of aphids and wireworms.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>imidacloprid</b> Admirer Pro  Controls aphids and leafhoppers only	0.25 - 0.38	7.0 - 10.5 fl oz	PHI = 21 days. Maximum of 10.5 fl oz per acre per season. Apply using one of the following methods: 1) Chemigation into root zone, 2) In-furrow spray at planting directed on or below seed; 3) In a narrow (2" or less) surface band over seed-line during planting incorporating to a depth of 1 to 1.5' with sufficient irrigation within 24 hours following applications, 4) In a narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, or 5) As a post-seeding drench, transplant drench or hill drench.
<b>imidacloprid</b> Advise 2FL Nuprid 2F  Controls aphids, leafhoppers, lygus bug only	see label	16 - 24 fl oz	PHI = 21 days. Maximum amount allowed per season 24 fl oz/acre/season. Apply using one of the following methods: 1) Chemigation into root-zone through low-pressure drip, trickle, microsprinkler or equivalent equipment, 2) In-furrow spray during planting directed on or below seed, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 In a narrow (2" or less) surface band over seed-line during planting incorporated to a depth of 1 to 1.5 inches with sufficient irrigation within 24 hours following application, 4) In a narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, or 5) As a post-seeding drench, transplant drench, or hill drench. Not for use on crops grown for seed unless allowed by state-specific supplemental labeling.
<b>imidacloprid + beta- cyfluthrin</b> Leverage 360  <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
<b>lambda-cyhalothrin</b> Lambda-Cy Grizzly Z Nufarm Lambda- Cyhalothrin 1EC Silencer  <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days. Label includes aphid, grasshopper, cutworm and others. Warrior may be used to control grasshoppers in bordering, non-crop areas that are not hayed or grazed. Do not apply more than 0.12 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Kaiso  <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	
<b>lambda-cyhalothrin</b> Warrior II  <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress  <i>RUP</i>	0.05 - 0.09	5.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>methoxyfenozide</b> Intrepid 2F  Controls armyworms only	0.06-0.12  0.12-0.25	4-8 fl oz for early season applications  8-16 fl oz for mid- to late-season applications	PHI = 7 days. Do not make applications less than 7 days apart. Do not make more than 4 applications per calendar year. Do not apply more than 64 fl oz per acre per calendar year.
<b>methomyl</b> Lannate LV  <i>RUP</i>	0.45 - 0.9	1.5 - 3 pts	PHI = 1 day. Of the 3 insects mentioned above, the label only includes cutworms.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>spinosad (microbial)</b> Spintor 2SC	0.062 - 0.094	4 - 6 fl oz	PHI = 28 days. Do not feed forage or hay to meat or dairy animals. Label includes armyworms and European corn borer.
<b>spinosad (microbial)</b> Success	0.047 - 0.094	3 - 6 fl oz	PHI = 28 days. Do not apply more than a total of 12 fl oz per acre per season.. <b>For control of armyworms, corn borer, loopers, leafminers and thrips only.</b> Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>spinetoram</b> Radiant SC	0.031 - 0.063	4 - 8 fl oz	PHI = 28 days. Do not apply more than 12 fl oz (0.094 lb ai) spinetoram per acre per season. Do not make more than 6 applications per season. Do not make applications less than 4 days apart.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC <i>RUP</i>	0.017 - 0.025	2.72 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground. Label includes aphids, armyworms, cutworms, grasshoppers, plant bugs, and more (see label).
<b>zeta-cypermethrin</b> Respect <i>RUP</i>	0.017 - 0.025	2.72 - 4 fl oz	

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## CORN INSECTS

Other Resources Available Through NDSU Extension Service:

Publications	E493	Aphid Management in Small Grains, Corn and Sorghum (1993)
	E631	Corn Insects in North Dakota (1990)
	E830	The Armyworm and the Army Cutworm (2000)
	E272	Grasshopper Management (1997)
	E188	Wireworm Control (2001)

### APHID

#### Corn Leaf and Greenbug

The greenbug and corn leaf aphid are the most common species causing problems in corn and sorghum. The greenbug is the most injurious because it injects a toxin with its saliva during feeding.

**Threshold:**

The critical period for injury by corn leaf aphid is during tassel emergence through pollination. Treatment is suggested only when 50% of the corn plants have 100+ aphids per plant during tassel emergence and plants are drought stressed.

**Natural Controls:**

Lady beetles, aphid lions, syrphid fly and parasitic wasps play a major role in reducing aphid populations. When natural enemies are present in large numbers, and the crop is well developed, farmers are discouraged from spraying fields.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin</b> Bifenture EC Brigade 2EC Capture 2EC Fanfare 2EC Sniper Tundra EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 30 days. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply more than 0.3 lb AI per acre per season including PRE, PPI at-plant and foliar applications.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.103	4.0 - 10.3 fl oz	PHI = 30 for grain, PHI = 60 days for forage. Do not apply more than 0.4 lb ai per acre per season. Do not graze livestock in treated area or cut treated crops for feed within 30 days of the last application.
<b>chlorpyrifos</b> Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.5 - 1	1 - 2 pts	PHI = 35 days for Lorsban 4E and 21 days for Lorsban Advanced. Do not allow meat or dairy animals to graze in treated areas nor harvested treated corn silage as feed for meat or dairy animals within 14 days after last treatment. Do not apply more than 6.38 pints per acre per season or more than 3 applications per season of any product containing chlorpyrifos. Do not make a second application within 10 days of the first application. Apply by air, ground or chemigation (treatment through irrigation systems) in sufficient water for adequate coverage. REI = 24 hours.
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.22 - 0.51 + 0.011 - 0.026	11 - 26 fl oz	PHI = 21 days for grain, ears, forage or fodder. Do not make more than 3 applications or apply more than 129 fl oz per season. See label for other restrictions.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.018 - 0.022	1.5 - 1.9 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 21 days, or within 12 days of cutting or grazing field corn for forage. Avoid application in the heat of day. Do not apply more than 8.1 fl oz per acre per season. Do not make more than 5 applications per season.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>dimethoate</b> Digon 400, Dimethoate 400 Dimethoate 2.67 EC	0.25 - 0.75	½ - 1½ pt	PHI = 14 days of harvest or grazing. Do not make more than 3 applications per season. Do not apply to corn during pollen shed.
<b>disulfoton</b> Di-Syston <i>RUP</i>	0.5 - 1	0.5 - 1 pt	Aerial application only. PHI = 28 days of corn harvest.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not apply more than 0.25 lb active per acre per season.
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate		Apply as a commercial seed treatment or for end-use at agricultural establishments (slurry or farmer applied seed treater). Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz (suppression)	PHI = 21 days. Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed corn fodder or silage to meat or dairy animals within 21 days after last treatment. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.06 lb ai per acre after silk initiation. Do not apply more than 0.03 lb ai per acre after corn has reached milk stage (yellow kernels with milky fluid).
<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>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 7 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year, or more than 18 oz per acre after silk initiation, or more than 9 oz per acre after milk stage. Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last application. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after application. Greenbug: 9 oz per acre (suppression only).
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225 - 0.45	12 - 24 fl oz	Do not harvest within 7 days or feed treated forage within 10 days of application. Field re-entry interval is 2 days for corn.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 0.75	2 - 3 pts	PHI = 12 days, cut for forage, or use for grazing. Do not apply during pollen shed if bees are visiting the areas. Do not apply more than 12 pts/A per year. Do not enter treated fields within 48 hours after application.
<b>methyl parathion</b> <i>RUP</i>	0.5	8 fl oz	Do not use within 12 days of corn harvest. Do not enter treated fields within 48 hours after application.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect  <i>RUP</i>	0.017 - 0.025	2.72 - 4 fl oz	PHI = 30 days of harvest for grain and stover and 60 days for forage. Do not apply more than 0.10 lb AI per acre per season including at-planting plus foliar applications. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground. Control may vary depending on aphid species present.

*RUP* - Restricted use pesticide

## ARMYWORMS

Armyworm outbreaks in North Dakota can occur when large migrations of moths from Southern states occur in late spring and early summer. Moths prefer to lay eggs in moist, shady areas where small grains or grasses have lodged or been damaged by hail or wind. Armyworms feed at night and hide under vegetation or in loose soil during the day. To scout for armyworms in grains, part the plants and inspect the soil for fecal pellets. If pellets or feeding damage are found, look for larvae under plant trash, soil clods or in soil cracks.

### Threshold:

Treat when 25% to 30% of the plants have 2 or more worms or 75% of the plants have 1 worm.

### Migrating Armyworms:

Treat a couple of swaths ahead of the infestation in the direction of movement to form a barrier strip.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>Bacillus thuringiensis</b> Agree Biobit Condor G DiPel DF Javelin M-peril MVP 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.
<b>beta-cyfluthrin</b> Baythroid XL  <i>RUP</i>	0.0125 - 0.022	1.6 - 2.8 fl oz	PHI = 21 days for grain or fodder; Green forage may be fed 0 days after last application. Maximum of 11.2 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Maximum number of applications per season = 4. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>bifenthrin + zeta-cypermethrin</b> Hero  <i>RUP</i>	0.04 - 0.103	4.0 - 10.3 fl oz	PHI = 30 for grain, PHI = 60 days for forage. Do not apply more than 0.4 lb ai per acre per season. Do not graze livestock in treated area or cut treated crops for feed within 30 days of the last application.
<b>bifenthrin</b> Capture LFR  <i>RUP</i>	At Planting: 0.04 - 0.08 0.0023 - 0.0046 lb active per 1000 linear feet of row  PRE: 0.040  PPI: 0.047 - 0.062	At Planting: 3.4 - 6.8 fl oz 0.20 - 0.39 fl oz per 1000 linear feet of row  PRE: 3.4 fl oz  PPI: 4.0 - 5.3	Apply as a 5-7 inch band over the row on the soil surface, a 5-7 inch band over the open furrow (T-band), in-furrow with the seed, or broadcast over the entire acre on the soil surface. Do not apply more than 0.1 lb ai per acre per season as an at-plant application. Do not apply more than 0.3 lb ai per acre per season including PRE, PPI, at-plant and foliar applications, including other bifenthrin products.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin</b> Bifenture EC Brigade 2EC Capture 2EC Fanfare 2EC Sniper Tundra 2EC <i>all RUP</i>	At Planting: 0.0023 - 0.0046 lb active per 1000 linear feet of row  PRE: 0.04  PPI: 0.047 - 0.062  Foliar: 0.033 - 0.10	At Planting: 0.15 - 0.30 fl oz per 1000 linear feet of row  PRE: 2.56 fl oz  PPI: 3.0 - 4.0 fl oz  Foliar: 2.1 - 6.4 fl oz	Apply as a 5-7 inch band over the row on the soil surface, a 5-7 inch band over the open furrow (T-band), in-furrow with the seed, or broadcast over the entire acre on the soil surface. Do not apply more than 0.1 lb ai per acre per season as an at-plant application. Do not apply more than 0.3 lb ai per acre per season including PRE, PPI, at-plant and foliar applications, including other bifenthrin products. PHI = 30 days. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.
<b>carbaryl</b> Sevin	1 - 1.5	rate varies by formulation	PHI = 48 days of grain harvest, or 14 days for silage or grazing.
<b>chlorpyrifos</b> Lorsban 4E Lorsban Advanced <i>RUP</i>	0.5 - 1	1 - 2 pts	PHI = 35 days for Lorsban 4E and 21 days for Lorsban Advanced. Do not allow meat or dairy animals to graze in treated areas nor harvested treated corn silage as feed for meat or dairy animals within 14 days after last treatment. Do not apply more than 6.38 pints per acre per season or more than 3 applications per season of any product containing chlorpyrifos. Do not make a second application within 10 days of the first application. Apply by air, ground or chemigation (treatment through irrigation systems) in sufficient water for adequate coverage. REI = 24 hours.
<b>chlorpyrifos</b> Warhawk <i>RUP</i>	0.5 - 1	1 - 2 pts	
<b>chlorpyrifos</b> Yuma 4E <i>RUP</i>	0.5 - 1	1 - 2 pts	
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.22 - 0.51 + 0.011 - 0.026	11 - 26 fl oz	PHI = 21 days for grain, ears, forage or fodder. Do not make more than 3 applications or apply more than 129 fl oz per season. See label for other restrictions.
<b>chlorpyrifos + zeta- cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.044	1.6 - 2.8	PHI = 21 days for grain or fodder. Green forage may be fed 0 days after last application. Do not apply more than 0.044 lb ai per acre per 7 day interval. Do not apply more than 0.175 lb ai per acre per season.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.018 - 0.022	1.5 - 1.9 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 21 days, or within 12 days of cutting or grazing field corn for forage. Avoid application in the heat of day. Do not apply more than 8.1 fl oz per acre per season. Do not make more than 5 applications per season.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not apply more than 0.25 lb active per acre per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. When applying by air, apply in a minimum of 2 gals of water per acre.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days. Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed corn fodder or silage to meat or dairy animals within 21 days after last treatment. Do not apply more than 0.12 lb ai (15.36 fl oz) per acre per season. Do not apply more than 0.06 lb ai (7.68 fl oz) per acre after silk initiation. Do not apply more than 0.03 lb ai (3.84 fl oz) per acre after corn has reached milk stage (yellow kernels with milky fluid).
<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>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 7 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year, or more than 18 oz per acre after silk initiation, or more than 9 oz per acre after milk stage. Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last application. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after application.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225 - 0.45	12 - 24 fl oz	Do not harvest within 7 days or feed treated forage within 10 days of application. Field re-entry interval is 2 days for corn.
<b>methoxyfenozide</b> Intrepid 2F	0.06 - 0.25	4 - 16 fl oz	PHI = 21 days. Do not apply more than 16 fl oz per acre per application or 64 fl oz per acre per season. Apply at first sign of egg hatch or when infestations reach threshold levels.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 0.75	2 - 3 pts	PHI = 12 days, cut for forage, or use for grazing. Do not apply during pollen shed if bees are visiting the areas. Do not apply more than 12 pts/A per year. Do not enter treated fields within 48 hours after application.
<b>methyl parathion</b> <i>RUP</i>	0.25	8 fl oz	PHI = 12 days of corn harvest. Do not enter treated fields within 48 hours or application.
<b>permethrin</b> Ambush 2E Pounce 3.2E Arctic 3.2E Permethrin 3.2EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.1 - 0.2	6.4 - 12.8 fl oz 4 - 8 fl oz 4 - 6 fl oz 4 - 8 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 30 days. Do not apply more than 0.6 pound ai per acre per season. Apply a minimum of 2 gal of finished spray per acre by air and 10 gals per acre by ground equipment.
<b>spinosad (microbial)</b> Success	0.047 - 0.094	3 - 6 fl oz	PHI = 28 days of grain or fodder harvest or within 7 days of forage harvest. Do not apply more than a total of 12 fl oz per acre per season.. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>spinosad (microbial)</b> Tracer	0.062 - 0.094	2 - 3 fl oz	PHI = 28 days of grain or fodder harvest or 7 days of forage harvest.



INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>spinetoram</b> Radiant SC	0.023 - 0.047	3 - 6 fl oz	PHI = 28 days for grain or 3 days for fodder and forage. Do not apply more than 16 fl oz of Radiant SC (0.125 lb ai of spinetoram) per acre per year. Do not make more than 3 applications per calendar year. Do not make applications less than 4 days apart.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.02 - 0.025	3.2 - 4 fl oz	PHI = 30 days of harvest for grain and stover and 60 days for forage. Do not apply more than 0.10 lb AI per acre per season including at-planting plus foliar applications. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## CORN ROOTWORM LARVAE

Rootworm larvae injure the root system of the corn plant. Yield potential may be reduced and/or lodging of plants may occur. Annual crop rotation from corn should prevent serious damage and losses. Early planting of corn allows for better root development prior to the late June hatch of rootworm eggs.

### Threshold:

The decision to rotate from corn or to use an insecticide may be based on field scouting for adult beetles during a three week period after pollination. Record the number of corn rootworm beetles on the foliage and silk of 100 plants. When the adult population averages 1 beetle per plant in continuous corn or 0.5 beetles per plant in first-year corn fields, the potential for larval root damage the next summer is sufficient to rotate from corn or to apply an insecticide.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin</b> Bifenture EC Brigade 2EC Capture 2EC Fanfare 2EC Sniper Tundra EC <i>RUP</i>	0.0046 lb ai per 1,000 ft of row	0.3 fl oz/1,000 ft of row	PHI = 30 days. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply more than 0.1lb AI per acre per season as an at plant application. Apply as a 5- to 7-inch T-band over an open seed furrow. Position spray nozzle behind the planter shoe, in front of press wheel. Apply in a min. of 3 gals finished spray per acre.
<b>bifenthrin</b> Capture LFR <i>RUP</i>	0.08 - 0.10  0.0046 - 0.0057 lb active per 1000 linear feet of row	6.8 - 8.5 fl oz  0.39 - 0.49 fl oz per 1000 linear feet of row	Apply as a 5-7 inch band (T-band) over the open furrow, or in-furrow with the seed. Do not apply more than 0.1 lb ai per acre per season as an at-plant application. Do not apply more than 0.3 lb ai per acre per season including at-plant plus foliar application of other bifenthrin products (such as Capture 2EC).
<b>chlorethoxyfos</b> Fortress 2.5 G Fortress 5 G <i>RUP</i>		2.5 G: 6 oz/1,000 ft of row - any row spacing 5 G: 3 oz/1,000 ft of row - any row spacing	Apply as a T-band or in-furrow at planting. Do not apply as a surface band behind the press wheel. Granules exposed on the soil surface must be incorporated. Crop rotational intervals: corn - anytime; other crops - 30 days.
<b>chlorpyrifos</b> Lorsban 15 G <i>RUP</i>	1	8 oz/1,000 ft of row - any row spacing	Apply in a T-band or in-furrow in front of press wheels at planting time or at time of cultivation. Not more than 1 application per season. Incorporate into top 0.5 to 1 inch of soil using chains or tines behind press wheel.
<b>chlorpyrifos</b> Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>		2.4 fl oz/1,000 ft of row	Apply in a T-band or in-furrow in front of press wheels at planting time or at time of cultivation with no more than 30% cover of crop residue remaining on the soil surface. Use a minimum of 5 GPA. Not more than 1 application per season. Incorporate into top 0.5 to 1 inch of soil using chains or tines behind press wheel. REI = 24 hours.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.63 - 0.82 + 0.032 - 0.042	32 - 42 fl oz Apply at cultivation or through sprinkler irrigation systems	PHI = 21 days for grain, ears, forage or fodder. Do not make more than 3 applications or apply more than 129 fl oz per season. See label for other restrictions.
<b>cyfluthrin + tebupirimiphos</b> Aztec 2.1 G <i>RUP</i>	0.12 - 0.15	6.7 oz/1,000 ft of row - any row	May be applied at planting as band, T-band or in furrow treatment. Cover or incorporate spills (including end-row spillage). Do not use on other crops grown for food or forage.
<b>fipronil</b> Regent 4SC <i>RUP</i>		See label for correct rate. 4.16 fl oz per acre or 0.24 fl oz per 1,000 row feet for 30 inch row spacing	PHI = 90 days. Do not plant small grains or other rotational crops within 12 months following application. Make one in-furrow application at planting time only. Do not apply more than 0.13 lb AI/acre per application. Do not apply this product through any kind of irrigation system.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>		0.66 fl oz per 1,000 ft of row	May be applied as a 5- to 7-inch T-band or in the seed furrow. <b>For Suppression Only.</b>
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate		Apply as a commercial seed treatment or for end-use at agricultural establishments (slurry or farmer applied seed treater). Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.005 (at plant)	0.66 fl oz (at plant)	PHI = 21 days. Do not harvest or graze livestock or cut treated crop for feed within 21 days of at plant application. Do not apply more than 0.09 lb ai (0.72 pt) per acre per crop at plant. Do not apply more than 0.12 lb ai per acre per crop from at plant and foliar application. For banded application - Make application at planting as a 5-7 inch T-band sprayed across the open seed furrow between the furrow openers and the press wheel. For In-furrow application - Make application into the seed furrow through spray nozzle or microtubes, behind the planter furrow openers and in front of the press wheel. Apply a minimum of 3 GPA.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	At plant: 0.005 lb ai per 1,000 ft of row	At plant: 0.33 oz per 1,000 ft of row	
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.005 lb ai per 1,000 ft of row	0.33 oz per 1,000 ft of row	
<b>phorate</b> Thimet 20 G <i>RUP</i>	1	6 oz/1,000 ft of row - any row spacing	Place granules in a 7-inch band over the row directly behind the planter shoe in front of or behind the press wheel and lightly incorporate. Do not use in-furrow application.
<b>tefluthrin</b> Force 1.5 G Force 3 G Force CS <i>RUP</i>	0.1 - 0.125	1.5 G: 8 - 10 oz/ 1,000 ft - any row spacing 3 G: 4 - 5 oz/1,000 ft of row - any row spacing CS: 0.46 - 0.57 oz/ 1,000 ft - any row spacing	Apply in a 7-inch band or in-furrow behind the planter shoe in front of the press wheel. Do not rotate to another crop within 30 days after application.
<b>terbufos</b> Counter 15 G <i>RUP</i>	1	8 oz/1,000 ft of row - any row spacing	May be applied in a 7-inch band at planting or in the seed furrow behind the planter shoe. Do not apply Accent or Beacon herbicide to corn treated with Counter 15 G.

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## CORN ROOTWORM ADULTS

Rootworm beetles feed on the leaves, silk and pollen of corn. Occasionally, the beetles congregate and feed on silks during early pollen shed. If silks are chewed back to the tips of ears (less than 1/2 inch of silks protruding) during the period of maximum pollen shed, poor pollination and grain set can occur. Adult injury very seldom occurs in North Dakota.

### Threshold:

When an average of 5 or more beetles per silk mass are found during the first week of pollen shed, control may be necessary. Another management threshold uses silk clipping. When silk clipping is occurring on 25% to 50% of the plants during pollen shed, control would be justified.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0125 - 0.022	1.6 - 2.8 fl oz	PHI = 21 days for grain or fodder; Green forage may be fed 0 days after last application. Maximum of 11.2 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Maximum number of applications per season = 4. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.103	4.0 - 10.3 fl oz	PHI = 30 for grain, PHI = 60 days for forage. Do not apply more than 0.4 lb ai per acre per season. Do not graze livestock in treated area or cut treated crops for feed within 30 days of the last application.
<b>bifenthrin</b> Bifenture EC Brigade 2EC Capture 2EC Fanfare 2EC Sniper Tundra EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 30 days. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply more than 0.3 lb AI per acre per season including PRE, PPI at-plant and foliar applications.
<b>carbaryl</b> Sevin	1	rate varies by formulation	PHI = 48 days of grain harvest, or 14 days for silage or grazing.
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.22 - 0.51 + 0.011 - 0.026	11 - 26 fl oz	PHI = 21 days for grain, ears, forage or fodder. Do not make more than 3 applications or apply more than 129 fl oz per season. See label for other restrictions.
<b>chlorpyrifos</b> Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.5 - 1	1 - 2 pts	PHI = 35 days for Lorsban 4E and 21 days for Lorsban Advanced. Do not allow meat or dairy animals to graze in treated areas nor harvested treated corn silage as feed for meat or dairy animals within 14 days after last treatment. Do not apply more than 6.38 pints per acre per season or more than 3 applications per season of any product containing chlorpyrifos. Do not make a second application within 10 days of the first application. Apply by air, ground or chemigation (treatment through irrigation systems) in sufficient water for adequate coverage. REI = 24 hours.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.044	1.6 - 2.8 fl oz	PHI = 21 days for grain or fodder; Green forage may be fed 0 days after last application. Maximum of 11.2 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Maximum number of applications per season = 4. 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>deltamethrin</b> Delta Gold <i>RUP</i>	0.018 - 0.022	1.5 - 1.9 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 21 days, or within 12 days of cutting or grazing field corn for forage. Avoid application in the heat of day. Do not apply more than 8.1 fl oz per acre per season. Do not make more than 5 applications per season.
<b>dimethoate</b> Dimethoate 2.67 EC	0.5 - 0.75	1- 1½ pt	PHI = 14 days of harvest or grazing. Do not make more than 3 applications per season. Do not apply to corn during pollen shed.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not apply more than 0.25 lb active per acre per season.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days. Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed corn fodder or silage to meat or dairy animals within 21 days after last treatment. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.06 lb ai per acre after silk initiation. Do not apply more than 0.03 lb ai per acre after corn has reached milk stage (yellow kernels with milky fluid).
<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>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 7 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year, or more than 18 oz per acre after silk initiation, or more than 9 oz per acre after milk stage. Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last application. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after application.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225 - 0.45	12 - 24 fl oz	Do not harvest within 7 days or feed treated forage within 10 days of application. Field re-entry interval is 2 days for corn.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.25 - 0.5	1 - 2 pts	PHI = 12 days, cut for forage, or use for grazing. Do not apply during pollen shed if bees are visiting the areas. Do not apply more than 12 pts/A per year. Do not enter treated fields within 48 hours after application.
<b>permethrin</b> Ambush 2E Pounce 3.2E Arctic 3.2E Permethrin 3.2EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.1 - 0.2	6.4 - 12.8 fl oz 4 - 8 fl oz 4 - 6 fl oz 4 - 8 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 30 days. Do not apply more than 0.6 pound ai per acre per season. Apply a minimum of 2 gal of finished spray per acre by air and 10 gals per acre by ground equipment.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC <i>RUP</i>	0.017 - 0.025	2.72 - 4 fl oz	PHI = 30 days of harvest for grain and stover and 60 days for forage. Do not apply more than 0.10 lb AI per acre per season including at-planting plus foliar applications. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>zeta-cypermethrin</b> Respect	0.017 - 0.025	2.72 - 4 fl oz	

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## CUTWORMS

Several cutworm species affect regional crops. The dingy cutworm, *Feltia jaculifera*, overwinters as a partially grown larva and is one of the first cutworm species to cause problems during crop emergence from early to mid-May. The moth of the dingy cutworm is known to lay her eggs on sunflower heads from mid-July through September. Crops following sunflowers in rotation are at greatest risk of injury by this cutworm. Other cutworms, the red-backed, *Exoa ochregaster*, and the darksided, *Exoa messoria*, overwinter as eggs which hatch in mid to late May. Eggs are laid in the fall and survive in weedy, wet, and reduced tillage areas. Feeding injury by these cutworms normally occurs in late May to early June.

Some criteria that may help predict cutworm problems are: 1) field history of cutworm damage; 2) surface crop residue from reduced or minimum tillage; 3) bottom land or low spots in field; 4) fair to poor drainage; 5) near shelterbelts with grassy ground cover. Because eggs of the important cutworms are laid during late summer in North Dakota, soil moisture at this time is important for their winter survival. Growers should be cautious when planting corn following pasture, alfalfa, or clover sites; survival may be greater at these locations.

### Thresholds:

Begin scouting for cutworms when corn is up to a stand and continue until mid-June. Treat when 3% to 6% of the plants are cut and small larvae (<3/4 inch) are present. Application rate of 15 to 20 gallons of water per acre by ground application is suggested.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL	0.0065 - 0.0125	0.8 - 1.6 fl oz	PHI = 21 days for grain or fodder; Green forage may be fed 0 days after last application. Maximum of 11.2 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Maximum number of applications per season = 4. Minimum application volume is 10 GPA by ground and 2 GPA by air.
	RUP		
<b>bifenthrin + zeta-cypermethrin</b> Hero	0.025 - 0.06	2.6 - 6.1 fl oz	PHI = 30 for grain, PHI = 60 days for forage. Do not apply more than 0.4 lb ai per acre per season. Do not graze livestock in treated area or cut treated crops for feed within 30 days of the last application.
	RUP		
<b>bifenthrin</b> Bifenture EC Brigade 2EC Capture 2EC Fanfare 2EC Sniper Tundra 2EC	At Planting: 0.0023 - 0.0046 lb active per 1000 linear feet of row  PRE: 0.04  PPI: 0.047 - 0.062  Foliar: 0.033 - 0.10 0.04 - 0.08	At Planting: 0.15 - 0.30 fl oz per 1000 linear feet of row  PRE: 2.56 fl oz  PPI: 3.0 - 4.0 fl oz  Foliar: 2.1 - 6.4 fl oz 3.4 - 6.8 fl oz	Apply as a 5-7 inch band over the row on the soil surface, a 5-7 inch band over the open furrow (T-band), in-furrow with the seed, or broadcast over the entire acre on the soil surface. Do not apply more than 0.1 lb ai per acre per season as an at-plant application. Do not apply more than 0.3 lb ai per acre per season including PRE, PPI, at-plant and foliar applications, including other bifenthrin products. PHI = 30 days. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.
	all RUP		
<b>bifenthrin</b> Capture LFR	RUP 0.0023 - 0.0046 lb active per 1000 linear feet of row	0.20 - 0.39 fl oz per 1000 linear feet of row	Apply as a 5-7 inch band over the row on the soil surface, a 5-7 inch band over the open furrow (T-band), in-furrow with the seed, or broadcast over the entire acre on the soil surface. Do not apply more than 0.1 lb ai per acre per season as an at-plant application. Do not apply more than 0.3 lb ai per acre per season including at-plant plus foliar application of other bifenthrin products (such as Capture 2EC).
<b>carbaryl</b> Sevin 5% bait	1 - 2	20 - 40 lbs	Broadcast treatment. No limitation on forage. Do not incorporate bait.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>chlorpyrifos</b> Lorsban 4E Lorsban Advanced Warhawk Yuma 4E  <i>RUP</i>	0.5 - 1	1 - 2 pts	PHI = 35 days for Lorsban 4E and 21 days for Lorsban Advanced. Do not allow meat or dairy animals to graze in treated areas nor harvested treated corn silage as feed for meat or dairy animals within 14 days after last treatment. Do not apply more than 6.38 pints per acre per season or more than 3 applications per season of any product containing chlorpyrifos. Do not make a second application within 10 days of the first application. Apply by air, ground or chemigation (treatment through irrigation systems) in sufficient water for adequate coverage. REI = 24 hours.
<b>Chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced  <i>RUP</i>	0.22 - 0.51 + 0.011 - 0.026 (postemerge)  0.037 + 0.002 per 1,000 ft of row (at-plant, T-band)	11 - 26 fl oz (postemerge)  1.89 fl oz per 1,000 ft of row (at-plant, T-band)	PHI = 21 days for grain, ears, forage or fodder. Do not make more than 3 applications or apply more than 129 fl oz per season. See label for other restrictions.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011)  <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios  <i>RUP</i>	0.013 - 0.025	0.8 - 1.6	PHI = 21 days for grain or fodder; Green forage may be fed 0 days after last application. Maximum of 11.2 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Maximum number of applications per season = 4. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>deltamethrin</b> Delta Gold  <i>RUP</i>	0.01 - 0.018	0.8 - 1.5 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 21 days, or within 12 days of cutting or grazing field corn for forage. Avoid application in the heat of day. Do not apply more than 8.1 fl oz per acre per season. Do not make more than 5 applications per season.
<b>esfenvalerate</b> Adjourn Asana XL  <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not apply more than 0.25 lb active per acre per season.
<b>gamma-cyhalothrin</b> Proaxis  <i>RUP</i>	0.0075 - 0.015	1.92 - 3.2 fl oz	PHI = 21 days. When applying by air, apply in a minimum of 2 gals of water per acre.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC  <i>RUP</i>	At plant: 0.005	At plant: 0.66 fl oz	PHI = 21 days. Do not harvest or graze livestock or cut treated crop for feed within 21 days of at plant application. Do not apply more than 0.09 lb ai (0.72 pt) per acre per crop at plant. Do not apply more than 0.12 lb ai per acre per crop from at plant and foliar application. For banded application - Make application at planting as a 5-7 inch T-band sprayed across the open seed furrow between the furrow openers and the press wheel. For In-furrow application - Make application into the seed furrow through spray nozzle or microtubes, behind the planter furrow openers and in front of the press wheel. Apply a minimum of 3 GPA.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	Foliar: 0.015 - 0.025	Foliar: 1.92 - 3.20 fl oz	PHI = 21 days. Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed corn fodder or silage to meat or dairy animals within 21 days after last treatment. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.06 lb ai per acre after silk initiation. Do not apply more than 0.03 lb ai per acre after corn has reached milk stage (yellow kernels with milky fluid).
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	Foliar: 0.015 - 0.025	Foliar: 1.0 - 1.67 oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	At plant: 0.005 lb ai per 1,000 ft of row	At plant: 0.33 oz per 1,000 ft of row	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	Foliar: 0.015 - 0.025	Foliar: 0.96 - 1.60 fl oz	PHI = 21 days. Apply as required by scouting, usually at 7 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year, or more than 18 oz per acre after silk initiation, or more than 9 oz per acre after milk stage. Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last application. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after application.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.45	24 fl oz	Do not harvest within 7 days or feed treated forage within 10 days of application. Field re-entry interval is 2 days for corn.
<b>methoxyfenozide</b> Intrepid	0.06 - 0.25	4 - 16 fl oz	PHI = 21 days. Do not apply more than 16 fl oz per acre per application or 64 fl oz per acre per season. Apply at first sign of egg hatch or when infestations reach threshold levels.
<b>permethrin</b> Ambush 2E Pounce 3.2E Arctic 3.2E Permethrin 3.2EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.1 - 0.2	6.4 - 12.8 fl oz 4 - 8 fl oz 4 - 8 fl oz 4 - 6 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 30 days. Do not apply more than 0.6 pound ai per acre per season. Apply a minimum of 2 gal of finished spray per acre by air and 10 gals per acre by ground equipment.
<b>tefluthrin</b> Force 1.5 G Force 3 G Force CS <i>RUP</i>	0.1 - 0.125	1.5 G: 8 - 10 oz/ 1,000 ft - any row spacing 3 G: 4 - 5 oz/1,000 ft of row - any row spacing CS: 0.46 - 0.57 oz/ 1,000 ft - any row spacing	Apply in a 7-inch band or in-furrow behind the planter shoe in front of the press wheel. Do not rotate to another crop within 30 days after application.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.008 - 0.0175	1.28 - 2.8 fl oz	PHI = 30 days of harvest for grain and stover and 60 days for forage. Do not apply more than 0.10 lb AI per acre per season including at-planting plus foliar applications. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## EUROPEAN CORN BORER - *Field corn, popcorn and sweet corn*

Managing corn borer in North Dakota is a challenge due to the lengthy emergence interval of the moths from overwintering. In North Dakota, borers have the potential for one or two generations during the season. The two generation borers are present in the southern region of the state. They begin emerging in early June and represent the first flush of larval feeding. The single-generation borer is present throughout North Dakota, emerging from mid-June to August. The challenge of the crop manager is to distinguish when egg laying and larval populations can be tolerated or if they need to be controlled. Corn should be monitored weekly for **at least five weeks** once plants exceed an extended leaf height of 17 inches. At this point, corn borer larvae will be able to survive on the plant. Inspect plants for the presence of egg masses, whorl feeding, and active larvae. Observing moth activity around field margins or within the field may alert you to developing infestations. Recent corn borer infestations in North Dakota developed in mid to late July and August as a result of the late emergence of the numerous single-generation type borers. In other years, the two-generation borers emerging first may contribute more to significant infestations.

### Field scouting for corn borers:

**Whorl stage corn** . . . Pull the whorls from 10 plants at 5 locations across the field. Select whorls at random, avoiding damaged plants. Unwrap the whorl leaves; count and record the number of live larvae found.

#### Worksheet for whorl stage corn -- You fill in the blanks

- |                              |                                     |                             |
|------------------------------|-------------------------------------|-----------------------------|
| 1. ___ % of plants infested  | x ___ Avg no. borers/plant          | = ___ Borers per plant      |
| 2. ___ borers per plant      | x ___ percent yield loss per borer* | = ___ percent yield loss    |
| 3. ___ percent yield loss    | x ___ expected yield (bu. per acre) | = ___ bushels per acre loss |
| 4. ___ bushel loss per acre  | x ___ price per bushel              | = \$ ___ loss per acre      |
| 5. ___ loss per acre         | x ___ percent control**             | = \$ ___ preventable loss/a |
| 6. ___ preventable loss/acre | - ___ cost of control per acre      | = \$ ___ profit (loss)/acre |

\*5% for corn in the early whorl stage; 4% for late whorl; 6% for pretassel

\*\*80% for granules; 75% for sprays.

**Tassel stage or older corn** . . . Examine the underside of the middle 7 leaves (3 leaves above and 3 leaves below the ear leaf) on 20 plants from 5 locations in the field. Multiply the number of egg masses found by 1.1 (correction factor for eggs on other leaves). Complete worksheet to determine the need for treatment.

#### Worksheet for tassel stage or older corn -- You fill in the blanks

- |                              |                                      |                                |
|------------------------------|--------------------------------------|--------------------------------|
| 1. ___ egg masses per plant* | x 4.5 borers per egg mass            | = ___ borers per plant         |
| 2. ___ borers per plant      | x ___ percent yield loss per borer** | = ___ percent yield loss       |
| 3. ___ percent yield loss    | x ___ expected yield (bu. per acre)  | = ___ bushels per acre loss    |
| 4. ___ bushel loss per acre  | x ___ price per bushel               | = \$ ___ loss per acre         |
| 5. ___ loss per acre         | x 80 percent control                 | = \$ ___ preventable loss/acre |
| 6. ___ preventable loss/acre | - ___ cost of control per acre       | = \$ ___ profit (loss) / acre  |

\*Cumulative counts taken five to seven days later can be added here

\*\*Use 0.04 for pollen-shedding corn, 0.03 if kernels are initiated

### Economic Threshold (Corn Borer/plant) When Factoring Crop Value and Control Costs

Control Costs <sup>2</sup> (\$/acre)	Value of Corn Crop <sup>1</sup> (\$/acre)								
	200	250	300	350	400	450	500	550	600
6	0.75	0.60	0.50	0.43	0.38	0.34	0.30	0.27	0.25
7	0.88	0.70	0.58	0.50	0.44	0.39	0.35	0.32	0.29
8	1.00	0.80	0.67	0.57	0.50	0.45	0.40	0.37	0.34
9	1.12	0.90	0.75	0.64	0.56	0.50	0.45	0.41	0.38
10	1.25	1.00	0.83	0.71	0.63	0.56	0.50	0.46	0.42
11	1.38	1.10	0.92	0.79	0.69	0.61	0.55	0.50	0.46
12	1.50	1.20	1.00	0.86	0.75	0.67	0.60	0.55	0.50
13	1.63	1.30	1.08	0.93	0.81	0.72	0.65	0.59	0.54
14	1.75	1.40	1.17	1.00	0.88	0.78	0.70	0.64	0.59
15	1.88	1.50	1.25	1.07	0.94	0.84	0.75	0.68	0.63
16	2.00	1.60	1.33	1.14	1.00	0.89	0.80	0.73	0.68

<sup>1</sup> Crop value = expected yield (bu/acre) X projected price (\$/bu)

<sup>2</sup> Control costs = insecticide price (\$/acre) + application costs (\$/acre)



INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>Bacillus thuringiensis</b> 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>	0.0125 - 0.022	1.6 - 2.8 fl oz	PHI = 21 days for grain or fodder; Green forage may be fed 0 days after last application. Maximum of 11.2 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Maximum number of applications per season = 4. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.103	4.0 - 10.3 fl oz	PHI = 30 for grain, PHI = 60 days for forage. Do not apply more than 0.4 lb ai per acre per season. Do not graze livestock in treated area or cut treated crops for feed within 30 days of the last application.
<b>bifenthrin</b> Bifenture EC Brigade 2EC Capture 2EC Fanfare 2EC Sniper Tundra EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 30 days. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply more than 0.3 lb AI per acre per season including PRE, PPI at-plant and foliar applications.
<b>carbaryl</b> Sevin	1 - 2	rate varies by formulation	PHI = 48 days of grain harvest, or 14 days for silage or grazing. The sweet corn postharvest interval is 0 days.
<b>chlorpyrifos</b> Lorsban 15 G <i>RUP</i>	0.66 - 1 (at plant)	4 - 6 oz/1,000 ft of row (at plant)	Restrictions same as above. May be broadcast aerially or banded with suitable ground application equipment prior to tassel emergence. Use high rate (6.5 lb product per acre) when applying broadcast. If directed carefully by ground equipment into whorls, use rates of 4 to 6 oz product per 1,000 ft of row.
<b>chlorpyrifos</b> Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.5 - 1	1 - 2 pts	PHI = 35 days for Lorsban 4E and 21 days for Lorsban Advanced. Do not allow meat or dairy animals to graze in treated areas nor harvested treated corn silage as feed for meat or dairy animals within 14 days after last treatment. Do not apply more than 6.38 pints per acre per season or more than 3 applications per season of any product containing chlorpyrifos. Do not make a second application within 10 days of the first application. Apply by air, ground or chemigation (treatment through irrigation systems) in sufficient water for adequate coverage. REI = 24 hours.
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.43 - 0.74 + 0.022 - 0.038	22 - 38 fl oz	PHI = 21 days for grain, ears, forage or fodder. Do not make more than 3 applications or apply more than 129 fl oz per season. See label for other restrictions.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.044	1.6 - 2.8	PHI = 21 days for grain or fodder; Green forage may be fed 0 days after last application. Maximum of 11.2 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Maximum number of applications per season = 4. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.018 - 0.022	1.5 - 1.9 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 21 days, or within 12 days of cutting or grazing field corn for forage. Avoid application in the heat of day. Do not apply more than 8.1 fl oz per acre per season. Do not make more than 5 applications per season. Apply to early instar larvae prior to boring into the ear or stalk.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.04 - 0.05	7.8 - 9.6 fl oz	PHI = 21 days. Do not apply more than 0.25 lb active per acre per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. When applying by air, apply in a minimum of 2 gals of water per acre.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days. Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed corn fodder or silage to meat or dairy animals within 21 days after last treatment. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.06 lb ai per acre after silk initiation. Do not apply more than 0.03 lb ai per acre after corn has reached milk stage (yellow kernels with milky fluid).
<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>	0.015 - 0.025	0.96 - 1.60 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 7 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year, or more than 18 oz per acre after silk initiation, or more than 9 oz per acre after milk stage. Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last application. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after application.
<b>methoxyfenozide</b> Intrepid	0.06 - 0.25	4 - 16 fl oz	PHI = 21 days. Do not apply more than 16 fl oz per acre per application or 64 fl oz per acre per season. Apply at first sign of egg hatch or when infestations reach threshold levels.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 1	2 - 4 pts	Apply when first eggs begin to hatch. May be applied by center pivot irrigation according to label restrictions. Observe label precautions for bees. Do not harvest, cut for forage, or graze within 12 days of application. The sweet corn postharvest interval is 5 days. Do not enter treated fields within 48 hours after application.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>permethrin</b> Ambush 2E Pounce 3.2E Pounce 1.5G Arctic 3.2E Permethrin 3.2EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.1 - 0.2	6.4 - 12.8 fl oz 4 - 8 fl oz 6.7 - 13.3 lbs 4 - 8 fl oz 4 - 6 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 30 days for grain. Do not apply more than 0.6 pounds ai per acre per season. The sweet corn postharvest interval is 1 day. Apply a minimum of 2 gals of finished spray per acre by air and 10 gals per acre by ground equipment.
<b>phorate</b> Phorate 20G <i>RUP</i>	1	5 lbs	Apply granules into whorl of plant prior to tassel emergence with air or ground equipment. PHI = 30 days of grazing or cutting for forage. Do not enter treated fields within 7 days after application.
<b>spinosad (microbial)</b> Success	0.047 - 0.094	3 - 6 fl oz	PHI = 28 days for grain or fodder harvest or within 7 days of forage harvest. Do not apply more than a total of 12 fl oz per acre per season.. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>spinosad (microbial)</b> Tracer	0.031 - 0.094	1 - 3 fl oz	PHI = 28 days for grain or fodder harvest or 7 days of forage harvest.
<b>spinetoram</b> Radiant SC	0.023 - 0.047	3 - 6 fl oz	PHI = 28 days for grain or 3 days for fodder and forage. Do not apply more than 16 fl oz of Radiant SC (0.125 lb ai of spinetoram) per acre per year. Do not make more than 3 applications per calendar year. Do not make applications less than 4 days apart.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.017 - 0.025	2.72 - 4 fl oz	PHI = 30 days of harvest for grain and stover and 60 days for forage. Do not apply more than 0.10 lb AI per acre per season including at-planting plus foliar applications. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## GRASSHOPPERS

In the Northern Plains, grasshopper egg hatch normally begins in late April to early May. Peak hatch occurs about mid-June. Heavy infestations typically occur in areas of low rainfall or during drought years. Outbreaks are usually preceded by several years of hot, dry summers and warm autumns. Cool, wet weather increases disease occurrence and delays development of grasshoppers, reducing the overall population.

**Grasshopper Thresholds: Infestation Ratings:** The threatening rating is considered the action threshold for grasshoppers. 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+

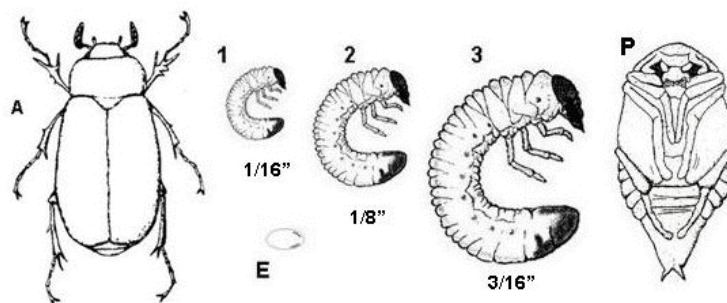
INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0165 - 0.022	2.1 - 2.8 fl oz	PHI = 21 days for grain or fodder; Green forage may be fed 0 days after last application. Maximum of 11.2 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Maximum number of applications per season = 4. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.025 - 0.06	2.6 - 6.1 fl oz	PHI = 30 for grain, PHI = 60 days for forage. Do not apply more than 0.4 lb ai per acre per season. Do not graze livestock in treated area or cut treated crops for feed within 30 days of the last application.
<b>bifenthrin</b> Bifenture EC Brigade 2EC Capture 2EC Fanfare 2EC Sniper Tundra EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 30 days. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply more than 0.3 lb AI per acre per season including PRE, PPI at-plant and foliar applications.
<b>carbaryl</b> Sevin	0.5 - 1.5	rate varies by formulation	PHI = 48 days of grain harvest, or 14 days for silage or grazing. The lower rate range is suggested for nymphs on small plants or sparse vegetation. The higher rate range is suggested for mature grasshoppers or when material is applied to crops requiring greater coverage.
<b>chlorpyrifos</b> Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	PHI = 35 days for Lorsban 4E and 21 days for Lorsban Advanced. Do not allow meat or dairy animals to graze in treated areas nor harvested treated corn silage as feed for meat or dairy animals within 14 days after last treatment. Do not apply more than 6.38 pints per acre per season or more than 3 applications per season of any product containing chlorpyrifos. Do not make a second application within 10 days of the first application. Apply by air, ground or chemigation (treatment through irrigation systems) in sufficient water for adequate coverage. REI = 24 hours.
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.12 - 0.25 + 0.006 - 0.013	6 - 13 fl oz	PHI = 21 days for grain, ears, forage or fodder. Do not make more than 3 applications or apply more than 129 fl oz per season. See label for other restrictions.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.033 - 0.044	2.1 - 2.8	PHI = 21 days for grain or fodder; Green forage may be fed 0 days after last application. Maximum of 11.2 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 7-day interval. Maximum number of applications per season = 4. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.018	1.0 - 1.5 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 21 days, or within 12 days of cutting or grazing field corn for forage. Avoid application in the heat of day. Do not apply more than 8.1 fl oz per acre per season. Do not make more than 5 applications per season.
<b>dimethoate</b> Digon 400, Dimethoate 400	0.38	0.75 pt	PHI = 14 days of harvest or grazing. Do not make more than 3 applications per season. Do not apply to corn during pollen shed.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>esfenvalerate</b> Adjourn <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not apply more than 0.25 lb active 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. The 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. Asana XL may be used in bordering, non-crop areas not hayed or grazed. The higher rates are for control of grasshopper nymphs larger than 2 <sup>nd</sup> instar.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. When applying by air, apply in a minimum of 2 gals of water per acre. Proaxis may be used in bordering, non-crop areas that are not hayed or grazed.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days. Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed corn fodder or silage to meat or dairy animals within 21 days after last treatment. Do not apply more than 0.12 lb ai per acre per season. Do not apply more than 0.06 lb ai per acre after silk initiation. Do not apply more than 0.03 lb ai per acre after corn has reached milk stage (yellow kernels with milky fluid).
<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>	At plant: 0.005 lb ai per 1,000 ft of row Foliar: 0.015 - 0.025	At plant: 0.33 oz per 1,000 ft of row Foliar: 0.96 - 1.60 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 7 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year, or more than 18 oz per acre after silk initiation, or more than 9 oz per acre after milk stage. Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last application. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after application.
<b>methyl parathion</b> <i>RUP</i>	0.5	1 pt	PHI = 12 days of corn harvest. Do not enter treated fields within 48 hours after application. Fields must be posted.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 0.75	2 - 3 pts	PHI = 12 days, cut for forage, or grazing. Do not apply during pollen shed if bees are visiting the areas. Do not apply more than 12 pts/A per year. Do not enter treated fields within 48 hours after application.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.017 - 0.025	2.72 - 4 fl oz	PHI = 30 days of harvest for grain and stover and 60 days for forage. Do not apply more than 0.10 lb AI per acre per season including at-planting plus foliar applications. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## WHITE GRUBS (LARVAE)

White grubs that are destructive to field crops in North Dakota have a three-year life cycle. In southeast North Dakota, the most common white grub pest occurs in continuous cropping situations at sites where willow and cottonwood trees are present. In other areas of the state, white grubs are most likely to be found when rotation from grassland, pasture, or grassy weed sites occur. Most root feeding occurs in the second year of the life cycle. In most cases, the number of second-year grubs will only be great enough to justify control once every three years.



**Life stages of *Phyllophaga implicita*:** A - adult June beetle; E - egg; grub stages with their head width in inches, 1 - first; 2 - second; 3 - third; and P - pupa.

**Thresholds:** Treatment is recommended when sampling indicates an average of one or more white grubs per square foot are found. The following sampling procedure provides treatment decisions based on this guideline.

**Soil sampling:** Fields need to be sampled to determine grub abundance and aid in determining if control is necessary. Sampling in late summer or early fall, before a freeze, provides a more reliable estimate of populations than spring sampling just before planting. Larvae are typically present in the upper 6 inches of soil until a killing frost occurs in the fall. Take soil samples, 1 square foot in size to a depth of 8 inches. Begin taking samples 45 yards from shelterbelts. A total of 30 samples per field, randomly spaced along the shelterbelts, are necessary. If at least a single grub is found in less than 40% of the samples, treatment may be required only out 20 yards from the tree line. If 40% to 60% of the samples are infested, treatment is needed to this distance and maybe as far as 65 yards. If greater than 60% of the samples are infested, treatment may be needed out to 90 yards from the tree line.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>abamectin + thiamethoxam</b> Avicta Complete Corn <i>RUP</i>	Refer to label	Refer to label	Avicta Complete Corn is a combination of Avicta Duo Corn and one or more of the following: Cruiser, Apron XL, Maxim XL and/or Dynasty. For use directions, please see individual product labels.
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.014 - 0.016 fl oz per 1,000 ft of row	2.5 - 2.8 fl oz	PHI = 21 days for grain or fodder; PHI = 0 for green forage. Maximum of 11.2 fl oz per acre per season. Maximum of 2.8 fl oz per acre at planting. Apply in water or liquid pop-up fertilizer. Apply in a minimum of 2 GPA mix solution if applying in water. Good agitation is required.
<b>bifenthrin</b> Bifenture EC Brigade 2EC Capture 2EC Fanfare 2EC Sniper Tundra 2EC <i>all RUP</i>	PRE: 0.04  PPI: 0.047 - 0.062	PRE: 2.56 fl oz  PPI: 3.0 - 4.0 fl oz	Do not apply more than 0.3 lb ai per acre per season including PRE, PPI, at-plant and foliar applications, including other bifenthrin products. PHI = 30 days. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply more than 0.3 lb AI per acre per season including PRE, PPI at-plant and foliar applications.
<b>bifenthrin</b> Capture LFR <i>RUP</i>	0.04 - 0.08  0.0023 - 0.0046 lb active per 1000 linear feet of row	3.4 - 6.8 fl oz  0.20 - 0.39 fl oz per 1000 linear feet of row	Apply as a 5-7 inch band over an open furrow (T-band), or in-furrow with the seed. Do not apply more than 0.1 lb ai per acre per season as an at-plant application. Do not apply more than 0.3 lb ai per acre per season including at-plant plus foliar application of other bifenthrin products (such as Capture 2EC).

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>chlorethoxyfos</b> Fortress 2.5 G Fortress 5 G <i>RUP</i>		2.5 G: 6 oz/1,000 ft of row - any row spacing 5 G: 3 oz/1,000 ft of row - any row spacing	Apply as a T-band or in-furrow at planting. Do not apply as a surface band behind the press wheel. Granules exposed on the soil surface must be incorporated. Crop rotational intervals: corn - anytime; other crops - 30 days.
<b>chlorpyrifos</b> Lorsban 4E Warhawk Yuma 4E <i>RUP</i>	-	2.4 fl oz/1,000 ft of row	Apply in a T-band or in-furrow in front of press wheels at planting time or at time of cultivation with no more than 30% cover of crop residue remaining on the soil surface. Use a minimum of 5 GPA. Not more than 1 application per season. Incorporate into top 0.5 to 1 inch of soil using chains or tines behind press wheel. REI = 24 hours.
<b>chlorpyrifos</b> Lorsban 15 G <i>RUP</i>	1 - 2	8-16 oz/1,000 ft of row - any row spacing	Apply in-furrow at planting time. (NDSU research indicates that Lorsban aids in white grub suppression. With heavy white grub infestation, some stand reduction may still occur.)
<b>Chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.056 + 0.003 per 1,000 ft of row (at-plant, T-band)	2.87 fl oz per 1,000 ft of row (at-plant, T-band)	PHI = 21 days for grain, ears, forage or fodder. Do not make more than 3 applications or apply more than 129 fl oz per season. See label for other restrictions.
<b>cyfluthrin + tebuirimiphos</b> Aztec 2.1 G <i>RUP</i>	6.7 oz	6.7 oz/1,000 ft of row - any row spacing	May be applied at planting as band, T-band or in furrow treatment. Cover or incorporate spills. Do not use on other crops grown for food or forage.
<b>fipronil</b> Regent 4SC <i>RUP</i>		See label for correct rate. 4.16 fl oz per acre or 0.24 fl oz per 1,000 row feet for 30 inch row spacing	PHI = 90 days. Do not plant small grains or other rotational crops within 12 months following application. Make one in-furrow application at planting time only. Do not apply more than 0.13 lb AI/acre per application. Do not apply this product through any kind of irrigation system.
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate		Apply as a commercial seed treatment or for end-use at agricultural establishments. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.005 (at plant)	0.66 fl oz (at plant)	PHI = 21 days. Do not harvest or graze livestock or cut treated crop for feed within 21 days of at plant application. Do not apply more than 0.09 lb ai (0.72 pt) per acre per crop at plant. Do not apply more than 0.12 lb ai per acre per crop from at plant and foliar application. For banded application - Make application at planting as a 5-7 inch T-band sprayed across the open seed furrow between the furrow openers and the press wheel. For In-furrow application - Make application into the seed furrow through spray nozzle or microtubes, behind the planter furrow openers and in front of the press wheel. Apply a minimum of 3 GPA.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.005 lb ai per 1,000 ft of row	0.33 oz per 1,000 ft of row	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.005 lb ai per 1,000 ft of row	0.33 oz per 1,000 ft of row	

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>tefluthrin</b> Force 1.5 G Force 3 G Force CS  <i>RUP</i>	0.1 - 0.125	1.5 G: 8 - 10 oz/ 1,000 ft - any row spacing 3 G: 4 - 5 oz/1,000 ft of row - any row spacing CS: 0.46 - 0.57 oz/ 1,000 ft - any row spacing	Apply in a 7-inch band or in-furrow behind the planter shoe in front of the press wheel. Do not rotate to another crop within 30 days after application.
<b>terbufos</b> Counter 15 G  <i>RUP</i>	1 - 2	8-16 oz/1,000 ft of row spacing - any row spacing	Apply in a 7-inch band (1 to 2 lb rate). Do not apply Accent or Beacon herbicide to corn treated with Counter 15 G.

*RUP* - Restricted use pesticide

## WIREWORMS

Wireworms are most likely to be problems when corn follows pasture or grassland. Continuous corn has developed problems in the past, also. Infestations often are found in coarse textured soils (sandy loam) where moisture is abundant, perhaps in low spots of fields.

### Thresholds:

There is no easy way to estimate wireworm infestations. Two methods are currently used.

**Soil Sampling** . . . Sample 20, well spaced, 1 square foot sites to a depth of 4 to 6 inches for every 40 acres being planted. If an average of 1 wireworm per square foot is found, treatment would be justified.

**Solar Baiting** . . . In September, establish bait stations for 2 to 3 weeks before freeze. Place bait stations randomly through the field, but representing all areas of the field. There should be 10 - 12 stations per 40 acre field. Place one cup wheat and one cup shelled corn in a 4- to 6-inch deep hole. Cover grain with soil and then an 18-inch square piece of clear plastic. Dig up the grain. If an average of one or more wireworm larvae are found per station, treatment would be justified.

**Seed Treatment** . . . Seed treatments and/or planter box treatment available for use on corn for managing wireworm. 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>abamectin + thiamethoxam</b> Avicta Complete Corn  <i>RUP</i>	Refer to label	Refer to label	Avicta Complete Corn is a combination of Avicta Duo Corn and one or more of the following: Cruiser, Apron XL, Maxim XL and/or Dynasty. For use directions, please see individual product labels.
<b>beta-cyfluthrin</b> Baythroid XL  <i>RUP</i>	0.012 - 0.016 fl oz per 1,000 ft of row	2.0 - 2.8 fl oz	PHI = 21 days for grain or fodder; PHI = 0 for green forage. Maximum of 11.2 fl oz per acre per season. Maximum of 2.8 fl oz per acre at planting. Apply in water or liquid pop-up fertilizer. Apply in a minimum of 2 GPA mix solution if applying in water. Good agitation is required.
<b>bifenthrin</b> Bifenture EC Brigade 2EC Capture 2EC Fanfare 2EC Sniper Tundra 2EC  <i>RUP</i>	At Planting: 0.0023 - 0.0046 lb active per 1000 linear feet of row  PRE: 0.04  PPI: 0.047 - 0.062  Foliar: 0.033 - 0.10	At Planting: 0.15 - 0.30 fl oz per 1000 linear feet of row  PRE: 2.56 fl oz  PPI: 3.0 - 4.0 fl oz  Foliar: 2.1 - 6.4 fl oz	Apply as a 5-7 inch band over the row on the soil surface, a 5-7 inch band over the open furrow (T-band), in-furrow with the seed, or broadcast over the entire acre on the soil surface. Do not apply more than 0.1 lb ai per acre per season as an at-plant application. Do not apply more than 0.3 lb ai per acre per season including PRE, PPI, at-plant and foliar applications, including other bifenthrin products. PHI = 30 days. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.



INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin</b> Capture LFR	0.04 - 0.08	3.4 - 6.8 fl oz	Do not apply more than 0.1 pound active per acre per season as an at-plant application. Do not apply more than 0.3 pound active per acre per season including at-plant plus foliar applications of other bifenthrin products (such as Capture 2EC). Apply as a 5-7 inch band over the open furrow (T-band), or in-furrow with the seed.
<i>RUP</i>	0.0023 - 0.0046 pounds active per 1000 linear feet of row	0.20 - 0.39 fl oz per 1000 linear feet of row	
<b>fipronil</b> Regent 4SC		See label for correct rate. 4.16 fl oz per acre or 0.24 fl oz per 1,000 row feet for 30 inch row spacing	PHI = 90 days. Do not plant small grains or other rotational crops within 12 months following application. Make one in-furrow application at planting time only. Do not apply more than 0.13 lb AI/acre per application. Do not apply this product through any kind of irrigation system.
<i>RUP</i>			
<b>chlorothoxyfos</b> Fortress 2.5 G and 5 G		2.5 G: 6 oz/1,000 ft of row - any row spacing 5 G: 3 oz/1,000 ft of row - any row spacing	Apply as a T-band or in-furrow at planting. Do not apply as a surface band behind the press wheel. Granules exposed on the soil surface must be incorporated. Crop rotational intervals: corn - anytime; other crops - 30 days.
<i>RUP</i>			
<b>chlorpyrifos</b> Lorsban 4E Warhawk Yuma 4E	2	4 pts	Broadcast PPI application in sufficient water to the soil surface and incorporate into the soil. Not more than 1 application per season. Incorporate into top 0.5 to 1 inch of soil using chains or tines behind press wheel. REI = 24 hours.
<i>RUP</i>			
<b>chlorpyrifos</b> Lorsban 15 G	1.2 - 2.4	8 - 16 oz/1,000 ft of row	T-Band or in-furrow at planting. If high wireworm numbers are anticipated, add insecticide seed treatment to planter box to augment control.
<i>RUP</i>			
<b>Chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced	0.056 + 0.003 per 1,000 ft of row (at-plant, T-band)	2.87 fl oz per 1,000 ft of row (at-plant, T-band)	PHI = 21 days for grain, ears, forage or fodder. Do not make more than 3 applications or apply more than 129 fl oz per season. See label for other restrictions.
<i>RUP</i>			
<b>cyfluthrin</b> Tombstone	0.12 - 0.16	2.0 - 2.8 fl oz	PHI = 21 days for grain or fodder. Green forage may be fed 0 days after last application. Maximum allowed per 7 day interval: 2.8 fl oz per acre. Maximum allowed per crop season: 11.2 fl oz per acre. Total mix volume should be applied in the open furrow ahead of the closing wheels for optimum coverage.
<i>RUP</i>			
<b>cyfluthrin + tebupirimiphos</b> Aztec 2.1 G	0.12 - 0.15	6.7 oz/1,000 ft of row - any row spacing	May be applied at planting as band, T-band, or in-furrow treatment. Cover or incorporate spills (including end-row spillage). Do not use on other crops grown for food or forage.
<i>RUP</i>			
<b>ethoprop</b> Mocap 10 G	1	12 oz/1,000 ft of row - any row spacing	Apply in a 7-inch band at planting. Do not apply in contact with seed!
<i>RUP</i>			
<b>fipronil</b> Regent 4SC		See label for correct rate. 3 fl oz per acre or 0.17 fl oz per 1,000 row feet for 30 inch row spacing	PHI = 90 days. Do not plant small grains or other rotational crops within 12 months following application. Make one in-furrow application at planting time only. Do not apply this product through any kind of irrigation system.
<i>RUP</i>			
<b>gamma-cyhalothrin</b> Proaxis		0.66 fl oz per 1,000 ft of row	May be applied as a 5- to 7-inch T-band or in the seed furrow. <b>For Suppression Only.</b>
<i>RUP</i>			
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate		Apply as a commercial seed treatment or for end-use at agricultural establishments. Follow all applicable directions, restrictions and precautions on the EPA registered label.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>imidacloprid</b> Latitude	refer to recommended label rate	1.5 oz per 42 lbs of seed	Apply as an on-farm seed treatment at planting time. Follow all applicable directions, restrictions and precautions on the EPA registered label. For control of overwintering and early season bean leaf beetles.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.005 (at plant) (suppression)	0.66 fl oz (at plant) (suppression)	PHI = 21 days. Do not harvest or graze livestock or cut treated crop for feed within 21 days of at plant application. Do not apply more than 0.09 lb ai (0.72 pt) per acre per crop at plant. Do not apply more than 0.12 lb ai per acre per crop from at plant and foliar application. For banded application - Make application at planting as a 5-7 inch T-band sprayed across the open seed furrow between the furrow openers and the press wheel. For In-furrow application - Make application into the seed furrow through spray nozzle or microtubes, behind the planter furrow openers and in front of the press wheel. Apply a minimum of 3 GPA.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.005 lb ai per 1,000 ft of row	0.33 oz per 1,000 ft of row	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.005 lb ai per 1,000 ft of row	0.33 oz per 1,000 ft of row	
<b>permethrin</b> Perm-Up <i>RUP</i>		0.3 oz per 1,000 linear ft of row	Apply as an in-furrow, band or T-band treatment using a minimum 4 inch band.
<b>phorate</b> Thimet 20 G <i>RUP</i>	1	6 oz/1,000 ft of row - any row spacing	Place granules in a 7-inch band over the row directly behind the planter shoe in front of the press wheel. Do not place Thimet in direct contact with seed!
<b>tefluthrin</b> Force 1.5 G Force 3 G Force CS <i>RUP</i>	0.1 - 0.125	1.5 G: 8 - 10 oz/1,000 ft - any row spacing 3 G: 4 - 5 oz/1,000 ft of row - any row spacing CS: 0.46 - 0.57 oz/1,000 ft - any row spacing	Apply in a 7-inch band or in-furrow behind the planter shoe in front of the press wheel. Do not rotate to another crop within 30 days after application.
<b>terbufos</b> Counter 15 G <i>RUP</i>	1	8 oz/1,000 ft or row - any row spacing	Apply in a 7-inch band or in-furrow at planting. Do not apply Accent or Beacon herbicide to corn treated with Counter 15 G.

*RUP* - Restricted use pesticide

## Handy Bt Trait Table

Reprinted with approval from authors - C. DiFonzo, Michigan State University and E. Cullen, University of Wisconsin

Insect targets listed in table: BCW - black cutworm, CEW - corn earworm, CRW - corn rootworm, ECB - European corn borer, FAW - fall armyworm, SB - stalk borer, WBC - western bean cutworm

Herbicide traits listed in table: GT - glyphosate tolerant, LL - Liberty Link or glufosinate tolerant, RR2 - Roundup Ready or glyphosate tolerant

Trait Group (Current Nov. 2010)	Bt protein	Insects controlled (bold) or suppressed (italics)	Herbicide Tolerance	Refuge % & Location
<b>Agrisure (Syngenta + Mycogen / DowAgro)</b>				
Agrisure CB/LL	Cry1Ab	<b>ECB</b> <i>CEW, FAW, SB</i>	LL	20% - ½ mile
Agrisure GT/CB/LL	Cry1Ab	<b>ECB</b> <i>CEW, FAW, SB</i>	GT, LL	20% - ½ mile
Agrisure RW	mCry3A	<b>CRW</b>	--	20% - adjacent
Agrisure GT/RW	mCry3A	<b>CRW</b>	GT	20% - adjacent
Agrisure CB/LL/RW	Cry1Ab mCry3A	<b>CRW, ECB</b> <i>CEW, FAW, SB</i>	LL	20% - adjacent
Agrisure 3000GT	Cry1Ab mCry3A	<b>CRW, ECB</b> <i>CEW, FAW, SB</i>	GT, LL	20% - adjacent
Agrisure Viptera 3110	Cry1Ab Vip3A	<b>BCW, CEW, ECB, FAW, WBC</b> <i>SB</i>	GT, LL	20% - ½ mile
Agrisure Viptera 3111	Cry1Ab mCry3A Vip3A	<b>BCW, CEW, CRW, ECB, FAW,</b> <b>WBC</b> <i>SB</i>	GT, LL	20% - adjacent
<b>Herculex (Mycogen / DowAgro)</b>				
Herculex 1	Cry1F	<b>BCW, ECB, FAW, WBC</b> <i>CEW</i>	LL, RR2	20% - ½ mile
Herculex RW	Cry34/35Ab1	<b>CRW</b>	LL	20% - adjacent
Herculex XTRA	Cry1F Cry34/35Ab1	<b>BCW, CRW, ECB, FAW, WBC</b> <i>CEW</i>	LL, RR2 (some)	20% - adjacent
<b>Optimum (DuPont / Pioneer)</b>				
Optimum AcreMax1	Cry1F Cry34/35Ab1	<b>BCW, CRW, ECB, FAW, WBC</b> <i>CEW</i>	LL, RR2	10% in the bag (CRW) plus 20% - ½ mile (ECB)**
Optimum AcreMax RW	Cry34/35Ab1	<b>CRW</b>	RR2	10% (non-Bt seed) in the bag**
Optimum Intrasect Insect Protection	Cry1F Cry1Ab	<b>CRW, ECB, FAW, WBC</b> <i>CEW,</i> <i>SB</i>	LL, RR2	5% - ½ mile**
<b>Yieldgard (Monsanto)</b>				
Yieldgard CB (YGCB)	Cry1Ab	<b>ECB</b> <i>CEW, FAW, SB</i>	RR2 (some)	20% - ½ mile

<b>Trait Group (Current Nov. 2010)</b>	<b>Bt protein</b>	<b>Insects controlled (bold) or suppressed (italics)</b>	<b>Herbicide Tolerance</b>	<b>Refuge % &amp; Location</b>
YieldGard RW (YGRW)	Cry3Bb1	<b>CRW</b>	RR2 (some)	20% - adjacent
YieldGard Plus	Cry1Ab Cry3Bb1	<b>CRW, ECB</b> <i>CEW, FAW, SB</i>	RR2 (some)	20% - adjacent
YieldGard VT Rootworm	Cry3Bb1	<b>CRW</b>	RR2	20% - adjacent
YieldGard VT Triple (VT3)	Cry1Ab Cry3Bb1	<b>CRW, ECB</b> <i>CEW, FAW, SB</i>	RR2	20% - adjacent
<b>Genuity (Monsanto or Monsanto + Mycogen / DowAgro)</b>				
Genuity VT Double Pro (VT2P)	Cry1A.105 Cry2Ab2	<b>CEW, ECB, FAW</b>	RR2	5% - ½ mile**
Genuity VT Triple Pro (VT3P)	Cry1A.105 Cry2Ab2 Cry3Bb1	<b>CEW, CRW, ECB, FAW</b>	RR2	20% - adjacent
SmartStax or Genuity SmartStax (GENSS)	Cry1A.105 Cry2Ab2 Cry1F Cry34/35Ab1 Cry3Bb1	<b>BCW, CEW, CRW, ECB, FAW, WBC</b>	RR2, LL	5% - adjacent**

\*\* Products approved for either a reduced refuge or a Refuge-In-Bag (RIB), where the seed company mixes non-Bt seed in with the transgenic corn prior to bagging.

## FIELD PEA

### CUTWORMS

Cutworms are an occasional problem in field pea. Cutworms overwinter as eggs or young larvae that feed on the newly emerged shoots in spring. The shoots may be cut off below the soil surface. Cotyledons (seeds) of pea often remain below the soil surface and can recover from cutworm damage if cool, moist growing conditions. However, recovered plants are generally set back 4 to 7 days by the damage.

**Threshold:**

The risk is low, unless more than 2 to 3 cutworms per square yard occur in the top 3 inches of soil.

**Insecticides approved for use on cutworms in Field Pea**

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i style="margin-left: 100px;">RUP</i>	0.007 - 0.013	0.8 - 1.6 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 5 GPA by air. Do not feed treated vines or hay to livestock.
<b>bifenthrin</b> Brigade 2EC Fanfare 2 EC Sniper <i style="margin-left: 100px;">RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 14 days. Apply in a minimum of 2 GPA by air or 10 GPA for ground application. Do not apply more than 0.2 lb ai (12.8 fl oz) to field pea per acre per season. Do not make applications less than 7 days apart.
<b>bifenthrin</b> Capture LFR <i style="margin-left: 100px;">RUP</i>	0.04 - 0.08 (0.0023 - 0.0046 lb/1000 linear feet)	3.4 - 6.8 fl oz (0.20 - 0.39 fl oz/ 1000 linear feet)	See label for soil application directions. Do not apply more than 0.2 lb ai (12.8 fl oz) bifenthrin to field pea per acre per season. Do not apply more than 0.1 lb ai per acre per season as an at-plant application.
<b>carbaryl</b> Sevin 4F	1.0 - 1.5	32 - 48 fl oz	Do not apply within 14 days of grazing or harvest for forage use or within 3 days of harvest of fresh peas or within 21 days of harvest of dried peas, seed, or hay. Most effective against cutworm species that feed on the upper parts of the plant. Apply as necessary up to a total of 4 applications but not more than once every 7 days.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i style="margin-left: 100px;">RUP</i>	0.013 - 0.025	0.8 - 1.6 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre per 14-day interval. Minimum application volume is 10 GPA by ground and 5 GPA by air. Do not feed treated vines or hay to livestock.
<b>esfenvalerate</b> Adjourn Asana XL <i style="margin-left: 100px;">RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. 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 style="margin-left: 100px;">RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. Do not apply more than 0.06 lb ai (0.96 pt) per acre per season. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i style="margin-left: 100px;">RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i style="margin-left: 100px;">RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 21 days. Do not graze livestock in treated area or harvest vines for forage or hay. Do not apply more than 0.12 lb ai per acre per season.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<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 = 21 days for dried shelled legumes. Do not apply more than 0.12 lb ai (7.68 fl oz) per acre per season. Do not graze livestock in treated area or harvest vines for forage or hay.
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.05 - 0.08	5.0 - 8.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.45 - 0.9	1.5 - 3 pts	PHI = 1 day. Do not apply more than 9 pts per acre per season. Do not make more than 6 applications per season per field. Minimum interval between treatments is 3 days.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.008 - 0.025	1.28 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

*RUP* - Restricted use pesticide

## GRASSHOPPERS

Grasshoppers are usually not a major problem in pea. Pea is not typically a preferred host, but grasshoppers can cause damage to field pea, especially during the flower to pod-filling stages.

**Grasshopper Thresholds: Infestation Ratings:** The threatening rating is considered the action threshold for grasshoppers. 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+

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.019 - 0.025	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>bifenthrin</b> Brigade 2EC Fanfare 2EC Sniper <i>RUP</i>	0.025 - 0.10	1.6 - 6.4 fl oz	PHI = 14 days. Apply in a minimum of 2 GPA by air or 10 GPA for ground application. Do not apply more than 0.2 lb ai (12.8 fl oz) to field pea per acre per season. Do not make applications less than 7 days apart.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 3 days. Do not apply more than 0.266 lb ai per acre per season. Do not make applications less than 5 days apart.
<b>carbaryl</b> Sevin	0.5 - 1.5	rate varies by formulation	PHI = 21 days. Do not apply within 14 days of graze or harvest for forage.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.050	1.6 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<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. The 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 = 21 days. Label includes aphid, grasshopper, cutworm and others. Proaxis may be used to control grasshoppers in bordering, non-crop areas that are not hayed or grazed.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days. Label includes aphid, grasshopper, cutworm and others. Warrior II may be used to control grasshoppers in bordering, non-crop areas that are not hayed or grazed. Do not graze livestock in treated area or harvest vines for forage or hay. Do not apply more than 0.12 lb ai per acre per season.
<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>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	Aphids Grasshoppers 0.02 0- 0.025  Leafhoppers 0.017 - 0.025	Aphids Grasshoppers 3.2 - 4 fl oz  Leafhoppers 2.72 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## LYGUS BUG (TARNISHED PLANT BUG)

The lygus bug or "tarnished plant bug" has been documented as a serious pest of many fruit and vegetable crops, but has not yet been demonstrated to cause significant problems in North Dakota field pea. Lygus bugs feed preferentially on meristematic tissue or developing reproductive tissue. Damage to flower buds or developing seeds occurs in other legume crops. It was suspected that lygus feeding caused a problem referred to as "chalk spot." It is a chalky white spot which may appear on the cotyledons of some legumes. It affects the appearance of the seed, lowering the grade and marketability. In 1996, chalk spot was a major concern in the North Dakota pea crop; however, no evidence was found that lygus bug caused the damage. The probable cause was pea being harvested at too high a moisture content. Peas harvested at high moisture levels are susceptible to bruising when harvested or handled roughly, resulting in damage similar to chalk spot.

**Economic Threshold:** None has been determined for the region.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.019 - 0.025	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>bifenthrin</b> Brigade 2EC Fanfare 2EC Sniper <i>RUP</i>	0.025 - 0.10	1.6 - 6.4 fl oz	PHI = 14 days. Apply in a minimum of 2 GPA by air or 10 GPA for ground application. Do not apply more than 0.2 lb ai (12.8 fl oz) to field pea per acre per season. Do not make applications less than 7 days apart.
<b>carbaryl</b> Sevin	0.5 - 1.5	rate varies by formulation	PHI = 21 days. Do not apply within 14 days of graze or harvest for forage.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.050	1.6 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>dimethoate</b> Dimethoate 4EC Dimethoate 4E Dimate 4EC	0.5	16 fl oz	PHI = 7 days. Do not feed or graze hay within 21 days of last application. Do not make more than 1 application per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. Label includes aphid, grasshopper, cutworm and others. Proaxis may be used to control grasshoppers in bordering, non-crop areas that are not hayed or grazed.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days. Do not graze livestock in treated area or harvest vines for forage or hay. Do not apply more than 0.12 lb ai per acre per season.
<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>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.



INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>zeta-cypermethrin</b>	Aphids	Aphids	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.
Mustang Max	Grasshoppers	Grasshoppers	
Mustang Max EC	0.02 0- 0.025	3.2 - 4 fl oz	
Respect			
<i>RUP</i>	Leafhoppers	Leafhoppers	
	0.017 - 0.025	2.72 - 4 fl oz	

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## PEA APHID

The most common insect pest found in field pea is the pea aphid. They are small, about 1/8+ inch long, and pale green. In North Dakota, aphids usually do not reach economic levels in field pea. Aphid populations are usually kept low by heavy rains or by beneficial insects such as parasitoid wasps and predators such as lady bird beetle and lacewings.

Scouting for aphids in pea is conducted using either a sweep net or examining the number of aphids per plant tip when 50 to 75 percent of the peas are flowering. Take 180 degree sweeps using a 15-inch sweep net or check at least five 8-inch plant tips from four different locations in the field. Population estimates should be calculated by averaging counts taken from four separate areas of the field.

### Economic Thresholds:

Canadian entomologists suggest the following guidelines. Economic thresholds may vary depending on the value of the crops and cost of control, as well as variation in potential seed weight caused by variation in precipitation and heat stress. The economic threshold in peas at \$5.71 per bushel and average control cost of \$6.73-\$9.25/acre is 2 to 3 aphids per 8-inch plant tips, or 9 to 12 aphids per sweep (or 90 to 120 aphids per 10 sweeps), at flowering. If the economic threshold is exceeded, a single application of insecticide when 50% of plants have produced some young pods will protect the crop against yield loss and be cost-effective. Cultivars of peas may also vary in their tolerance to feeding by pea aphids, thus economic injury levels may differ between cultivars. The economic thresholds presented above were developed using "Century" field peas.

Aphid feeding on peas in the flowering and early pod stage can result in lower yields due to less seed formation and smaller seed size. Protein content and other quality issues do not appear to be affected.

The following table relates yield loss in peas for average aphid counts from 1 to 8 aphids per 8-inch pea stem tip when about 25% of the crop has begun to flower.

Aphids per sweep	Aphids per tip	% yield loss
7	1	3.4
10	2	4.9
12	3	6.1
15	4	7.1
16	5	8.0
18	6	8.8
20	7	9.6
21	8	10.3

Research in Manitoba has shown that insecticides applied when pods first form protects pea yield better than earlier or later applications. Control at the early pod stage provides protection through the pod formation and elongation stages, which are very sensitive to aphid damage.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.019 - 0.025	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock. For pea aphid, use high rate of 3.2 fl oz/acre for pest suppression only.
<b>bifenthrin</b> Brigade 2EC Fanfare 2EC Sniper <i>RUP</i>	0.025 - 0.10	1.6 - 6.4 fl oz	PHI = 14 days. Apply in a minimum of 2 GPA by air or 10 GPA for ground application. Do not apply more than 0.2 lb ai (12.8 fl oz) to field pea per acre per season. Do not make applications less than 7 days apart.
<b>carbaryl</b> Sevin	0.5 - 1.5	rate varies by formulation	PHI = 21 days. Do not apply within 14 days of graze or harvest for forage. Not labeled for pea aphid.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.050	1.6 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock. For pea aphid, use high rate of 3.2 fl oz/acre for pest suppression only.
<b>dimethoate</b> Dimethoate 4EC Dimethoate 4E Dimate 4EC	0.125 - 0.5	0.33 - 1 pt	PHI = 7 days. Do not feed or graze hay within 21 days of last application. Do not make more than 1 application per season.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. 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 = 21 days. Proaxis may be used to control grasshoppers in bordering, non-crop areas that are not hayed or grazed.
<b>imidacloprid</b> Attendant 600 Senator 600	refer to recommended label rate	1.6 - 3.2 fl oz per cwt of seed	Apply as a commercial seed treatment. Follow all applicable directions, restrictions and precautions on the EPA registered label. For control of early season aphids.
<b>imidacloprid</b> Enhance AW	refer to recommended label rate	5 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. Do not graze or feed livestock on treated area for 60 days after planting. Follow all applicable directions, restrictions and precautions on the EPA registered label. For control of early season aphids.
<b>imidacloprid</b> Admire Pro  Controls aphids and leafhoppers only	0.25 - 0.38	7.0 - 10.5 fl oz	PHI = 21 days. Maximum of 10.5 fl oz per acre per season. Apply using one of the following methods: 1) Chemigation into root zone, 2) In-furrow spray at planting directed on or below seed; 3) In a narrow (2" or less) surface band over seed-line during planting incorporating to a depth of 1 to 1.5' with sufficient irrigation within 24 hours following applications, 4) In a narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, or 5) As a post-seeding drench, transplant drench or hill drench.
<b>imidacloprid</b> Mana Alias 4F	0.25 - 0.38	8.0 - 12.0 fl oz	PHI = 21 days. Maximum amount allowed per season 12 fl oz/acre/season. Apply using one of the following methods: 1) Chemigation into root zone, 2) In-furrow spray at planting directed on or below seed; 3) In a narrow (2" or less) surface band over seed-line during planting incorporating to a depth of 1 to 1.5' with sufficient irrigation within 24 hours following applications, 4) In a narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, or 5) As a post-seeding drench, transplant drench or hill drench.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Mana Alias 4F	0.044	1.4 fl oz	PHI = 7 days. Minimum interval between applications = 5 days. Maximum of 4.2 fl oz per acre (0.13 lb ai per acre) allowed per crop season.
<b>imidacloprid</b> Advise 2FL Nuprid 2F	see label	16 - 24 fl oz	PHI = 21 days. Maximum amount allowed per season 24 fl oz/acre/season. Apply using one of the following methods: 1) Chemigation into root-zone through low-pressure drip, trickle, microsprinkler or equivalent equipment, 2) In-furrow spray during planting directed on or below seed, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 In a narrow (2" or less) surface band over seed-line during planting incorporated to a depth of 1 to 1.5 inches with sufficient irrigation within 24 hours following application, 4) In a narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, or 5)As a post-seeding drench, transplant drench, or hill drench. Not for use on crops grown for seed unless allowed by state-specific supplemental labeling.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days. Do not graze livestock in treated area or harvest vines for forage or hay. Do not apply more than 0.12 lb ai per acre per season.
<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>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	Aphids Grasshoppers 0.02 0- 0.025  Leafhoppers 0.017 - 0.025	Aphids Grasshoppers 3.2 - 4 fl oz  Leafhoppers 2.72 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## WIREWORMS

Wireworms are most likely to be problems when field peas follows pasture or grassland. Infestations often are found in coarse textured soils (sandy loam) where moisture is abundant, perhaps in low spots of fields.

### Thresholds:

There is no easy way to estimate wireworm infestations. Two methods are currently used.

**Soil Sampling:** Sample 20, well spaced, 1 square foot sites to a depth of 4 to 6 inches for every 40 acres being planted. If an average of 1 wireworm per square foot is found, treatment would be justified.

**Solar Baiting:** In September, establish bait stations for 2 to 3 weeks before freeze. Place bait stations randomly through the

field, but representing all areas of the field. There should be 10 - 12 stations per 40 acre field. Place one cup wheat and one cup shelled corn in a 4- to 6-inch deep hole. Cover grain with soil and then an 18-inch square piece of clear plastic. Dig up the grain. If an average of one or more wireworm larvae are found per station, treatment would be justified.

**Seed Treatment:** Please the seed treatment section in the introduction for more information.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>bifenthrin</b> Capture LFR	0.04 - 0.08	3.4 - 6.8 fl oz	Do not apply more than 0.1 lb ai per acre per season as an at-plant application. Do not apply more than 0.3 pound active per acre per season including at-plant plus foliar applications of other bifenthrin products (such as Capture 2EC). Apply as a 5-7 inch band over the open furrow (T-band), or in-furrow with the seed.
<i>RUP</i>	0.0023 - 0.0046 pounds active per 1000 linear feet of row	0.20 - 0.39 fl oz per 1000 linear feet of row	
<b>imidacloprid</b> Attendant 600 Senator 600	refer to recommended label rate	1.6 - 3.2 fl oz per cwt of seed	Apply as a commercial seed treatment. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Enhance AW	refer to recommended label rate	5 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. Do not graze or feed livestock on treated area for 60 days after planting. Follow all applicable directions, restrictions and precautions on the EPA registered label.

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## FLAX INSECTS

Flax may be infested from the time of emergence to maturity by various insect pests. Fields should be examined regularly and controls applied when infestations reach the economic threshold. The following species are potentially damaging but often occur in too low a number to cause economic loss.

### ARMY CUTWORM

Larvae of the army cutworm, *Euxoa auxiliaris*, damage flax and many other crops by feeding on foliage in the spring, and to a lesser degree, in the fall. It can be an important pest in southwestern North Dakota. Populations of 9 per square yard can cause significant damage.

### ASTER LEAFHOPPER

The aster leafhopper, *Macrostelus quadrilineatus*, can damage flax. This insect feeds by sucking juices from the flax plants. More importantly, aster leafhoppers can carry the Aster Yellows mycoplasma and the crinkle virus, and can infect the plants with these diseases while feeding. The damage from these insects is most serious on late-seeded crops.

### BERTHA ARMYWORM

The bertha armyworm, *Mamestra configurata*, was a regular pest of flax before canola and mustard were grown on the prairies. However, since their widespread introduction, the bertha armyworm rarely causes economic damage to weed-free flax fields. If bertha armyworm-infested canola fields are swathed and green flax fields are nearby, the flax can suffer significant damage from invading larvae. When abundant, bertha armyworms cause serious damage by chewing through the stems below the bolls, causing them to drop to the ground. Young bertha larvae are green but larger larvae are usually velvet-black.

### CUTWORMS

Two subterranean species of cutworms, the redbacked, *Euxoa ochrogaster*, and the pale western, *Agrotis orthogonia*, attack flax.

The adult moths of these species lay eggs on the soil surface in weedy summer fallow fields during late summer. These eggs overwinter and the young larvae feed on flax seedlings in the spring. Cutworms usually remain below ground, cut off the young plants near the soil surface and draw them down where they are eaten. An average population of 10 cutworms per square yard can cause a 10% reduction in the yield of flax, and control should be considered.

### GRASSHOPPERS

Grasshoppers have been the **No. 1 threat to North Dakota flax** in recent years. Young grasshoppers may attack young plants and cause damage. However, more damage is done to the crop before harvest by the older, larger grasshoppers. They can quickly cause large numbers of bolls to drop by chewing through the more succulent portions of the stem below the bolls. Growers need to be aware of grasshopper activity in the vicinity of flax fields well before adult migration begins in July. Because of the limited availability of insecticides in flax, attempts to reduce grasshopper populations in neighboring crops and non-crop areas are advisable.

#### Insecticides registered for controlling insects in flax

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
carbaryl Sevin	0.5 - 1.5	rate varies by formulation	PHI = 42 days for seed or straw. Do not apply more than a total of 3 lbs of active ingredient per acre per crop.
zeta-cypermethrin Mustang Max EC RUP	0.025	4.0 fl oz	PHI = 7 days. Do not apply more than 0.15 lb ai per acre per season. Do not make applications less than 7 days apart. Apply by ground or air using sufficient water to obtain full coverage of foliage (minimum of 10 GPA by ground and 2 GPA by air).

## WIREWORMS

Wireworms, although often serious pests of cereal grains in the seedling stage, seldom damage flax. Cruiser and Gaucho are labeled as commercial seed treatment for control of wireworm on flax and use decisions must be made at time of seed purchase. Please the seed treatment section in the introduction for more information.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>imidacloprid</b> Gaucho 600	refer to recommended label rate		Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Dyna-Shield Imidacloprid 5	refer to recommended label rate	12.8 fl oz per cwt of seed	Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Senator 600	refer to recommended label rate	25.6 fl oz per cwt of seed	Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>thiamethoxam</b> Cruiser 5FS	refer to recommended label rate		Follow all applicable directions, restrictions and precautions on the EPA registered label.

## FORAGE INSECTS

**NOTE:** When spraying legume fields, apply insecticides between 8 p.m. and 8 a.m. to protect the local bee population. Never spray fields in bloom.

### ALFALFA BLOTCH LEAFMINER

Alfalfa acreage in the upper Midwest was recently invaded by the alfalfa blotch leafminer (ABL). ABL is a gnatlike fly (Diptera) from Europe that was first detected in North America, in Massachusetts, in 1968. By 1994, populations of ABL reached northern Minnesota and by 1997 could be found throughout Wisconsin, the northern 2/3 of Minnesota, and the northeastern corner of Illinois. By October 1998, ABL was distributed throughout Minnesota, Wisconsin, northern Illinois, and eastern North Dakota. Observations suggest that this insect may reduce alfalfa yields by 7% to 20% and protein content by 10% to 20%. Both adults and larvae damage the plant.

Females feed by puncturing leaves with their ovipositors, creating characteristic "pinholes," and consuming plant juices. A single female creates an average of 3,769 pinholes during her lifetime. Larvae emerging from eggs create distinctive mines as they feed. Within a field, it is not uncommon for 70% or more of the leaflets to be attacked. The wounds also increase the susceptibility of alfalfa to diseases, especially spring black stem. Still unclear is the economic impact of damage caused by ABL, but the visible damage caused by even low numbers of flies can be disturbing. In the northeastern United States, populations have been suppressed by parasitic wasps and control is not recommended.

Severe infestations appear one year after initial colonization by the leafminer. Infestations have now spread to central North Dakota. The first generation in May-June causes the most visible damage. Infested fields take on a whitish cast due to the larval mines in the leaves. The same appearance can be confused with alfalfa weevil feeding; however, you do not have the skeletonizing of the leaves by the leafminers.

#### Alfalfa Blotch Leafminer Thresholds:

Treatment is suggested if 30% to 40% of the plants exhibit pinhole feeding injury. Though several insecticides are available for ABL control in alfalfa, insecticide efficacy trials in Minnesota have not demonstrated significant economic return. If insecticides are used, they must be applied during the "pinhole" stage.

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 or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E (alfalfa only) <i>RUP</i>	0.5 - 1	1 - 2 pts	Do not cut or graze treated alfalfa within 7 days after application of ½ pint per acre, within 14 days after application of 1 pint per acre, or within 21 days after application of rates above 1 pint per acre. Do not make more than 4 applications per season or one application per cutting of any product containing chlorpyrifos. Do not make a second application within 10 days of the first application. Apply in at least 2 to 5 GPA by air and 10 GPA by ground. REI = 24 hours.
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced (alfalfa only) <i>RUP</i>	0.31 - 0.74 + 0.016 - 0.038	16 - 38 fl oz	PHI = 7 days for 6-13 fl oz per acre, 14 days for 13-26 fl oz per acre, 21 days for greater than 26 fl oz per acre. Do not apply more than 119 fl oz per acre per season. Do not make a second application within 10 days of the first application.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.031 - 0.044	2.0 - 2.8 fl oz	PHI or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer (alfalfa only) <i>RUP</i>	0.03	3.84 fl oz	Apply only to pure stands of alfalfa. PHI = 1 day for forage or within 7 days for hay. Do not apply more than 0.03 lb ai per acre per cutting. Do not apply more than 0.12 lb ai per acre per season. Avoid application when bees are actively foraging. Apply in minimum of 2 GPA by air or 10 GPA by ground.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>lambda-cyhalothrin</b> Kaiso 24 WG (alfalfa only)	0.03	2 oz	
<i>RUP</i>			
<b>lambda-cyhalothrin</b> Grizzly Z Nufarm Lambda- Cyhalothrin 1EC (alfalfa only)	0.02 - 0.03	2.56 - 3.84 fl oz	
<i>RUP</i>			
<b>lambda-cyhalothrin</b> Warrior II (alfalfa only)	0.03	1.92 fl oz	
<i>RUP</i>			
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress (alfalfa only)	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 1 day for forage, 7 days for hay. Apply as required by scouting. Use minimum of 10 GPA by ground and minimum of 5 GPA by air. Do not apply more than 31 oz per acre per year or 9 oz per cutting. Bee precaution: remove bee shelters for 2-3 days following application of Voliam Xpress.
<i>RUP</i>			
<b>methomyl</b> Lannate LV	0.45 - 0.9	1.5 - 3 pts	PHI = 0 days. Do not graze or feed to livestock for 7 days.
<i>RUP</i>			

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## ALFALFA WEEVIL

### Larvae

Historically, alfalfa weevil larvae are not a widespread concern in North Dakota, occurring mainly in the southern counties when they are a problem. The light green larvae have a white stripe down the center of the back. They feed in the terminal buds of the growing alfalfa. They may be found in rolled up leaves at the growing tip of the plant. Feeding injury appears as small, circular holes in leaves. As larvae increase in size, feeding injury is more evident. Severely damaged fields take on a silvery appearance due to browning of injured leaf tissue.

#### Alfalfa Weevil Management:

If alfalfa weevil infestations are observed, one of the best strategies is to cut fields for hay early. After cutting, monitor carefully for signs of damage or delayed regrowth, particularly in the swath area where larvae may be concentrated.

When early cutting of the crop is not possible, treatment should be considered when 30% of the plants show feeding damage and larvae are still present. The second cutting should be scouted for feeding injury. Treat if 50% of the crowns have weevil feeding, and re-growth is delayed 3-6 days. Feeding injury is often concentrated underneath the windrows. To sample, inspect 20 stems from each of 5 sites in the field, recording the percent of damaged plants and whether larvae were found.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL	0.0125 - 0.022	1.6 - 2.8 fl oz	PHI or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<i>RUP</i>			
<b>carbaryl</b> Sevin	1.5	rate varies by formulation	PHI = 7 days (alfalfa).
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E (alfalfa only)	0.5 - 1	1 - 2 pts	Do not cut or graze treated alfalfa within 7 days after application of ½ pint per acre, within 14 days after application of 1 pint per acre, or within 21 days after application of rates above 1 pint per acre. Do not make more than 4 applications per season or one application per cutting of any product containing chlorpyrifos. Do not make a second application within 10 days of the first application. Apply in at least 2 to 5 GPA by air and 10 GPA by ground. REI = 24 hours.
<i>RUP</i>			



INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced (alfalfa only) <i>RUP</i>	0.31 - 0.74 + 0.016 - 0.038	16 - 38 fl oz	PHI = 7 days for 6-13 fl oz per acre, 14 days for 13-26 fl oz per acre, 21 days for greater than 26 fl oz per acre. Do not apply more than 119 fl oz per acre per season. Do not make a second application within 10 days of the first application.
<b>chlorpyrifos + zeta- cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.044	1.6 - 2.8 fl oz	PHI or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 1 day for forage or within 7 days for hay. Apply in minimum of 2 gal/A by air or 10 gal/A by ground.
<b>indoxacarb</b> Steward EC	0.065 - 0.11  0.034 - 0.065	6.7 - 11.3 fl oz  <b>Reduced Rate</b> 4.0 - 6.7 fl oz	PHI = 7 days. Do not apply more than 45 fl oz per acre per season. Apply no more than 11.3 fl oz per cutting. When Steward EC is used alfalfa grown for seed, the seed may not be used for sprouts or livestock feed. All seed from treated crop must be tagged "Not for Human or Animal Use" at the processing plant. A <b>reduced rate</b> has been issued as a state 2 (ee) label for control of alfalfa weevil larvae when only 10 to 14 days of residual are needed. Or, when a tank-mixture with OP or pyrethroid insecticides is needed for control of alfalfa weevil larvae and aphids.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer (alfalfa only) <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	Apply only to pure stands of alfalfa. PHI = 1 day for forage or within 7 days for hay. Do not apply more than 0.03 lb ai per acre per cutting. Do not apply more than 0.12 lb ai per acre per season. Avoid application when bees are actively foraging. Apply in minimum of 2 gal/A by air or 10 gal/A by ground.
<b>lambda-cyhalothrin</b> Kaiso 24 WG (alfalfa only) <i>RUP</i>	0.02 - 0.03	1.33 - 2.0 oz	
<b>lambda-cyhalothrin</b> Grizzly Z Nufarm Lambda- Cyhalothrin 1EC (alfalfa only) <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	
<b>lambda-cyhalothrin</b> Warrior II (alfalfa only) <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress (alfalfa only) <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 1 day for forage, 7 days for hay. Apply as required by scouting. Use minimum of 10 GPA by ground and minimum of 5 GPA by air. Do not apply more than 31 oz per acre per year or 9 oz per cutting. Bee precaution: remove bee shelters for 2-3 days following application of Voliam Xpress.
<b>malathion</b> Malathion 57EC	0.9 - 1.25	1.5 - 2 pts	No time limitation. Not effective on adults.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>methomyl</b> Lannate LV <i>RUP</i>	0.9	3 pts	PHI = 0 days. Do not graze or feed to livestock for 7 days.
<b>methoxychlor</b> Methoxychlor 2EC	1 - 1.5	2 - 3 qts	PHI = 7 days.
<b>methyl parathion</b> <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	PHI = 15 days of cutting or grazing. Do not enter treated fields within 48 hours after application.
<b>permethrin</b> Ambush 2E Pounce 3.2EC Arctic 3.2E Permethrin 2EC Perm-Up 25 WP Perm-Up 32. EC <i>RUP</i>	0.1 - 0.2	6.4 - 12.8 fl oz 4 - 8 fl oz 4 - 8 fl oz 4 - 8 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 14 days at rates above 0.1 lb/A. Do not apply more than 0.2 lb active/cutting.
<b>phosmet</b> Imidan 50 WP	0.75	2 lbs	Do not apply more than once per cutting. Do not graze or cut for hay within 7 days of application. Do not apply to alfalfa during the bloom period.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect (alfalfa only) <i>RUP</i>	0.014 - 0.025	2.24 - 4 fl oz	PHI = 3 days of cutting or grazing or up to 7 days of harvesting seed. Do not make applications less than 7 days apart. Do not apply more than 0.075 lb AI per acre per season.

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## CUTWORMS

The variegated cutworm is an occasional pest of alfalfa and sweetclover in North Dakota. These larvae are about 2 inches long when full grown. Their color ranges from black to light greenish-yellow or tan. They have a distinctive row of pale yellow spots down the middle of their backs. Generally, the most serious damage from this cutworm would be on the stubble following the first cutting. Larvae may concentrate beneath windrows, causing severe damage to these areas.

### Threshold:

Treatments would be justified when more than 2 worms per square foot are present after the hay has been cut - if larvae are not expected to pupate in the next 3 to 4 days.

Another management strategy is to delay cutting if larvae are close to full size and about to pupate. By delaying cutting, the feeding is distributed through the dense canopy of an established stand which is less detrimental than concentrated feeding on the young regrowth.

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 or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<b>carbaryl</b> Sevin	1.5	rate varies by formulation	PHI = 7 days (alfalfa).
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E (alfalfa only) <i>RUP</i>	0.5 - 1	1 - 2 pts	Do not cut or graze treated alfalfa within 7 days after application of ½ pint per acre, within 14 days after application of 1 pint per acre, or within 21 days after application of rates above 1 pint per acre. Do not make more than 4 applications per season or one application per cutting of any product containing chlorpyrifos. Do not make a second application within 10 days of the first application. Apply in at least 2 to 5 GPA by air and 10 GPA by ground. REI = 24 hours.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced (alfalfa only) <i>RUP</i>	0.22 - 0.51 + 0.011 - 0.026	11 - 26 fl oz	PHI = 7 days for 6-13 fl oz per acre, 14 days for 13-26 fl oz per acre, 21 days for greater than 26 fl oz per acre. Do not apply more than 119 fl oz per acre per season. Do not make a second application within 10 days of the first application.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.013 - 0.025	0.8 - 1.6 fl oz	PHI or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.0125	1.92 - 3.2 fl oz	PHI = 1 day for forage or within 7 days for hay. Apply in minimum of 2 gal/A by air or 10 gal/A by ground.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC (alfalfa only) <i>RUP</i>	0.015 - 0.025	1.92 - 3.20 fl oz	Apply only to pure stands of alfalfa. PHI = 1 day for forage or within 7 days for hay. Do not apply more than 0.03 lb ai per acre per cutting. Do not apply more than 0.12 lb ai per acre per season. Avoid application when bees are actively foraging. Apply in minimum of 2 gal/A by air or 10 gal/A by ground.
<b>lambda-cyhalothrin</b> Kaiso 24 WG (alfalfa only) <i>RUP</i>	0.015 - 0.025	1.0 - 1.67 oz	
<b>lambda-cyhalothrin</b> Warrior II (alfalfa only) <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress (alfalfa only) <i>RUP</i>	0.05 - 0.08	5.0 - 8.0 fl oz	PHI = 1 day for forage, 7 days for hay. Apply as required by scouting. Use minimum of 10 GPA by ground and minimum of 5 GPA by air. Do not apply more than 31 oz per acre per year or 9 oz per cutting. Bee precaution: remove bee shelters for 2-3 days following application of Voliam Xpress.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.23 - 0.9	0.75 - 3 pts	PHI = 0 days. Do not graze or feed to livestock for 7 days.
<b>methyl parathion</b> <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	Wait 15 days before cutting or grazing. Do not enter treated fields within 48 hours after application.
<b>permethrin</b> Ambush 2E Pounce 3.2EC Arctic 3.2E Permethrin 2EC Perm-Up 25 WP Perm-Up 32. EC <i>RUP</i>	0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.05 - 0.2 0.05 - 0.2	6.4 - 12.8 fl oz 4 - 8 fl oz 4 - 8 fl oz 4 - 8 fl oz 3.2 - 12.8 fl oz 2 - 8 fl oz	PHI = 14 days at rates above 0.1 lb/A. Do not apply more than 0.2 lb active/cutting.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect (alfalfa only) <i>RUP</i>	0.014 - 0.025	2.24 - 4 fl oz	PHI = 3 days of cutting or grazing or up to 7 days of harvesting seed. Do not make applications less than 7 days apart. Do not apply more than 0.075 lb AI per acre per season.

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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 or where plant cover attracted adults the previous season. Infestations could occur any time after emergence begins. Later infestations may develop when grasshopper adults migrate from harvested fields.

**Grasshopper Thresholds: Infestation Ratings:** Threatening is considered the action threshold for grasshoppers. 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+

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 or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<b>carbaryl</b> Sevin	1 - 1.5	rate varies by formulation	PHI = 7 days (alfalfa).
<b>chlorpyrifos</b> Lorsban 4E Lorsban Advanced Warhawk Yuma 4E (alfalfa only) <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	Do not cut or graze treated alfalfa within 7 days after application of ½ pint per acre, within 14 days after application of 1 pint per acre, or within 21 days after application of rates above 1 pint per acre. Do not make more than 4 applications per season or one application per cutting of any product containing chlorpyrifos. Do not make a second application within 10 days of the first application. Apply in at least 2 to 5 GPA by air and 10 GPA by ground. REI = 24 hours.
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced (alfalfa only) <i>RUP</i>	0.12 - 0.25 + 0.006 - 0.013	6 - 13 fl oz	PHI = 7 days for 6-13 fl oz per acre, 14 days for 13-26 fl oz per acre, 21 days for greater than 26 fl oz per acre. Do not apply more than 119 fl oz per acre per season. Do not make a second application within 10 days of the first application.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.031 - 0.044	2.0 - 2.8 fl oz	PHI or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<b>dimethoate</b> Digon 400, Dimethoate 400	0.25 - 0.5	0.5 - 1 pt	Do not apply to alfalfa in bloom. PHI = 10 days or pasturing. Make only 1 application per cutting. Do not enter treated fields without protective clothing until spray dries.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 1 day for forage or within 7 days for hay. Apply in minimum of 2 gal/A by air or 10 gal/A by ground. Proaxis may be used in bordering, non-crop areas that are not hayed or grazed

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC (alfalfa only) <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	Apply only to pure stands of alfalfa. PHI = 1 day for forage or within 7 days for hay. Do not apply more than 0.03 lb ai (3.84 fl oz) per acre per cutting. Do not apply more than 0.12 lb ai (15.36 fl oz) per acre per season. Avoid application when bees are actively foraging. Apply in minimum of 2 gal/A by air or 10 gal/A by ground.
<b>lambda-cyhalothrin</b> Kaiso 24 WG (alfalfa only) <i>RUP</i>	0.02 - 0.03	1.33 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II (alfalfa only) <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress (alfalfa only) <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 1 day for forage, 7 days for hay. Apply as required by scouting. Use minimum of 10 GPA by ground and minimum of 5 GPA by air. Do not apply more than 31 oz per acre per year or 9 oz per cutting. Bee precaution: remove bee shelters for 2-3 days following application of Voliam Xpress.
<b>malathion</b> Malathion 57EC	1	1.5 pts	No limitation on cutting or grazing.
<b>malathion</b> Malathion ULV	0.6	8 oz	Aerial application. Applied alone or dissolved in 1 pint of diesel oil per acre. No time limitation on cutting or grazing.
<b>methyl parathion</b> <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	PHI = 15 days, cutting or grazing. Do not enter treated fields within 48 hours after application.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect (alfalfa only) <i>RUP</i>	0.014 - 0.025	2.24 - 4 fl oz	PHI = 3 days of cutting or grazing or up to 7 days of harvesting seed. Do not make applications less than 7 days apart. Do not apply more than 0.075 lb AI per acre per season.

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## LEAFHOPPERS

The potato leafhopper is wedge-shaped and pale green in color. It is only 1/8 inch long. Adults are very active, jumping or flying when disturbed. Both adults and nymphs will run backwards or sideways rapidly. Damage by leafhoppers is referred to as hopper-burn. Foliage becomes dwarfed, crinkled and curled. Small triangular brown areas appear at the tips of leaves, gradually spreading around the entire leaf margin.

### Potato Leafhopper Thresholds:

Suggested treatment guidelines are presented below. Thresholds are based on the number of leafhoppers per sweep when swinging a sweep net in a pendulumlike motion through the tops of the plants.

<u>Stem Length</u> <u>(inches)</u>	<u>Average No.</u> <u>Leafhoppers/Sweep</u>
3 or less	0.2
6	0.5
8 - 10	1.0
12 -14	2.0

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 or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<b>carbaryl</b> Sevin	1	rate varies by formulation	PHI = 7 days (alfalfa).
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced (alfalfa only) <i>RUP</i>	0.12 - 0.25 + 0.006 - 0.013	6 - 13 fl oz	PHI = 7 days for 6-13 fl oz per acre, 14 days for 13-26 fl oz per acre, 21 days for greater than 26 fl oz per acre. Do not apply more than 119 fl oz per acre per season. Do not make a second application within 10 days of the first application.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E (alfalfa only) <i>RUP</i>	0.5 - 1	1 - 2 pts	Do not cut or graze treated alfalfa within 7 days after application of ½ pint per acre, within 14 days after application of 1 pint per acre, or within 21 days after application of rates above 1 pint per acre. Do not make more than 4 applications per season or one application per cutting of any product containing chlorpyrifos. Do not make a second application within 10 days of the first application. Apply in at least 2 to 5 GPA by air and 10 GPA by ground. REI = 24 hours.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.013 - 0.025	0.8 - 1.6 fl oz	PHI or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<b>dimethoate</b> Digon 400, Dimethoate 400	0.25 - 0.5	0.5 - 1 pt	PHI = 10 days of harvest or pasturing. Make only 1 application per cutting. Do not enter treated fields within 4 days after application.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 1 day for forage or within 7 days for hay. Apply in minimum of 2 gal/A by air or 10 gal/A by ground. Rates for leafhoppers are lower; refer to label.
<b>indoxacarb</b> Steward EC	0.09 - 0.11	9.2 - 11.3 fl oz	PHI = 7 days. Do not apply more than 45 fl oz per acre per season. Apply no more than 11.3 fl oz per cutting. When Steward EC is used alfalfa grown for seed, the seed may not be used for sprouts or livestock feed. All seed from treated crop must be tagged "Not for Human or Animal Use" at the processing plant.
<b>lambda-cyhalothrin</b> Lambda-Cy Grizzly Z Nufarm Lambda-Cyhalothrin 1EC (alfalfa only) <i>RUP</i>	0.015 - 0.025	1.92 - 3.20 fl oz	Apply only to pure stands of alfalfa. PHI = 1 day for forage or within 7 days for hay. Do not apply more than 0.03 lb ai per acre per cutting. Do not apply more than 0.12 lb ai per acre per season. Avoid application when bees are actively foraging. Apply in minimum of 2 gal/A by air or 10 gal/A by ground.
<b>lambda-cyhalothrin</b> Kaiso 24 WG (alfalfa only) <i>RUP</i>	0.015 - 0.025	1.0 - 1.67 oz	
<b>lambda-cyhalothrin</b> Warrior II (alfalfa only) <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress (alfalfa only) <i>RUP</i>	0.05 - 0.08	5.0 - 8.0 fl oz	PHI = 1 day for forage, 7 days for hay. Apply as required by scouting. Use minimum of 10 GPA by ground and minimum of 5 GPA by air. Do not apply more than 31 oz per acre per year or 9 oz per cutting. Bee precaution: remove bee shelters for 2-3 days following application of Voliam Xpress.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>malathion</b> Malathion 57EC	1	1.5 pts	No preharvest interval on foraging or grazing.
<b>permethrin</b> Ambush 2E Pounce 3.2EC Arctic 3.2E Permethrin 2EC Perm-Up 25 WP Perm-Up 32. EC	0.05 - 0.2 0.05 - 0.2 0.05 - 0.2 0.05 - 0.2 0.1 - 0.2 0.1 - 0.2	3.2 - 12.8 fl oz 2 - 8 fl oz 2 - 8 fl oz 2 - 8 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 14 days at rates above 0.1 lb/A. Do not apply more than 0.2 lb active/cutting.
<i>RUP</i>			
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect (alfalfa only)	0.014 - 0.025	2.24 - 4 fl oz	PHI = 3 days of cutting or grazing or up to 7 days of harvesting seed. Do not make applications less than 7 days apart. Do not apply more than 0.075 lb AI per acre per season.
<i>RUP</i>			

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## LYGUS OR PLANT BUGS

Lygus bugs are a serious pest of alfalfa seed production. These insects are 1/4 inch long and range in color from pale green to light brown to reddish-brown. There is a light-colored, heart-shaped spot on the back. The nymphs are pale green and look similar to aphids, but are much more active movers. Lygus bugs feed on foliage, but the most serious feeding is on the flower buds, flowers, and developing seeds. Feeding causes blossoms to drop, and seeds to shrivel, turn brown and then fail to germinate.

### Threshold:

Treatments are justified when sweep net samples collect an average of 3 to 5 lygus bugs (adults and nymphs) per pendulum sweep. If insecticides are considered, attempt to time treatments for the control of nymphs prior to the onset of bloom. Protecting insect pollinators in seed production fields is very important.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0125 - 0.022	1.6 - 2.8 fl oz	Preharvest interval or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<b>bifenthrin</b> Capture 2EC** **Allowable under North Dakota state label #90-0003, issued 4/2/90. <i>RUP</i>	0.06 - 0.1	3.8 - 6.4 fl oz	For use in alfalfa seed production fields <u>only</u> . Do not cut alfalfa seed crop for hay or forage or allow grazing. Seed alfalfa is to be tagged at the processing plant: "Not for human or animal consumption." <u>It shall be the grower's responsibility to notify the processing plant of any seed crop treated with Capture 2EC.</u>
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E (alfalfa only) <i>RUP</i>	0.5 - 1	1 - 2 pts	Do not cut or graze treated alfalfa within 7 days after application of 1/2 pint per acre, within 14 days after application of 1 pint per acre, or within 21 days after application of rates above 1 pint per acre. Do not make more than 4 applications per season or one application per cutting of any product containing chlorpyrifos. Do not make a second application within 10 days of the first application. Apply in at least 2 to 5 GPA by air and 10 GPA by ground. REI = 24 hours.
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced (alfalfa only) <i>RUP</i>	0.31 - 0.74 + 0.016 - 0.038	16 - 38 fl oz	PHI = 7 days for 6-13 fl oz per acre, 14 days for 13-26 fl oz per acre, 21 days for greater than 26 fl oz per acre. Do not apply more than 119 fl oz per acre per season. Do not make a second application within 10 days of the first application.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.044	1.6 - 2.8 fl oz	Preharvest interval or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<b>dimethoate</b> Digon 400, Dimethoate 400	0.25 - 0.5	0.5 - 1 pt	Do not apply to alfalfa in bloom. PHI = 10 days. Make only 1 application per cutting. Do not enter treated fields without protective clothing until sprays have dried.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 1 day for forage or within 7 days for hay. Apply in minimum of 2 gal/A by air or 10 gal/A by ground.
<b>lambda-cyhalothrin</b> Lambda-Cy Grizzly Z Nufarm Lambda- Cyhalothrin 1EC Silencer (alfalfa only) <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	Apply only to pure stands of alfalfa. PHI = 1 day for forage or within 7 days for hay. Do not apply more than 0.03 lb ai per acre per cutting. Do not apply more than 0.12 lb ai per acre per season. Avoid application when bees are actively foraging. Apply in minimum of 2 gal/A by air or 10 gal/A by ground.
<b>lambda-cyhalothrin</b> Kaiso 24 WG (alfalfa only) <i>RUP</i>	0.02 - 0.03	1.33 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II (alfalfa only) <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress (alfalfa only) <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 1 day for forage, 7 days for hay. Apply as required by scouting. Use minimum of 10 GPA by ground and minimum of 5 GPA by air. Do not apply more than 31 oz per acre per year or 9 oz per cutting. Bee precaution: remove bee shelters for 2-3 days following application of Voliam Xpress.
<b>malathion</b> Malathion 57EC	1.25	2 pts	No preharvest interval.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.45 - 0.9	1.5 - 3 pts	PHI = 0 days. Do not graze or feed to livestock for 7 days.
<b>methyl parathion</b> <i>RUP</i>	0.5 - 1.0	1 - 2 pts	Do not apply within 15 days of harvest, cutting or grazing. Do not enter treated fields within 48 hours after application.
<b>permethrin</b> Ambush 2E Pounce 3.2EC Arctic 3.2E Permethrin 2EC Perm-Up 25 WP Perm-Up 32. EC <i>RUP</i>	0.05 - 0.2 0.05 - 0.2 0.05 - 0.2 0.05 - 0.2 0.1 - 0.2 0.1 - 0.2	3.2 - 12.8 fl oz 2 - 8 fl oz 2 - 8 fl oz 2 - 8 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 14 days at rates above 0.1 lb/A. Do not apply more than 0.2 lb active/cutting.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect (alfalfa only) <i>RUP</i>	0.014 - 0.025	2.24 - 4 fl oz	PHI = 3 days of cutting or grazing or up to 7 days of harvesting seed. Do not make applications less than 7 days apart. Do not apply more than 0.075 lb AI per acre per season.

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## PEA APHID

The pea aphid is light green and about 1/4 inch long. Alfalfa infested by pea aphids may appear wilted and have a bronze color. When present, pea aphids will crowd together on the terminal shoot, leaves or stems. Monitor fields closely during periods of slow plant growth.

### Pea Aphid Thresholds:

Many aphids per plant are required before the vigor of that plant is reduced. Light populations may be beneficial by providing a food source for predatory and parasitic insects. On 10-inch tall alfalfa, treatment would not be needed until aphids exceed 50 per stem. Taller alfalfa will tolerate greater numbers.

INSECTICIDE	DOSAGE IN LB		PRODUCT PER ACRE	RESTRICTIONS ON USE
	AI/ACRE			
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.022		2.8 fl oz (aphid suppression)	PHI or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<b>carbaryl</b> Sevin	1		rate varies by formulation	PHI = 7 days (alfalfa).
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced (alfalfa only) <i>RUP</i>	0.22 - 0.51 + 0.011 - 0.026		11 - 26 fl oz	PHI = 7 days for 6-13 fl oz per acre, 14 days for 13-26 fl oz per acre, 21 days for greater than 26 fl oz per acre. Do not apply more than 119 fl oz per acre per season. Do not make a second application within 10 days of the first application.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E (alfalfa only) <i>RUP</i>	0.25		0.5 pt (suppression only)	Do not cut or graze treated alfalfa within 7 days after application of ½ pint per acre, within 14 days after application of 1 pint per acre, or within 21 days after application of rates above 1 pint per acre. Do not make more than 4 applications per season or one application per cutting of any product containing chlorpyrifos. Do not make a second application within 10 days of the first application. Apply in at least 2 to 5 GPA by air and 10 GPA by ground. REI = 24 hours.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>			9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.44		2.8 fl oz (aphid suppression)	PHI or pre-grazing interval is 7 days. Maximum allowed per cutting: 3.2 fl oz/acre. A total of 12.8 fl oz may be applied per acre per season. Due to potential injury to bees, do not apply to alfalfa grown for seed.
<b>dimethoate</b> Digon 400, Dimethoate 400	0.25 - 0.5		0.5 - 1 pt	PHI = 10 days of harvest or pasturing. Make only 1 application per cutting. Do not enter treated fields within 4 days after application.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015		2.56 - 3.84 fl oz	PHI = 1 day for forage or within 7 days for hay. Apply in minimum of 2 gal/A by air or 10 gal/A by ground. Rates for leafhoppers are lower; refer to label.
<b>indoxacarb</b> Steward EC	0.09 - 0.11		9.2 - 11.3 fl oz	PHI = 7 days. Do not apply more than 45 fl oz per acre per season. Apply no more than 11.3 fl oz per cutting. When Steward EC is used alfalfa grown for seed, the seed may not be used for sprouts or livestock feed. All seed from treated crop must be tagged "Not for Human or Animal Use" at the processing plant.

INSECTICIDE	DOSAGE IN LB	PRODUCT	RESTRICTIONS ON USE
	AI/ACRE	PER ACRE	
<b>lambda-cyhalothrin</b> Lambda-Cy Grizzly Z Nufarm Lambda- Cyhalothrin 1EC Silencer (alfalfa only) <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz (suppression)	Apply only to pure stands of alfalfa. PHI = 1 day for forage or within 7 days for hay. Do not apply more than 0.03 lb ai per acre per cutting. Do not apply more than 0.12 lb ai per acre per season. Avoid application when bees are actively foraging. Apply in minimum of 2 gal/A by air or 10 gal/A by ground.
<b>lambda-cyhalothrin</b> Kasio 24 WG (alfalfa only) <i>RUP</i>	0.02 - 0.03	1.33 - 2.0 oz	
<b>lambda-cyhalothrin</b> Warrior II (alfalfa only) <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress (alfalfa only) <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 1 day for forage, 7 days for hay. Apply as required by scouting. Use minimum of 10 GPA by ground and minimum of 5 GPA by air. Do not apply more than 31 oz per acre per year or 9 oz per cutting. Bee precaution: remove bee shelters for 2-3 days following application of Voliam Xpress.
<b>malathion</b> Malathion 57EC	1	1.5 pts	No preharvest interval on foraging or grazing.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.45 - 0.9	1.5 - 3 pts	PHI = 0 days. Do not graze or feed to livestock for 7 days.
<b>methyl parathion</b> <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	Wait 15 days before cutting or grazing. Do not enter treated fields within 48 hours after application.
<b>permethrin</b> Ambush 2E Pounce 3.2EC Arctic 3.2E Permethrin 2EC Perm-Up 25 WP Perm-Up 32. EC <i>RUP</i>	0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.05 - 0.2 0.05 - 0.2	6.4 - 12.8 fl oz 4 - 8 fl oz 4 - 8 fl oz 4 - 8 fl oz 3.2 - 12.8 fl oz 2 - 8 fl oz	PHI = 14 days at rates above 0.1 lb/A. Do not apply more than 0.2 lb active/cutting.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect (alfalfa only) <i>RUP</i>	0.014 - 0.025	2.24 - 4 fl oz	PHI = 3 days of cutting or grazing or up to 7 days of harvesting seed. Do not make applications less than 7 days apart. Do not apply more than 0.075 lb AI per acre per season.

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# LENTIL

## CUTWORMS

Cutworms are an occasional problem in lentil. Cutworms overwinter as eggs or young larvae that feed on the newly emerged shoots in spring. The shoots may be cut off below the soil surface. Cotyledons (seeds) of lentil often remain below the soil surface and can recover from cutworm damage if cool, moist growing conditions. However, recovered plants are generally set back 4 to 7 days by the damage.

**Threshold:**

The risk is low, unless more than 2 to 3 cutworms per square yard occur in the top 3 inches of soil.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.007 - 0.013	0.8 - 1.6 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 5 GPA by air. Do not feed treated vines or hay to livestock.
<b>bifenthrin</b> Brigade 2EC Fanfare 2EC Sniper <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 14 days. Apply in a minimum of 2 GPA by air or 10 GPA for ground application. Do not apply more than 0.2 lb ai (12.8 fl oz) to field pea per acre per season. Do not make applications less than 7 days apart.
<b>bifenthrin</b> Capture LFR <i>RUP</i>	0.04 - 0.08 (0.0023 - 0.0046 lb/1000 linear feet)	3.4 - 6.8 fl oz (0.20 - 0.39 fl oz/ 1000 linear feet)	See label for soil application directions. Do not apply more than 0.1 lb ai per acre per season as an at-plant application.
<b>carbaryl</b> Sevin 4F	1.0 - 1.5	32 - 48 fl oz	Do not apply within 14 days of grazing or harvest for forage use or within 21 days of harvest of dried seed or hay. Most effective against cutworm species that feed on the upper parts of the plant. Apply as necessary up to a total of 4 applications but not more than once every 7 days.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.013 - 0.025	0.8 - 1.6 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre per 14-day interval. Minimum application volume is 10 GPA by ground and 5 GPA by air. Do not feed treated vines or hay to livestock.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. 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 = 21 days. Do not apply more than 0.06 lb ai (0.96 pt) per acre per season. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 21 days. Do not graze livestock in treated area or harvest vines for forage or hay. Do not apply more than 0.12 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Kaiso 24WG <i>RUP</i>	0.015 - 0.025	1 - 1.67 fl oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.05 - 0.08	5.0 - 8.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.008 - 0.025	1.28 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## GRASSHOPPERS

Grasshoppers are a potential problem in lentil. Lentil crops are less tolerant to grasshopper feeding than some other pulse crops. In lentils, grasshoppers pose the greatest threat from the bud stage through early pod development. Damage on lentil plants is often not highly visible because grasshoppers do not normally prefer lentil foliage. However, grasshoppers will consume flower buds and especially early pods of lentil plants. This can result in yield loss and a delay in maturity due to delayed pod set.

### Threshold:

Scout fields from the early bud stage through pod development. Research conducted by Agriculture and Agri-Food Canada in Saskatoon found that 2 grasshoppers per square yard, feeding on lentil flowers or pods, can reduce yields enough to warrant insecticide treatment.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.019 - 0.025	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>bifenthrin</b> Brigade 2EC Fanfare 2EC Sniper <i>RUP</i>	0.025 - 0.10	1.6 - 6.4 fl oz	PHI = 14 days. Apply in a minimum of 2 GPA by air or 10 GPA for ground application. Do not apply more than 0.2 lb ai (12.8 fl oz) to field pea per acre per season. Do not make applications less than 7 days apart.
<b>bifenthrin + zeta- cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 3 days. Do not apply more than 0.266 lb ai per acre per season. Do not make applications less than 5 days apart.
<b>carbaryl</b> Sevin	0.5 - 1.5	rate varies by formulation	PHI = 21 days. Do not apply within 14 days of graze or harvest for forage.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.050	1.6 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>esfenvalerate</b> Asana XL <i>RUP</i>	0.02 - 0.03	Low Rate: 3.9 - 5.8 fl oz	PHI = 21 days. The 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.
	0.03 - 0.05	High Rate: 5.8-9.6 fl oz	

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. Label includes aphid, grasshopper, cutworm and others. Proaxis may be used to control grasshoppers in bordering, non-crop areas that are not hayed or grazed.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days. Label includes aphid, grasshopper, cutworm and others. Warrior II may be used to control grasshoppers in bordering, non-crop areas that are not hayed or grazed. Do not graze livestock in treated area or harvest vines for forage or hay. Do not apply more than 0.12 lb ai per acre per season.
<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>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	Aphids Grasshoppers 0.02 0- 0.025 Leafhoppers 0.017 - 0.025	Aphids Grasshoppers 3.2 - 4 fl oz Leafhoppers 2.72 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## LYGUS BUG (TARNISHED PLANT BUG)

Lygus bug feeding on the immature reproductive structures of lentils causes seed and pod abortion, as well as a serious seed-quality problem known as "chalk spot." This problem has been reported for lentil in the Pacific Northwest production areas, but has not been seen as a significant problem in North Dakota. Lygus bugs feed with piercing, sucking mouthparts and inject toxic saliva into the immature seed. This forms a depression around the feeding area and leaves a chalky blemish. Monitor adult lygus bug populations during blooming and podding by using a sweep net, making 25, 180° sweeps in at least 5 randomly selected places in a field.

### Threshold:

Insecticide treatment is recommended when 7 to 10 adults are collected per 25 sweeps.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.019 - 0.025	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>bifenthrin</b> Brigade 2EC Fanfare 2EC Sniper <i>RUP</i>	0.025 - 0.10	1.6 - 6.4 fl oz	PHI = 14 days. Apply in a minimum of 2 GPA by air or 10 GPA for ground application. Do not apply more than 0.2 lb ai (12.8 fl oz) to field pea per acre per season. Do not make applications less than 7 days apart.
<b>carbaryl</b> Sevin	0.5 - 1.5	rate varies by formulation	PHI = 21 days. Do not apply within 14 days of graze or harvest for forage.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.050	1.6 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>dimethoate</b> Dimethoate 4EC Dimethoate 4E Dimate 4EC	0.5	16 fl oz	PHI = 7 days. Do not feed or graze hay within 21 days of last application. Do not make more than 1 application per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. Label includes aphid, grasshopper, cutworm and others. Proaxis may be used to control grasshoppers in bordering, non-crop areas that are not hayed or grazed.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days. Do not graze livestock in treated area or harvest vines for forage or hay. Do not apply more than 0.12 lb ai per acre per season.
<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>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	Aphids Grasshoppers 0.02 0- 0.025 Leafhoppers 0.017 - 0.025	Aphids Grasshoppers 3.2 - 4 fl oz Leafhoppers 2.72 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

## PEA APHID

The most common insect pest found in lentil is the pea aphid. They are small, about 1/8+ inch long, and pale green. In North Dakota, aphids usually do not reach economic levels in field pea. Aphids have many natural enemies, including lady bird beetles, parasitic wasps, lacewings and syrphid flies, but chemical control may be necessary if these insects do not keep aphids at subeconomic levels.

**Threshold:** Insecticide treatment for pea aphid control should be considered (1) when an economic threshold of 30 to 40 aphids are collected per 180° sweep of a 15-inch diameter insect net, (2) when few natural enemies are present, and (3) when aphid numbers do not decline over a 2-day period.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.019 - 0.025	2.4 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock. For pea aphid, use high rate of 3.2 fl oz/acre for pest suppression only.
<b>bifenthrin</b> Brigade 2EC Fanfare 2EC Sniper <i>RUP</i>	0.025 - 0.10	1.6 - 6.4 fl oz	PHI = 14 days. Apply in a minimum of 2 GPA by air or 10 GPA for ground application. Do not apply more than 0.2 lb ai (12.8 fl oz) to field pea per acre per season. Do not make applications less than 7 days apart.
<b>carbaryl</b> Sevin	0.5 - 1.5	rate varies by formulation	PHI = 21 days. Do not apply within 14 days of graze or harvest for forage. Not labeled for pea aphid.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.050	1.6 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock. For pea aphid, use high rate of 3.2 fl oz/acre for pest suppression only.
<b>dimethoate</b> Dimethoate 4EC Dimethoate 4E Dimate 4EC	0.125 - 0.5	0.33 - 1 pt	PHI = 7 days. Do not feed or graze hay within 21 days of last application. Do not make more than 1 application per season.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. 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 = 21 days. Proaxis may be used to control grasshoppers in bordering, non-crop areas that are not hayed or grazed.
<b>imidacloprid</b> Attendant 600 Senator 600	refer to recommended label rate	1.6 - 3.2 fl oz per cwt of seed	Apply as a commercial seed treatment. Follow all applicable directions, restrictions and precautions on the EPA registered label. For control of early season aphids.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Admire Pro  Controls aphids and leafhoppers only	0.25 - 0.38	7.0 - 10.5 fl oz	PHI = 21 days. Maximum of 10.5 fl oz per acre per season. Apply using one of the following methods: 1) Chemigation into root zone, 2) In-furrow spray at planting directed on or below seed; 3) In a narrow (2" or less) surface band over seed-line during planting incorporating to a depth of 1 to 1.5' with sufficient irrigation within 24 hours following applications, 4) In a narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, or 5) As a post-seeding drench, transplant drench or hill drench.
<b>imidacloprid</b> Enhance AW	refer to recommended label rate	5 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. Do not graze or feed livestock on treated area for 60 days after planting. Follow all applicable directions, restrictions and precautions on the EPA registered label. For control of early season aphids.
<b>imidacloprid</b> Mana Alias 4F	0.25 - 0.38	8.0 - 12.0 fl oz	PHI = 21 days. Maximum amount allowed per season 12 fl oz/acre/season. Apply using one of the following methods: 1) Chemigation into root zone, 2) In-furrow spray at planting directed on or below seed; 3) In a narrow (2" or less) surface band over seed-line during planting incorporating to a depth of 1 to 1.5' with sufficient irrigation within 24 hours following applications, 4) In a narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, or 5) As a post-seeding drench, transplant drench or hill drench.
<b>imidacloprid</b> Mana Alias 4F	0.044	1.4 fl oz	PHI = 7 days. Minimum interval between applications = 5 days. Maximum of 4.2 fl oz per acre (0.13 lb ai per acre) allowed per crop season.
<b>imidacloprid</b> Advise 2FL Nuprid 2F	see label	16 - 24 fl oz	PHI = 21 days. Maximum amount allowed per season 24 fl oz/acre/season. Apply using one of the following methods: 1) Chemigation into root-zone through low-pressure drip, trickle, microsprinkler or equivalent equipment, 2) In-furrow spray during planting directed on or below seed, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 In a narrow (2" or less) surface band over seed-line during planting incorporated to a depth of 1 to 1.5 inches with sufficient irrigation within 24 hours following application, 4) In a narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, or 5) As a post-seeding drench, transplant drench, or hill drench. Not for use on crops grown for seed unless allowed by state-specific supplemental labeling.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days. Do not graze livestock in treated area or harvest vines for forage or hay. Do not apply more than 0.12 lb ai per acre per season.
	<i>RUP</i>		
<b>lambda-cyhalothrin</b> Kaiso 24 WG	0.02 - 0.03	1.33 - 2.0 oz	
	<i>RUP</i>		
<b>lambda-cyhalothrin</b> Warrior II	0.02 - 0.03	1.28 - 1.92 fl oz	
	<i>RUP</i>		



<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	Aphids Grasshoppers 0.02 0- 0.025 Leafhoppers 0.017 - 0.025	Aphids Grasshoppers 3.2 - 4 fl oz Leafhoppers 2.72 - 4 fl oz	PHI = 21 days. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 5 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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# LUPINE

Lupine has been grown as a grain legume. One of the primary insect pests of lupine in North Dakota has been blister beetles. Most species of blister beetles have one generation per year. Adults emerge from the soil throughout the growing season (May through September), though periods of peak activity vary with the species. Most species are more abundant in July and August. Common blister beetle species that feed on lupine are the ash gray and black blister beetles. The larvae of most blister beetle species infesting legumes prey on grasshopper egg pods. Therefore, large populations of blister beetles are frequently associated with grasshopper outbreaks. Consequently, legumes grown near rangeland have a greater likelihood of blister beetle infestation.

## Insecticides approved for control of insect pests of Lupine.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0125 - 0.025	1.6 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock. Label include blister beetles, plant bugs, grasshoppers, and other insect pests. For pea aphid, use high rate of 3.2 fl oz/acre for pest suppression only.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 3 days. Do not apply more than 0.266 lb ai per acre per season. Do not make applications less than 5 days apart.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.050	1.6 - 3.2 fl oz	PHI = 7 days. Maximum of 6.4 fl oz per acre per season. Maximum of 3.2 fl oz per acre between 14-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. Do not feed treated vines or hay to livestock.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 21 days. Label includes aphid, blister beetle, grasshopper, cutworm and others. Proaxis may be used to control grasshoppers in bordering, non-crop areas that are not hayed or grazed.
<b>imidacloprid</b> Admire Pro  Controls aphids and leafhoppers only	0.25 - 0.38	7.0 - 10.5 fl oz	PHI = 21 days. Maximum of 10.5 fl oz per acre per season. Apply using one of the following methods: 1) Chemigation into root zone, 2) In-furrow spray at planting directed on or below seed; 3) In a narrow (2" or less) surface band over seed-line during planting incorporating to a depth of 1 to 1.5' with sufficient irrigation within 24 hours following applications, 4) In a narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, or 5) As a post-seeding drench, transplant drench or hill drench.
<b>imidacloprid</b> Attendant 600 Senator 600	refer to recommended label rate	1.6 - 3.2 fl oz per cwt of seed	Apply as a commercial seed treatment. Follow all applicable directions, restrictions and precautions on the EPA registered label. For control of early season aphids and wireworms.
<b>imidacloprid</b> Enhance AW	refer to recommended label rate	5 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. Do not graze or feed livestock on treated area for 60 days after planting. Follow all applicable directions, restrictions and precautions on the EPA registered label. For early season control of aphids and wireworms.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>imidacloprid</b> Advise 2FL Nuprid 2F	see label	16 - 24 fl oz	PHI = 21 days. Maximum amount allowed per season 24 fl oz/acre/season. Apply using one of the following methods: 1) Chemigation into root-zone through low-pressure drip, trickle, microsprinkler or equivalent equipment, 2) In-furrow spray during planting directed on or below seed, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 In a narrow (2" or less) surface band over seed-line during planting incorporated to a depth of 1 to 1.5 inches with sufficient irrigation within 24 hours following application, 4) In a narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, or 5)As a post-seeding drench, transplant drench, or hill drench. Not for use on crops grown for seed unless allowed by state-specific supplemental labeling.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.056 - 0.066	2.4 - 2.8 fl oz	PHI = 7 days. Minimum interval between applications = 14 days. Do not apply more than 6.4 fl oz per acre per season (0.05 lb ai beta-cyfluthrin, 0.10 lb ai imidacloprid). Do not feed treated vines or hay to livestock.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 21 days. Label includes aphid, grasshopper, cutworm and others. Warrior may be used to control grasshoppers in bordering, non-crop areas that are not hayed or grazed. Do not apply more than 0.12 lb ai per acre per season.
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.05 - 0.09	5.0 - 9.0 fl oz	PHI = 21 days. Apply as required by scouting, usually at 5 day or more intervals. Use minimum of 10 GPA by ground and minimum 5 GPA by air. Do not apply more than 31 oz per acre per year. Do not graze livestock in treated areas or harvest vines for forage or hay.
<b>methoxyfenozide</b> Intrepid 2F	0.06-0.12	4-8 fl oz for early season applications	PHI = 7 days. Do not make applications less than 7 days apart. Do not make more than 4 applications per calendar year. Do not apply more than 64 fl oz per acre per calendar year.
Controls armyworms only	0.12-0.25	8-16 fl oz for mid-to late-season applications	
<b>spinosad (microbial)</b> Success	0.047 - 0.094	3 - 6 fl oz	PHI = 28 days. Do not apply more than a total of 12 fl oz per acre per season.. <b>For control of armyworms, corn borer, loopers, leafminers and thrips only.</b> Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC <i>RUP</i>	0.017 - 0.025	2.72 - 4 fl oz	PHI = 21 days. Label includes aphid, blister beetle, grasshopper, cutworm and others.

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## MUSTARD INSECTS

Yellow mustard (*Sinapis alba*) is the most common type grown in North Dakota; small acreages of brown and Oriental (*Brassica juncea*) are also being grown. These mustards are grown for the seed and used as a condiment. Insects that affect canola may also affect mustard grown for seed. Fortunately, these insects have not caused serious problems for mustard seed on an annual basis.

### FLEA BEETLES

Mustard grown for seed has generally not been at risk to significant flea beetle feeding injury. However, circumstances can develop that put mustard seedlings at greater risk.

This crop has demonstrated greater tolerance to flea beetle feeding and is less attractive to the beetles when canola is available. However, if delays in emergence (*cold soils, mid-May snows, etc.*) of all mustards occurs, particularly canola, mustard plants may also be vulnerable. If canola is not available to attract beetles, mustard plants may attract beetles in large numbers and put the crop at greater risk of stand loss. Once the crop advances beyond the seedling stage, serious damage usually does not occur, since vigorously growing mustard can outgrow the beetle defoliation. No major effects on plant vigor have been noted from the feeding of the larvae on plant roots.

Insecticides are not generally available for use in mustard seed production. Insecticides for mustard greens are numerous, but are not permitted for use in mustard seed. Insecticides labeled for canola are not approved for use in mustard grown for seed. It is hoped that efforts underway to address insecticide availability for this crop will be successful.

In December 2003, the insecticide **seed treatment** Gaucho 600 was labeled for use on mustard grown for seed. As with canola, mustard seed growers now have an insecticide option that can provide some early season protection from flea beetle feeding, but they must plan on this approach as they acquire planting seed in the winter.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate		Apply as a commercial seed treatment or for end-use at agricultural establishments (total slurry treater, farmer applied seed treater). To provide early season protection of seedlings against injury by aphids, flea beetles and wireworms. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Gaucho 600		10.24 - 25.6 fl oz per hundredweight of seed	For use in commercial seed treaters only. The label does <b>NOT</b> allow for use in hopper-box, slurry-box or other seed treatment applications at, or immediately before, planting for mustard. Provides protection from flea beetle feeding injury. Rates can be varied depending on assessment of flea beetle risk based on population size observed.
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.025	4 fl oz	PHI = 7 days. Do not apply more than 0.15 pounds ai per acre per season. Do not make applications less than 7 days apart.

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## OATS INSECTS

**Other Resources Available Through NDSU Extension Service:**

Publications	E493	Aphid Management in Small Grains, Corn and Sorghum (1993)
	E830	The Armyworm and the Army Cutworm (2000)
	E1230	Cereal Leaf Beetle Management (2002)
	PP680	Wheat Stem Infesting Insects in North Dakota (1989)
	E1007	Biology and Management of Barley Thrips (1991)
	E272	Grasshopper Management (1997)
	E188	Wireworm Control (2001)

### APHID

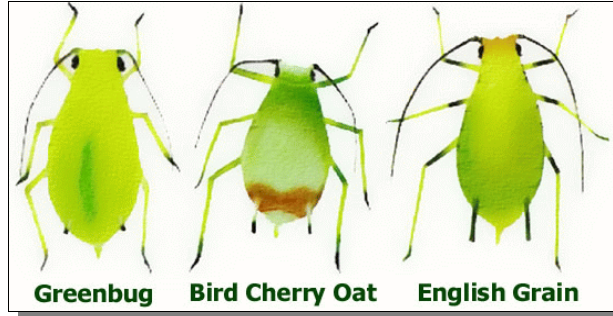
**Small Grain Aphid descriptions:**

**Greenbug** - pale green with darker stripe down back.

**Bird Cherry Oat Aphid** - olive green, brownish patch at the base of cornicles.

**English Grain Aphid** - bright green with long black cornicles.

The greenbug, English grain aphid and bird cherry oat aphids are the principle species that cause problems in North Dakota small grains. None of these aphids are known to overwinter in North Dakota; they migrate to the region from the South in late spring. The greenbug is the most injurious because it injects a toxin with its saliva during feeding. The English grain aphid is the most common aphid seen in small grains. Its population grows rapidly when feeding on wheat heads. The bird cherry oat aphid feeds primarily on leaves in the lower part of the small grain plant. These aphids transmit barley yellow dwarf virus. When aphid populations are high, the disease can spread through small grain fields. At greatest risk are later planted fields which attract migrating aphids that are moving from more mature fields.



**Thresholds for Small Grains: English Grain, Bird Cherry Oat, Greenbug**

To protect small grains from yield loss due to aphid feeding, the treatment threshold is 85% stems with more than one aphid present or 12-15 aphid per stem, prior to complete heading. Field scouting should begin at stem elongation and continue up to the heading stage of wheat. Aphid populations at or above the thresholds during these growth stages will result in economic injury to plants.

The greatest risk of yield loss from aphids feeding on grains is in the vegetative to boot stages. Significant yield reductions after the onset of flowering could not be demonstrated in research published from South Dakota in 1997 (Voss et al., 1997. J of Economic Entomology 90: 1346-1350). Reasons for these conclusions were that: after heading the only major yield component aphids can affect is seed weight; aphids are unable to sustain the very large populations necessary to achieve significant impact on this factor. Other components of yield are determined earlier (number of spikelets - determined at jointing; number of seeds - determined at flowering).

**Russian Wheat Aphid (RWA):**

15% to 20% of tillers infested up to flowering; 20+% infested tillers from flowering to early milk stage

**Note:** A tiller is infested whether it has one or several RWA present. RWA have only been found in southwest North Dakota during late summer; no economic damage has been reported. No RWA have been reported in North Dakota since the early '90s. Occasionally, RWA have overwintered during mild winters in Montana.

**Natural Controls:**

Lady beetles, aphid lions, syrphid fly, and parasitic wasps play a major role in reducing aphid populations. When natural enemies are present in large numbers, and the crop is well developed, farmers are discouraged from spraying fields.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.014 - 0.019	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing interval = 3 days. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre per 3 day interval. Minimum application volume of 10 GPA by ground and 2 GPA by air.
<b>fenpropathrin</b> Danitol 2.4 EC <b>PENDING 2009</b> <i>RUP</i>	0.2	10 2/3 fl oz	Apply as a ground application in a minimum of 5 gallons of water per acre. Make a single application in the pre-boot stage. Do not exceed 0.2 lb ai per acre per season. PHI = 14 days.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate	0.8 - 2.4 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> Enhance AW	refer to recommended label rate	4 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. 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>lambda-cyhalothrin</b> Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Kaiso 24WG <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>malathion</b> Malathion 5	0.9	1.5 pts	PHI = 7 days. Do not apply below 60° F.
<b>malathion</b> Malathion 57EC	0.9 - 1.25	1.5 - 2 pts	
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225 - 0.45	12 - 24 fl oz	PHI = 7 days or feed treated forage within 10 days of application. Do not apply more than 6 pints (96 fl oz) per acre per season. Do not make more than 4 applications per crop per season.
<b>methomyl</b> Lannate SP <i>RUP</i>	N/A	0.25 - 0.5 lb	PHI = 7 days or feed treated forage within 10 days of application. Do not apply more than 2 lbs per acre per season. Do not make more than 4 applications per crop per season.
<b>methyl parathion</b> Cheminova Methyl 4EC <i>RUP</i>	0.25 - 0.75	8 - 24 fl oz	PHI = 15 days of harvest or grazing. To avoid injury to bees, do not apply during pollen shed if bees are visiting the areas to be treated during foraging hours. Do not enter treated fields within 48 hours after application.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 0.75	32 - 48 fl oz	

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## ARMYWORMS

Armyworm outbreaks in North Dakota can occur when large migrations of moths from Southern states occur in late spring and early summer. Moths prefer to lay eggs in moist, shady areas where small grains or grasses have lodged or been damaged by hail or wind. Armyworms feed at night and hide under vegetation or in loose soil during the day. To scout for armyworms in grains, part the plants and inspect the soil for fecal pellets. If pellets or feeding damage is found, look for larvae under plant trash, soil clods or in soil cracks.

### Threshold for Small Grains:

Treat when 4 to 5 or more worms per square foot are present.

### Migrating Armyworms:

Treat a couple of swaths ahead of the infestation in the direction of movement to form a barrier strip.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.014 - 0.019	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing interval = 3 days. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre per 3 day interval. Minimum application volume of 10 GPA by ground and 2 GPA by air.
<b>lambda-cyhalothrin</b> Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Kaiso 24WG <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>malathion</b> Malathion 57EC	1.25	2 pts	PHI = 7 days. Do not apply below 60° F.
<b>malathion</b> Malathion 5	1.25	2 pts	
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225 - 0.45	12 - 24 fl oz	PHI = 7 days or feed treated forage within 10 days of application. Do not apply more than 6 pts (96 fl oz) per acre per season. Do not make more than 4 applications per crop per season.
<b>methomyl</b> Lannate SP <i>RUP</i>	N/A	0.25 - 0.5 lb	PHI = 7 days or feed treated forage within 10 days of application. Do not apply more than 2 lbs per acre per season. Do not make more than 4 applications per crop per season.
<b>methyl parathion</b> Cheminova Methyl 4EC <i>RUP</i>	0.25	8 fl oz	PHI = 15 days. Do not enter treated fields within 48 hours after methyl parathion application.
<b>methyl parathion</b> Methyl parathion 8EC <i>RUP</i>	0.5	8 fl oz	
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 0.75	2 - 3 pts	
<b>spinosad (microbial)</b> Entrust	0.05 - 0.1	1 - 2 oz	Do not apply more than 5.6 oz (0.28 lb a.i.) per acre per season. PHI = 21 days for grain and straw harvest or within 14 days of forage or hay harvest.
<b>spinosad (microbial)</b> Success	0.047 - 0.094	3 - 6 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest. Do not apply more than a total of 19 fl oz per acre per season. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>spinosad (microbial)</b> Tracer	0.031 - 0.094	1 - 3 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest.
<b>spinetoram</b> Radiant SC	0.023 - 0.047	3 - 6 fl oz	PHI = 21 days for grain or straw harvest or within 3 days of forage, fodder or hay harvest. Do not apply more than 18 fl oz (0.141 lb ai spinetoram) per acre per year. Do not make more than 3 applications in one calendar year. Do not make applications less than 4 days apart.

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## CEREAL LEAF BEETLE

The cereal leaf beetle is an imported insect pest from Europe. This insect has just been found in **Williams and McKenzie counties of North Dakota**. It was first detected in Michigan in 1962, Utah in 1984, and Montana in 1989. The cereal leaf beetle is a serious pest of barley and wheat in Montana. Both adults and larvae of the cereal leaf beetle damage grain crops through their foliar feeding. The larvae are the most damaging stage and the target of control measures. Generally, the newer plant tissue is preferred with feeding occurring on the upper leaf surface causing characteristic elongated slits.

### Monitoring and Treatment Threshold:

The first sign of CLB activity in the spring is adult feeding damage on the plant foliage. While this is the first sign of adult activity, adults are not the target of control. Eggs and larvae are monitored by plant inspection since thresholds are expressed as egg and larvae numbers per plant or per stem. Examine 10 plants per location and select 1 location for every 10 acres of field. Count number of eggs and larvae per plant (small plants) or per stem (larger plants) and get an average number of eggs and larvae, based on the samples you have taken.

Boot stage is a critical point in plant development and impact of cereal leaf beetle feeding damage can be felt on both yield and grain quality. **Before boot stage**, the threshold is: three 3 eggs and larvae or more per plant (including all the tillers present before the emergence of the flag leaf). Larvae feeding in early growth stages can have a general impact on plant vigor. When the flag leaf emerges, feeding is generally restricted to the flag leaf which can significantly impact grain yield and quality. The threshold is decreased **at the boot stage** to: 1 larvae or more per flag leaf.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.008 - 0.014	1.0 - 1.8 fl oz	PHI = 30 days. Pre-grazing interval = 3 days. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre per 3 day interval. Minimum application volume of 10 GPA by ground and 2 GPA by air.
<b>diflubenzuron</b> Dimilin 2L <i>RUP</i>	0.0625	4 fl oz	<b>For use only west of US highway 281.</b> Do not apply within 25 feet by ground or 150 feet by air of bodies of water. Applications must include a 25 foot vegetative buffer strip to limit runoff. Use 5 to 15 GPA total volume by ground, 3 to 5 GPA total volume by air. PHI = 50 days for grain harvest, 15 days for hay harvest, or 3 days for forage harvest. Do not exceed 4 fl oz per acre per season. Do not make more than 1 application per season.
<b>fenpropathrin</b> Danitol 2.4 EC <b>PENDING 2010</b> <i>RUP</i>	0.2	10 2/3 fl oz	Apply as a ground application in a minimum of 5 gallons of water per acre. Make a single application in the pre-boot stage. Do not exceed 0.2 lb ai per acre per season. PHI = 14 days.
<b>lambda-cyhalothrin</b> Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Kaiso 24WG <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>malathion</b> Malathion 5EC	0.6-1.25	1 - 2 pt	PHI = 7 days for grain or to graze. Treatment is most effective at temperatures over 70° F.
<b>malathion</b> Fyfanon ULV	0.3-0.6	4 - 8 oz	
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225-0.45	0.75 - 1.5 pt 0.25 - 0.5 lbs	PHI = 7 days, or 10 day to graze. There is a 24-hour re-entry interval.



INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>methomyl</b> Lannate SP <i>RUP</i>	N/A	0.25 - 0.5 lb	PHI = 7 days or feed treated forage within 10 days of application. Do not apply more than 2 lbs per acre per season. Do not make more than 4 applications per crop per season.
<b>spinosad (microbial)</b> Entrust	0.025 - 0.1	0.5 - 2 oz	Do not apply more than 5.6 oz (0.28 lb a.i.) per acre per season. PHI = 21 days for grain and straw harvest or within 14 days of forage or hay harvest.
<b>spinosad (microbial)</b> Success	0.031 - 0.094	2 - 6 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest. Do not apply more than a total of 19 fl oz per acre per season.. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>spinosad (microbial)</b> Tracer	0.031 - 0.094	1 - 3 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest.
<b>spinetoram</b> Radiant SC	0.016 - 0.047	2 - 6 fl oz	PHI = 21 days for grain or straw harvest or within 3 days of forage, fodder or hay harvest. Do not apply more than 18 fl oz (0.141 lb ai spinetoram) per acre per year. Do not make more than 3 applications in one calendar year. Do not make applications less than 4 days apart.

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## CUTWORMS

Several cutworm species affect regional crops. In western North Dakota, the pale western and the army cutworms are important pests of small grains. Eggs of pale western hatch in the spring and larvae feed underground. Eggs of the army cutworm hatch in the fall and spring feeding is above ground. In eastern North Dakota, the Dingy cutworm, *Feltia jaculifera*, overwinters as a partially grown larva and is one of the first cutworm species to cause problems during crop emergence from early to mid-May. The moth of the dingy cutworm is known to lay her eggs on sunflower heads from mid-July through September. Crops following sunflowers in rotation are at greatest risk of injury by this cutworm. Other cutworms, the red-backed, *Exoa ochregaster*, and the darksided, *Exoa messoria*, overwinter as eggs which hatch in mid to late May. Eggs are laid in the fall and survive in weedy, wet, and reduced-tillage areas. Feeding injury by these cutworms normally occurs in late May to early June.

### Management and Thresholds in Small Grains:

Treatment is recommended when cutworms number 4 to 5 per square foot.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.008 - 0.014	1.0 - 1.8 fl oz	PHI = 30 days. Pre-grazing interval = 3 days. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre per 3 day interval. Minimum application volume of 10 GPA by ground and 2 GPA by air.
<b>lambda-cyhalothrin</b> Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Kaiso 24WG <i>RUP</i>	0.015 - 0.025	1 - 1.67 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>methyl parathion</b> Cheminova Methyl 4EC <i>RUP</i>	0.375 - 0.5	12 - 16 fl oz	PHI = 15 days

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## GRASSHOPPERS

In the Northern Plains, grasshopper egg hatch normally begins in late April to early May. Peak hatch occurs about mid-June. Heavy infestations typically occur in areas of low rainfall or during drought years. Outbreaks are usually preceded by several years of hot, dry summers and warm falls. Cool, wet weather increases disease occurrence and delays development of grasshoppers, reducing the overall population.

### Cultural Control Methods:

- Early seeding** - Allows for early establishment and vigorous growth of plants.
- Crop rotation** - Avoid planting in areas of high egg deposits. Fields with late-maturing crops or green plant cover attract adults which then lay eggs.
- Tillage** - Summer fallow will act as a trap crop, attracting females for egg laying. Spring tillage of these sites will reduce successful emergence of nymphs.

**Grasshopper Thresholds: Infestation Ratings:** The threatening rating is considered the action threshold for grasshoppers. 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+

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.014 - 0.019	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing interval = 3 days. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre per 3 day interval. Minimum application volume of 10 GPA by ground and 2 GPA by air.
<b>diflubenzuron</b> Dimilin 2L <i>RUP</i>	0.031	2 fl oz	<b>For use only west of US highway 281.</b> Do not apply within 25 feet by ground or 150 feet by air of bodies of water. Applications must include a 25 foot vegetative buffer strip to limit runoff. Use 5 to 15 GPA total volume by ground, 3 to 5 GPA total volume by air. PHI = 50 days for grain harvest, 15 days for hay harvest, or 3 days for forage harvest. Do not exceed 4 fl oz per acre per season. Do not make more than 1 application per season.
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate	1.2 - 2.4 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.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>lambda-cyhalothrin</b> Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Kaiso 24WG <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 7 days of treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>malathion</b> Malathion 57EC	0.9 - 25	1.5 - 2 pts	PHI = 7 days. No time limitation on grazing or straw for dairy or slaughter animals. Treatment is most effective at temperatures over 70° F.
<b>malathion</b> Fyfanon ULV	0.6	8 oz	PHI = 7 days.
<b>methyl parathion</b> Cheminova Methyl 4EC <i>RUP</i>	0.5	1 pt	PHI = 15 days. Do not enter fields for 48 hrs after application.
<b>methyl parathion</b> Penncap-M <i>RUP</i>	0.5 - 0.75	2 - 3 pts	
<b>spinosad (microbial)</b> Entrust (suppression only)	0.05 - 0.1	1 - 2 oz	Do not apply more than 5.6 oz (0.28 lb a.i.) per acre per season. PHI = 21 days for grain and straw harvest or within 3 days of forage or hay harvest.
<b>spinosad (microbial)</b> Tracer (suppression only)	0.047 - 0.094	1.5 - 3 fl oz	Do not apply more than 9 fl oz (0.28 lb ai) per acre per season. PHI = 21 days of grain or straw harvest or within 3 days of forage or hay harvest.
<b>spinetoram</b> Radiant SC (suppression only)	0.023 - 0.047	3 - 6 fl oz	PHI = 21 days for grain or straw harvest or within 3 days of forage, fodder or hay harvest. Do not apply more than 18 fl oz (0.141 lb ai spinetoram) per acre per year. Do not make more than 3 applications in one calendar year. Do not make applications less than 4 days apart.

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## POTATO INSECTS

Other resources available through NDSU Extension Service:

Publications	E1001	Potato Leafhopper Biology and Control
	EB No. 26	Potato Production and Pest Management in North Dakota and Minnesota
Video	282	Potato Production in the Red River Valley

### APHIDS

Aphids are major pests of seed potatoes because they transmit viruses which lead to rejection of the seed lot. For this reason, seed producers must keep aphid numbers lower than what can be tolerated on table stock. The most common aphid found on potato is the green peach aphid, an important vector of potato leaf roll virus (PLRV). Many aphids can transmit potato virus Y (PVY). Control measures are targeted specifically against aphids to keep virus spread to a minimum in seed production; control is not as common in normal commercial production.

**Threshold:**

**Seed Stock** . . . To prevent the spread of PLRV, treat when aphid populations reach levels of 10 aphids per 100 leaves. Insecticides will not effectively prevent the spread of PVY.

**Table Stock** . . . To prevent a yield loss from direct feeding by aphids, treat when aphid densities reach 30 aphids per 100 leaves. Sample only middle to lower leaves; aphids will rarely be found on young leaves.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acetamiprid</b> Assail 30SG	0.028 - 0.075	1.5 - 4.0 oz	Use high rate under heavy pest pressures or dense foliage. Aphid species may differ in susceptibility to this product. If you are unsure of the aphid species present and its susceptibility, use the higher rate. Do not make more than 4 applications per season. Do not apply more than once every 7 days. Do not apply less than 7 days before harvest. Do not exceed a total of 0.3 lb ai (16 fl oz) per acre per season. Apply a minimum of 5 GPA of water by air and 20 GPA of water by ground. Thorough coverage is important to obtain optimum control. There are no rotational crop plantback restrictions.
Assail 70WP	0.044 - 0.075	1.0 - 1.7 oz	
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.022	2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 21 days. Do not make applications less than 21 days apart. Do not apply more than 0.2 lb ai per acre per season. Leaves cannot be used for food or feed.
<b>bifenthrin + imidacloprid</b> Brigadier <i>RUP</i>	0.075 - 0.096	4.8 - 6.14 fl oz	PHI = 21 days. Allow 7 days between applications. Maximum use rate of 25.6 fl oz total per season. An adjuvant, MSO, NIS, or COC may be tank-mixed.
<b>clothianidin</b> Belay 2.13SC	Foliar: 0.033 - 0.05  In-furrow or side dress: 0.15 - 0.2	Foliar: 2 - 3 fl oz  In-furrow or side dress: 9 - 12.0 fl oz  Seed treatment: 0.4 - 0.6 fl oz/cwt depending on seeding rate	Foliar: PHI = 14 days. Do not apply more than 8.4 fl oz per acre per season. Do not apply treatments less than 7 days apart.  Soil Application: Apply once at planting or as a side-dress during hilling using one of the following methods: 1) In a narrow band center on the plant row in the bedding operation just prior to planting, 2) In-Furrow spray at planting. Direct spray in the furrow on the seed pieces or potatoes. 3) As a side dress to both sides of the row or as a spray at ground crack directly over the row during hilling. Cover immediately with soil. Do not apply more than 0.2 lb ai (12 fl oz) per acre per season (one application).

Potato

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.044	2.8 fl oz  (pest suppression)	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.018 - 0.028	1.5 - 2.4 fl oz (suppression)	PHI = 3 days. Allow 3 days between applications. Do not apply more than 12.0 fl oz per acre per season.
<b>dimethoate</b> Digon 400 Dimethoate 400 Dimethoate 2.67 EC	0.38 - 0.75	¾ - 1½ pt	No preharvest interval. Do not enter treated fields without protective clothing until sprays have dried.
<b>dinotefuran</b> Venom 70 SG	0.050 - 0.075  0.28 - 0.33	FOLIAR: 1 - 1.5 fl oz  SOIL: 6.5 + 7.5 fl oz	Foliar Application: PHI = 7. Do not apply more than 4.5 fl oz per acre per season. Soil Application: Apply once at preplant, preemergence or at ground cracks using one of the following methods: 1) In a narrow band center on the plant row in the bedding operation just prior to planting, 2) In-Furrow spray at planting. Direct spray in the furrow on the seed pieces or potatoes. 3) As a side dress to both sides of the row or as a spray at ground crack directly over the row during hilling. Cover immediately with soil. Do not apply more than 12 fl oz per acre per season.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Do not graze livestock on treated vines.
<b>flonicamid</b> Beleaf	0.036 - 0.089	1.2 - 2.8 fl oz	PHI = 7 days. Use lower rates for building populations and/or up to 7 day residual control. Use higher rates for greater populations, dense foliage, and/or up to 14 days residual control. Do not apply more than 8.4 fl oz per acre per season. Do not apply more than 2.8 fl oz per acre per application. Do not apply more than 3 applications per season. Allow a minimum of 7 days between applications. Use a minimum of 10 GPA by ground and 3 GPA by air. If green peach aphid is present, use higher rates.
<b>imidacloprid</b> Admire Pro	refer to label	5.7 - 8.7 fl oz (depending on row-spacing)  0.17 - 0.35 fl oz/cwt (seed piece treatment)	Apply in one of the following methods: 1. In-furrow spray during planting directed on seed pieces or seed potatoes, 2. Subsurface side-dress on both sides of the row covered with 3 or more inches of soil, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, 4) Narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, 5) seed piece treatment. There is a 12 month plant-back restriction for all crops not registered.
<b>imidacloprid</b> Mana Alias 4F	0.125 - 0.25	4.0 - 8.0 fl oz or 0.2 - 0.4 fl oz/cwt	Apply in one of the following methods: 1. In-furrow spray during planting directed on seed pieces or seed potatoes, 2. Subsurface side-dress on both sides of the row covered with 3 or more inches of soil, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, 4) Narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting. There is a 12 month plant-back restriction for all crops not registered.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>imidacloprid</b> Mana Alias 4F	0.048	1.52 fl oz	Broadcast or directed foliar spray. PHI = 7 days. Minimum interval between applications = 7 days. Maximum of 6.4 fl oz per acre (0.2 lb ai per acre) allowed per crop season when making foliar applications.
<b>imidacloprid</b> Advise 2FL Nuprid 2F	0.20 - 0.31	13 - 20 fl oz or 0.9 - 1.3 fl oz / 1,000 row-feet	Maximum amount allowed per season 20 fl oz/acre/season. Apply using one of the following methods: 1) In-furrow spray during planting directed on seed pieces or seed potatoes, 2) Subsurface side-dress on both sides of the row covered with 3 or more inches of soil; 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, or 4) Narrow band directly below the eventual seed row in a bedding operation 4 or fewer days before planting.
<b>imidacloprid</b> Nuprid 1.6F	0.048	3.8 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum amount allowed per season 15 fl oz/acre/season. May be applied through properly calibrated ground, aerial or chemigation application equipment.
<b>imidacloprid</b> Provado 1.6F	0.047	3.8 fl oz	A total of 16 fl. oz. (0.2 lb active ingredient) per acre per season may be applied as a foliar spray. There is a 12 month plant-back restriction for all crops not registered. PHI = 7 days.
<b>imidacloprid + beta- cyfluthrin</b> Leverage 360 <i>RUP</i>	0.066	2.8 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Do not apply more than 12.8 fl oz per acre per season (0.1 lb ai beta-cyfluthrin, 0.2 lb ai imidacloprid). Leverage 360 can be applied through calibrated ground, aerial, or chemigation equipment.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Do not apply more than 0.12 lb ai per acre per season. Do not apply within 7 days of harvest.
<b>lambda-cyhalothrin</b> Kaiso 24WG <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Do not apply more than 0.12 lb ai per acre per season. Do not apply within 7 days of harvest.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.020 - 0.029 + 0.039 - 0.059	6 - 9 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai of lambda-cyhalothrin containing products per acre per season or more than 0.216 lb ai of chlorantraniliprole containing products per acre per season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 5 GPA for aerial application.
<b>lambda-cyhalothrin + thiamethoxam</b> Endigo ZC <i>RUP</i>	0.028 - 0.031 + 0.037 - 0.041	4 - 4.5 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai per acre per season of lambda-cyhalothrin containing products or more than 0.094 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or less than 3 GPA for aerial applications
<b>malathion</b> Malathion 57 EC	0.66 - 1	1.0 - 1.5pts.	PHI = 0 days.
<b>methamidophos</b> Monitor <i>RUP</i>	0.75 - 1	1.5 - 2 pts	PHI = 14 days.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>methomyl</b> Lannate LV <i>RUP</i>	0.5 - 1	1.5 - 3 pts	PHI = 6 days. Field re-entry interval is 1 day.
<b>oxamyl</b> Vydate L <i>RUP</i>	0.5 - 1	2 - 4 pts	PHI = 7 days.
<b>permethrin</b> Ambush 2E Arctic 3.2EC Pounce 3.2EC Permethrin 2EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.05 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2	3.2 - 12.8 fl oz 4 - 8 fl oz 4 - 8 fl oz 4 - 8 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 14 days. Do not feed vines to livestock. Do not apply more than 1.6 pounds ai per acre per season.
<b>phorate</b> Thimet 20 G <i>RUP</i>		11.3 oz/1,000 ft of row (light or sandy soils); 17 oz/1,000 ft of row (heavy or clay soils)	Band application at planting. PHI = 90 days. Do not apply more than one application of Thimet 20-G per crop season.
<b>pymetrozine</b> Fulfill	0.086	2.75 - 5.5 oz	PHI = 14 days. Do not apply more than 11 oz of Fulfill per acre per season. Allow 7 days between applications.
<b>spirotetramat</b> Movento	0.06 - 0.08	4 - 5 fl oz	PHI = 7 days. Minimum of 7 days between applications. Maximum of 10 fl oz per acre per season.
<b>thiamethoxam</b> Actara	0.047	3 fl oz	Control may require the use of 2 applications made at 7 to 10 day intervals. PHI = 14 days. Use sufficient water volume to ensure thorough coverage. Do not use less than 10 GPA for ground or 5GPA by air. Actara may be applied by chemigation. Do not apply more than 6 oz per acre per season.
<b>thiamethoxam</b> Platinum 2SC	0.078 - 0.125	5 - 8 fl oz	Soil application; see label for complete details. May be applied as: in-furrow during planting; impregnated on dry granular fertilizer before or during planting; or at plant emergence as a direct spray and incorporated into the soil with overhead irrigation within 24 hours. Only 1 soil application per season and do not exceed 0.125 lb AI/acre per season.
<b>thiamethoxam</b> Platinum 75SG	0.078 - 0.125	1.66 - 2.67	
<b>thiamethoxam</b> Platinum Ridomil Gold	0.095 - 0.121	2.2 fl oz / 1000 ft row	Product per acre is determined by the row spacing; see label for further discussion. This product includes the fungicide mefenoxam for control of <i>Pythium</i> seedling disease and pink rot.
<b>thiamethoxam + chlorantraniliprole</b> Voliam flexi	0.047	4 oz	PHI = 14 days. Do not exceed a total of 8 oz or 0.094 lb ai of thiamethoxam containing foliar products or 0.2 lb ai of chlorantraniliprole containing products per acre per growing season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or 5 GPA for aerial applications.
<b>zeta-cypermethrin</b> Mustang Max EC Respect <i>RUP</i>	0.020 - 0.025	3.2 - 4 fl oz	PHI = 1 day. Do not apply more than 0.15 lb AI per acre per season. Do not make applications less than 4 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## CABBAGE LOOPER

Many different defoliating insects can be found on potatoes. Potatoes are relatively tolerant of some defoliation, especially if the attack is not sustained. The cabbage looper is a light green caterpillar with white or pale yellow stripes down the side. They have only three pair of fleshy prolegs, causing them to loop when moving forward.

### Threshold:

Normal populations seldom reach economically significant levels in North Dakota.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0125 - 0.022	1.6 - 2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 21 days. Do not make applications less than 21 days apart. Do not apply more than 0.2 lb ai per acre per season. Leaves cannot be used for food or feed.
<b>chlorantraniliprole</b> Coragen	0.045 - 0.065	3.5 - 5.0 fl oz	PHI = 14 days. REI = 4 hours. Do not apply more than 15.4 fl oz (0.2 lbs ai) per acre per season. Minimum interval between treatments is 5 days. Minimum application volume is 10 GPA by ground and 5 GPA by air.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.044	1.6 - 2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.028	1.0 - 2.4 fl oz	PHI = 3 days. Allow 3 days between applications. Do not apply more than 12.0 fl oz per acre per season. For best control apply to 1 <sup>st</sup> and 2 <sup>nd</sup> instar larvae.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Do not feed vines to livestock.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.066	2.8 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Do not apply more than 12.8 fl oz per acre per season (0.1 lb ai beta-cyfluthrin, 0.2 lb ai imidacloprid). Leverage 360 can be applied through calibrated ground, aerial, or chemigation equipment.
<b>indoxacarb</b> Avaunt	0.045 - 0.11	2.5 - 6.0 fl oz	PHI = 7 days. Do not apply more than 24 fl oz (0.44 lb ai) per acre per season. Minimum interval between sprays is 5 days.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Do not apply more than 0.12 lb ai per acre per season. Do not apply within 7 days of harvest.
<b>lambda-cyhalothrin</b> Kaiso 24WG <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Do not apply more than 0.12 lb ai per acre per season.
<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>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.020 - 0.029 + 0.039 - 0.059	6 - 9 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai of lambda-cyhalothrin containing products per acre per season or more than 0.216 lb ai of chlorantraniliprole containing products per acre per season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 5 GPA for aerial application.
<b>lambda-cyhalothrin + thiamethoxam</b> Endigo ZC <i>RUP</i>	0.021 - 0.028 + 0.028 - 0.037	3 - 4 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai per acre per season of lambda-cyhalothrin containing products or more than 0.094 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or less than 3 GPA for aerial applications
<b>methamidophos</b> Monitor <i>RUP</i>	0.75 - 1	1.5 - 2 pts	PHI = 14 days.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.3	1.5 pts	Do not harvest within 6 days. Do not apply more than 4.5 lb ai per acre per crop. REI = 48 hours.
<b>novaluron</b> Rimon	0.05 - 0.0778	9 - 12 fl oz	PHI = 14 days. Do not apply more two applications per crop per season or 24 oz. per acre per season. Re-application on a 7 to 14 days interval will be required to protect new growth.
<b>permethrin</b> Ambush 2E Arctic 3.2EC Pounce 3.2EC Permethrin 2EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.05 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2	3.2 - 12.8 fl oz 4 - 8 fl oz 4 - 8 fl oz 4 - 8 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 14 days. Do not feed vines to livestock. Do not apply more than 1.6 pounds ai per acre per season.
<b>spinosad (microbial)</b> Success	0.071 - 0.094	4.5 - 6 fl oz	PHI = 7 days. Do not apply more than a total of 21 fl oz per acre per season.. Do not make applications less than 7 days apart or apply more than 4 times per crop. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>spinetoram (microbial)</b> Radiant SC	0.047 - 0.063	6 - 8 fl oz	PHI = 7 days. Do not apply more than 32 fl oz (0.250 lb ai spinetoram) per acre per season. Do not make more than 4 applications per season. Do not make applications less than 7 days apart.
<b>thiamethoxam + chlorantraniliprole</b> Voliam flexi	0.047	4 oz	PHI = 14 days. Do not exceed a total of 8 oz or 0.094 lb ai of thiamethoxam containing foliar products or 0.2 lb ai of chlorantraniliprole containing products per acre per growing season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or 5 GPA for aerial applications.
<b>zeta-cypermethrin</b> Mustang Max EC Respect <i>RUP</i>	0.011 - 0.025	1.76 - 4 fl oz	PHI = 1 day. Do not apply more than 0.15 lb AI per acre per season. Do not make applications less than 4 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## COLORADO POTATO BEETLE

This beetle is the most common and destructive leaf feeding pest of potato. Both adults and larvae feed on foliage. The adult is 3/8 inch long, with oval body and a yellow-brown color with 5 black stripes on each wing cover. The larvae are 1/8 to 3/8 inch long, brick red to light orange in color. Eggs are laid on the underside of leaves in clusters of 10 to 30 and are orange colored when ready to hatch.

In North Dakota, overwintered beetles emerge from May to June. The first-generation larvae are present in the fields from June through July. Beetles from these larvae appear in fields in July, feeding and laying eggs for a second generation.

One of the greatest concerns with management programs for beetles is resistance to insecticides. The best way to manage the development of resistance in an insect population is the reduced use of compounds, limiting the selection of surviving (resistant) individuals. In North Dakota, resistance to the pyrethroid insecticides has been documented and the use of these compounds should be limited to one application per season. If control failures occur following the application of any product, switching to a different class of insecticides is recommended.

**Threshold:**

The current recommendation is that spraying be initiated at first egg hatch. Best results have been achieved by flagging the first egg masses that can be located, monitoring these daily, and spraying at 15 to 30% hatch. If the insecticide used is effective but not persistent, a second application should be made 5 to 10 days later. With this approach, the first-generation beetle larvae should be controlled with one or two applications.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>abamectin</b> Epi-Mek 0.15 EC	See label.	8 - 16 fl oz	PHI = 16 days. 7 days application interval between repeated applications. Do not apply more than 32 fl oz per acre per season. Do not allow livestock to graze or feed treated foliage to livestock.
<b>abamectin</b> Abamectin E-AG Temprano	See label.	8 - 16 fl oz	PHI = 14 days. Apply at approximately 50% egg hatch. 7 days application interval between repeated applications. Do not apply more than 32 fl oz per acre per season. Do not make more than 2 applications per season. Do not use with stickers or binder type products (such as Bravo Weather Stik). Do not allow livestock to graze or feed treated foliage to livestock.
<b>acetamiprid</b> Assail 30SG	0.028-0.075	1.5 - 4.0 oz	Use high rate under heavy pest pressures or dense foliage. Do not make more than 4 applications per season. Do not apply more than once every 7 days. Do not apply less than 7 days before harvest. Do not exceed a total of 0.3 lb ai (16 fl oz) per acre per season. Apply a minimum of 5 GPA of water by air and 20 GPA of water by ground. Thorough coverage is important to obtain optimum control. There are no rotational crop plantback restrictions.
Assail 70WP	0.025 - 0.075	0.6 - 1.7 oz	
<b>azinphos-methyl</b> Guthion 2L <i>RUP</i>	0.375	1.5 pt	PHI = 7 days. Repeat as necessary. Allow 7 days between applications.
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0125 - 0.022	1.6 - 2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>bifenthrin + imidacloprid</b> Brigadier <i>RUP</i>		4.2 - 6.14 fl oz	PHI = 21 days. Allow 7 days between applications. Maximum use rate of 25.6 fl oz total per season. An adjuvant, MSO, NIS, or COC may be tank-mixed.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 21 days. Do not make applications less than 21 days apart. Do not apply more than 0.2 lb ai per acre per season. Leaves cannot be used for food or feed.
<b>carbaryl</b> Sevin	1	rate varies by formulation used	First-generation beetles are likely to occur in late June to early July. Treat as soon as larvae appear. No preharvest interval.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>chlorantraniliprole</b> Coragen	0.045 - 0.065	3.5 - 5.0 fl oz	PHI = 14 days. REI = 4 hours. Do not apply more than 15.4 fl oz (0.2 lbs ai) per acre per season. Minimum interval between treatments is 5 days. Do not apply Coragen more than twice to a generation of Colorado potato beetle or within any 30 day period. Application to the next generation of beetles must be with an effective product with a different mode of action. Minimum application volume is 10 GPA by ground and 5 GPA by air.
<b>clothianidin</b> Belay 2.13SC	Foliar: 0.033 - 0.05  In-furrow or side dress: 0.15 - 0.2	Foliar: 2 - 3 fl oz  In-furrow or side dress: 9 - 12.0 fl oz  Seed treatment: 0.4 - 0.6 fl oz/cwt depending on seeding rate	Foliar: PHI = 14 days. Do not apply more than 8.4 fl oz per acre per season. Do not apply treatments less than 7 days apart. Soil Application: Apply once at planting or as a side-dress during hilling using one of the following methods: 1) In a narrow band center on the plant row in the bedding operation just prior to planting, 2) In-Furrow spray at planting. Direct spray in the furrow on the seed pieces or potatoes. 3) As a side dress to both sides of the row or as a spray at ground crack directly over the row during hilling. Cover immediately with soil. Do not apply more than 0.2 lb ai (12 fl oz) per acre per season (one application).
<b>cryolite</b> Kryocide		10-12 lbs	Do not apply more than 96 lbs per acre per season. Apply 5-15 GPA by air and 15-100 GPA. Apply with a minimum of 7 days between applications.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.044	1.6 - 2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.018 - 0.028	1.5 - 2.4 fl oz	PHI = 3 days. Allow 3 days between applications. Do not apply more than 12.0 fl oz per acre per season.
<b>dinotefuran</b> Venom 70 SG	0.050 - 0.075  0.28 - 0.33	FOLIAR: 1 - 1.5 fl oz  SOIL: 6.5 + 7.5 fl oz	Foliar Application: PHI = 7. Do not apply more than 4.5 fl oz per acre per season. Soil Application: Apply once at preplant, preemergence or at ground cracks using one of the following methods: 1) In a narrow band center on the plant row in the bedding operation just prior to planting, 2) In-Furrow spray at planting. Direct spray in the furrow on the seed pieces or potatoes. 3) As a side dress to both sides of the row or as a spray at ground crack directly over the row during hilling. Cover immediately with soil. Do not apply more than 12 fl oz per acre per season.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Do not graze livestock on treated vines.
<b>imidacloprid</b> Admire Pro	refer to label	5.7 - 8.7 fl oz (depending on row-spacing)  0.17 - 0.35 fl oz/cwt (seed piece treatment)	Apply in one of the following methods: 1. In-furrow spray during planting directed on seed pieces or seed potatoes, 2. Subsurface side-dress on both sides of the row covered with 3 or more inches of soil, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, 4) Narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, 5) seed piece treatment. There is a 12 month plant-back restriction for all crops not registered.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Mana Alias 4F	0.125 - 0.25	4.0 - 8.0 fl oz or 0.2 - 0.4 fl oz/cwt	Apply in one of the following methods: 1. In-furrow spray during planting directed on seed pieces or seed potatoes, 2. Subsurface side-dress on both sides of the row covered with 3 or more inches of soil, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, 4) Narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting. There is a 12 month plant-back restriction for all crops not registered.
<b>imidacloprid</b> Mana Alias 4F	0.048	1.52 fl oz	Broadcast or directed foliar spray. PHI = 7 days. Minimum interval between applications = 7 days. Maximum of 6.4 fl oz per acre (0.2 lb ai per acre) allowed per crop season when making foliar applications.
<b>imidacloprid</b> Advise 2FL Nuprid 2F	0.20 - 0.31	13 - 20 fl oz or 0.9 - 1.3 fl oz / 1,000 row-feet	Maximum amount allowed per season 20 fl oz/acre/season. Apply using one of the following methods: 1) In-furrow spray during planting directed on seed pieces or seed potatoes, 2) Subsurface side-dress on both sides of the row covered with 3 or more inches of soil; 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, or 4) Narrow band directly below the eventual seed row in a bedding operation 4 or fewer days before planting.
<b>imidacloprid</b> Nuprid 1.6F	0.048	3.8 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum amount allowed per season 15 fl oz/acre/season. May be applied through properly calibrated ground, aerial or chemigation application equipment.
<b>imidacloprid</b> Provado 1.6F	0.047	3.8 fl oz	A total of 16 fl. oz. (0.2 lb active ingredient) per acre per season may be applied as a foliar spray. There is a 12 month plant-back restriction for all crops not registered. PHI = 7 days.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.066	2.8 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Do not apply more than 12.8 fl oz per acre per season (0.1 lb ai beta-cyfluthrin, 0.2 lb ai imidacloprid). Leverage 360 can be applied through calibrated ground, aerial, or chemigation equipment.
<b>indoxacarb</b> Avaunt	0.065 - 0.11	3.5 - 6.0 fl oz	PHI = 7 days. Do not apply more than 24 fl oz (0.44 lb ai) per acre per season. Minimum interval between sprays is 5 days. In situations where Colorado potato beetles are difficult to control, add piperonyl butoxide (PBO), a synergist, at 0.25 lb ai per acre to Avaunt mixture to achieve optimum control.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Do not apply more than 0.12 lb ai per acre per season. Do not apply within 7 days of harvest.
<b>lambda-cyhalothrin</b> Kaiso 24WG <i>RUP</i>	0.02 - 0.03	1.33 - 2 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Do not apply more than 0.12 lb ai per acre per season.
<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>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.020 - 0.029 + 0.039 - 0.059	6 - 9 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai of lambda-cyhalothrin containing products per acre per season or more than 0.216 lb ai of chlorantraniliprole containing products per acre per season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 5 GPA for aerial application.
<b>lambda-cyhalothrin + thiamethoxam</b> Endigo ZC <i>RUP</i>	0.017 - 0.031 + 0.023 - 0.041	2.5 - 4.5 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai per acre per season of lambda-cyhalothrin containing products or more than 0.094 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or less than 3 GPA for aerial applications
<b>methamidophos</b> Monitor <i>RUP</i>	0.75 - 1	1.5 - 2 pts	PHI = 14 days.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 1.5	2 - 6 pts	PHI = 5 days. Do not enter treated fields within 48 hours after application.
<b>novaluron</b> Rimon	0. - 0.167	9 - 12 fl oz	PHI = 14 days. Do not apply more two applications per crop per season or 24 oz. per acre per season. Re-application on a 7 to 14 days interval will be required to protect new growth. Do not apply more than twice to a single generation of Colorado potato beetle and do not apply to successive generations.
<b>oxamyl</b> Vydate L <i>RUP</i>	0.5 - 1	2 - 4 pts	PHI = 7 days.
<b>permethrin</b> Ambush 2E Arctic 3.2EC Pounce 3.2EC Permethrin 2EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.05 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2	3.2 - 12.8 fl oz 4 - 8 fl oz 4 - 8 fl oz 4 - 8 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 14 days. Do not feed vines to livestock. Do not apply more than 1.6 pounds ai per acre per season.
<b>phorate</b> Thimet 20-G		11.3 oz/1,000 ft of row (light or sandy soils); 17.3 oz/1,000 ft of row (heavy or clay soils)	Band application at planting. PHI = 90 days. Do not apply more than one application of Thimet 20-G per crop season.
<b>phosmet</b> Imidan 50 WP	1	2 lbs	PHI = 7 days.
<b>spinosad (microbial)</b> Entrust (formulation approved for <b>Organic</b> crops)	0.05 - 0.1	1 - 2 fl oz	PHI = 7 days. Do not apply more than a total of 0.33 lbs a.i. per crop. Do not apply to consecutive generations of CPB and do not make more than 2 applications per single generation of CPB.
<b>spinosad (microbial)</b> Success	0.047 - 0.094	3 - 6 fl oz	PHI = 7 days. Do not apply more than a total of 21 fl oz per acre per season.. Do not make applications less than 7 days apart or apply more than 4 times per crop. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>spinetoram (microbial)</b> Radiant SC	0.047 - 0.063	6 - 8 fl oz	PHI = 7 days. Do not apply more than 32 fl oz (0.250 lb ai spinetoram) per acre per season. Do not make more than 4 applications per season. Do not make applications less than 7 days apart.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>thiamethoxam</b> Actara	0.023 - 0.047	1.5 - 3.0 fl oz	PHI = 14 days. Use sufficient water volume to ensure thorough coverage. Do not use less than 10 GPA for ground or 5GPA by air. Actara may be applied by chemigation. Do not apply more than 6.0 oz per acre per season.
<b>thiamethoxam</b> Platinum 2SC	0.078 - 0.125	5 - 8 fl oz	Soil application; see label for complete details. May be applied as: in-furrow during planting; impregnated on dry granular fertilizer before or during planting; or at plant emergence as a direct spray and incorporated into the soil with overhead irrigation within 24 hours. Only 1 soil application per season and do not exceed 0.125 lb AI/acre per season.
<b>thiamethoxam</b> Platinum 75SG	0.078 - 0.125	1.66 - 2.67	
<b>thiamethoxam</b> Platinum Ridomil Gold	0.095 - 0.121	2.2 fl oz / 1000 ft row	Product per acre is determined by the row spacing; see label for further discussion. This product includes the fungicide, mefenoxam, for control of <i>Pythium</i> seedling disease and pink rot.
<b>thiamethoxam + chlorantraniliprole</b> Voliam flexi	0.047	4 oz	PHI = 14 days. Do not exceed a total of 8 oz or 0.094 lb ai of thiamethoxam containing foliar products or 0.2 lb ai of chlorantraniliprole containing products per acre per growing season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or 5 GPA for aerial applications.
<b>zeta-cypermethrin</b> Mustang Max EC Respect <i>RUP</i>	0.020 - 0.025	3.2 - 4 fl oz	PHI = 1 day. Do not apply more than 0.15 lb AI per acre per season. Do not make applications less than 4 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

*RUP* - Restricted use pesticide

## POTATO INSECT COMPLEX

This grouping of insects refers to aphids, leafhoppers, wireworms, flea beetles and Colorado potato beetle. The at-planting granular treatments provide variable levels of control of these different pests during the early part of the season.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>clothianidin</b> Belay 2.13SC	Foliar: 0.033 - 0.05	Foliar: 2 - 3 fl oz	Foliar: PHI = 14 days. Do not apply more than 8.4 fl oz per acre per season. Do not apply treatments less than 7 days apart.
	In-furrow or side dress: 0.15 - 0.2	In-furrow or side dress: 9 - 12.0 fl oz	Soil Application: Apply once at planting or as a side-dress during hilling using one of the following methods: 1) In a narrow band center on the plant row in the bedding operation just prior to planting, 2) In-Furrow spray at planting. Direct spray in the furrow on the seed pieces or potatoes. 3) As a side dress to both sides of the row or as a spray at ground crack directly over the row during hilling. Cover immediately with soil. Do not apply more than 0.2 lb ai (12 fl oz) per acre per season (one application).
		Seed treatment: 0.4 - 0.6 fl oz/cwt depending on seeding rate	

INSECTICIDE	DOSAGE IN LB	PRODUCT	RESTRICTIONS ON USE
	AI/ACRE	PER ACRE	
<b>dinotefuran</b> Venom 70 SG (Does not control wireworms)	0.050 - 0.075	FOLIAR: 1 - 1.5 fl oz	Foliar Application: PHI = 7. Do not apply more than 4.5 fl oz per acre per season.
	0.28 - 0.33	SOIL: 6.5 - 7.5 fl oz	Soil Application: Apply once at preplant, preemergence or at ground cracks using one of the following methods: 1) In a narrow band center on the plant row in the bedding operation just prior to planting, 2) In-Furrow spray at planting. Direct spray in the furrow on the seed pieces or potatoes. 3) As a side dress to both sides of the row or as a spray at ground crack directly over the row during hilling. Cover immediately with soil. Do not apply more than 12 fl oz per acre per season.
<b>disulfoton</b> Di-Syston 15 G <i>RUP</i>		15 - 23 oz/1,000 ft of row	Band application at planting. Do not apply Di-Syston within 75 days. Do not plant food or feed crop in rotation after a field treatment with Di-Syston unless it is a registered use for Di-Syston.
<b>imidacloprid</b> Admire Pro	refer to label	5.7 - 8.7 fl oz (depending on row-spacing)	Apply in one of the following methods: 1. In-furrow spray during planting directed on seed pieces or seed potatoes, 2. Subsurface side-dress on both sides of the row covered with 3 or more inches of soil, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, 4) Narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, 5) seed piece treatment. There is a 12 month plant-back restriction for all crops not registered.
		0.17 - 0.35 fl oz/cwt (seed piece treatment)	
<b>imidacloprid</b> Mana Alias 4F	0.125 - 0.25	4.0 - 8.0 fl oz  (0.2 - 0.4 fl oz per cwt)	Apply in one of the following methods: 1. In-furrow spray during planting directed on seed pieces or seed potatoes, 2. Subsurface side-dress on both sides of the row covered with 3 or more inches of soil, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, 4) Narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting. There is a 12 month plant-back restriction for all crops not registered.
<b>imidacloprid</b> Mana Alias 4F	0.048	1.52 fl oz	Broadcast or directed foliar spray. PHI = 7 days. Minimum interval between applications = 7 days. Maximum of 6.4 fl oz per acre (0.2 lb ai per acre) allowed per crop season when making foliar applications.
<b>imidacloprid</b> Genesis		8 - 16 fl oz (0.4 - 0.8 fl oz per cwt)	This is a seed-piece application ONLY. Treatments provide protection only to the seed piece, not to daughter tubers. Plant seed pieces as soon as possible after cutting and treating. Do not apply any subsequent application of imidacloprid (Gaucho, Admire in furrow, or Provado) following Genesis seed-piece treatment.
<b>imidacloprid</b> Advise 2FL Nuprid 2F		8 - 16 fl oz (0.4 - 0.8 fl oz per cwt)	Seed piece treatment ONLY. Maximum of 20 fl oz per acre per season. Do not apply any subsequent in-furrow application of any imidacloprid product.
<b>phorate</b> Phorate 20 G Thimet 20 G <i>RUP</i>		11.3 - 17 oz/1,000 ft of row	Band application at planting. Do not apply Thimet within 90 days of harvest.

INSECTICIDE	DOSAGE IN LB	PRODUCT	RESTRICTIONS ON USE
	AI/ACRE	PER ACRE	
<b>thiamethoxam</b> CruiserMAXX Potato		0.19 - 0.27 oz/CWT depending on seeding rate	Seed treatment only. Protects the seed piece only from wireworm, not the daughter tubers. Provides protections from insects and several soil- or seed-borne diseases. Treated seed may be stored for several days provided cool (<60F) and moist (85-90% RH) air is forced through the piles (<6' in height).

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**NOTE:** The lower rate of application is suggested in light or sandy soils and the higher rate is suggested in heavy or clay soils.

### POTATO LEAFHOPPER

Direct feeding damage to foliage is the primary concern with leafhoppers. The potato leafhopper migrates north in the spring, arriving before potatoes emerge. Leafhoppers develop in alfalfa first, moving to potatoes later.

Leafhopper adults are wedge-shaped, 1/8 inch long, and lime green to yellow green in color. The nymphs resemble the adults but are wingless. When disturbed, the nymphs move across the leaf in a sideways fashion.

Damage by leafhoppers is referred to as hopper-burn. Foliage becomes dwarfed, crinkled, and curled. Small triangular brown areas appear at the tips of leaves, gradually spreading around the entire leaf margin. Immature leafhoppers are more destructive than the adults, and generally more numerous than adults.

#### Potato Leafhopper Threshold:

Treatments are recommended when potato leafhoppers can be found at a level of 1 nymph per 10 leaves. Sample 35 leaves in each of 5 locations in a field. Pluck leaves from the plants and inspect the underside of the leaf for the presence of nymphs.

### FLEA BEETLE

Flea beetles are small, dull black beetles, about 1/16 inch long, with hind legs adapted for jumping. The adults overwinter in the soil, emerging in the spring to begin feeding on young foliage. Newly emerged plants are most vulnerable. When abundant, flea beetles shot-hole the foliage with numerous small round holes. Severely damaged leaves do not recover.

#### Flea Beetle Threshold:

Thresholds for this pest are not well-defined. Past recommendations have suggested treatment when 10% of the leaf area is lost due to flea beetle feeding. Early season weed control and removal of crop debris make fields less attractive to flea beetles.

#### Insecticides Registered for Flea Beetles and Potato Leafhoppers control in potatoes.

INSECTICIDE	DOSAGE IN LB	PRODUCT	RESTRICTIONS ON USE
	AI/ACRE	PER ACRE	
<b>acetamiprid</b> Assail 30SG	Flea Beetles: 0.028 - 0.047	Flea Beetles: 1.5 - 2.5 oz	Use high rate under heavy pest pressures or dense foliage. Do not make more than 4 applications per season. Do not apply more than once every 7 days. Do not apply less than 7 days before harvest. Do not exceed a total of 0.3 lb ai per acre per season. Apply a minimum of 5 GPA of water by air and 20 GPA of water by ground. Thorough coverage is important to obtain optimum control. There are no rotational crop plantback restrictions.
	Potato leafhopper: 0.028 - 0.075	Potato leafhopper: 1.5 - 4.0 oz	
Assail 70WP	Flea Beetles: 0.025 - 0.05	Flea Beetles: 0.6 - 1.1 oz	
	Potato leafhopper: 0.025 - 0.075	Potato leafhopper: 0.6 - 1.7 oz	
<b>azinphos-methyl</b> Guthion 2L	0.5 - .75	2 - 3 pts	PHI = 7 days. Repeat as necessary. Allow 7 days between applications.
	<i>RUP</i>		
<b>beta-cyfluthrin</b> Baythroid XL	0.013 - 0.022	1.6 - 2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing. Use lower rates for leafhopper.
	<i>RUP</i>		



INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin</b> Bifenture EC Bridage 2EC Fanfare Sniper	0.033 - 0.1	2.1 - 6.4	PHI = 21 days. Do not apply more than 0.5 lb ai per acre per season, including soil and foliar treatments. Do not make more than 2 foliar treatments per season. Do not make applications less than 21 days apart. Apply in a minimum of 10 GPA by ground and 3 GPA by air.
<b>Flea beetles only</b>	<i>RUP</i>		
<b>bifenthrin + zeta-cypermethrin</b> Hero	0.025 - 0.06	2.6 - 6.1 fl oz	PHI = 21 days. Do not make applications less than 21 days apart. Do not apply more than 0.2 lb ai per acre per season. Leaves cannot be used for food or feed.
	<i>RUP</i>		
<b>carbaryl</b> Sevin	1	rate varies by formulation used	No preharvest interval.
<b>clothianidin</b> Belay 2.13SC	Foliar: 0.033 - 0.05  In-furrow or side dress: 0.15 - 0.2	Foliar: 2 - 3 fl oz  In-furrow or side dress: 9 - 12.0 fl oz  Seed treatment: 0.4 - 0.6 fl oz/cwt depending on seeding rate	Foliar: PHI = 14 days. Do not apply more than 8.4 fl oz per acre per season. Do not apply treatments less than 7 days apart. Soil Application: Apply once at planting or as a side-dress during hilling using one of the following methods: 1) In a narrow band center on the plant row in the bedding operation just prior to planting, 2) In-Furrow spray at planting. Direct spray in the furrow on the seed pieces or potatoes. 3) As a side dress to both sides of the row or as a spray at ground crack directly over the row during hilling. Cover immediately with soil. Do not apply more than 0.2 lb ai (12 fl oz) per acre per season (one application).
<b>cyfluthrin</b> Tombstone Tombstone Helios	0.013 - 0.044	0.8 - 2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing. Use lower rates for leafhopper.
	<i>RUP</i>		
<b>deltamethrin</b> Delta Gold	0.018 - 0.028	1.5 - 2.4 fl oz	PHI = 3 days. Allow 3 days between applications. Do not apply more than 12.0 fl oz per acre per season.
	<i>RUP</i>		
<b>dimethoate</b> Digon 400 Dimethoate 400	0.5	1 pt	No preharvest interval. Do not enter treated fields without protective clothing until sprays have dried.
<b>dinotefuran</b> Venom 70 SG	0.050 - 0.2  0.28 - 0.33	FOLIAR: 1 - 4 fl oz  SOIL: 6.5 + 7.5 fl oz	Foliar Application: PHI = 7. Do not apply more than 4.5 fl oz per acre per season. Soil Application: Apply once at preplant, preemergence or at ground cracks using one of the following methods: 1) In a narrow band center on the plant row in the bedding operation just prior to planting, 2) In-Furrow spray at planting. Direct spray in the furrow on the seed pieces or potatoes. 3) As a side dress to both sides of the row or as a spray at ground crack directly over the row during hilling. Cover immediately with soil. Do not apply more than 12 fl oz per acre per season.
<b>esfenvalerate</b> Adjourn Asana XL	0.25 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Do not feed vines to livestock.
	<i>RUP</i>		

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Admire Pro	refer to label	5.7 - 8.7 fl oz (depending on row-spacing)  0.17 - 0.35 fl oz/cwt (seed piece treatment)	Apply in one of the following methods: 1. In-furrow spray during planting directed on seed pieces or seed potatoes, 2. Subsurface side-dress on both sides of the row covered with 3 or more inches of soil, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, 4) Narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, 5) seed piece treatment. There is a 12 month plant-back restriction for all crops not registered.
<b>imidacloprid</b> Mana Alias 4F	0.125 - 0.25	4.0 - 8.0 fl oz or 0.2 - 0.4 fl oz/cwt	Apply in one of the following methods: 1. In-furrow spray during planting directed on seed pieces or seed potatoes, 2. Subsurface side-dress on both sides of the row covered with 3 or more inches of soil, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, 4) Narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting. There is a 12 month plant-back restriction for all crops not registered.
<b>imidacloprid</b> Mana Alias 4F	0.048	1.52 fl oz	Broadcast or directed foliar spray. PHI = 7 days. Minimum interval between applications = 7 days. Maximum of 6.4 fl oz per acre (0.2 lb ai per acre) allowed per crop season when making foliar applications.
<b>imidacloprid</b> Advise 2FL Nuprid 2F	0.20 - 0.31	13 - 20 fl oz or 0.9 - 1.3 fl oz / 1,000 row-feet	Maximum amount allowed per season 20 fl oz/acre/season. Apply using one of the following methods: 1) In-furrow spray during planting directed on seed pieces or seed potatoes, 2) Subsurface side-dress on both sides of the row covered with 3 or more inches of soil; 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, or 4) Narrow band directly below the eventual seed row in a bedding operation 4 or fewer days before planting.
<b>imidacloprid</b> Nuprid 1.6F	0.048	3.8 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum amount allowed per season 15 fl oz/acre/season. May be applied through properly calibrated ground, aerial or chemigation application equipment.
<b>imidacloprid</b> Provado 1.6F	0.047	3.8 fl oz	A total of 16 fl. oz. (0.2 lb active ingredient) per acre per season may be applied as a foliar spray. There is a 12 month plant-back restriction for all crops not registered. PHI = 7 days.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.066	2.8 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Do not apply more than 12.8 fl oz per acre per season (0.1 lb ai beta-cyfluthrin, 0.2 lb ai imidacloprid). Leverage 360 can be applied through calibrated ground, aerial, or chemigation equipment.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Do not apply more than 0.12 lb ai per acre per season. Do not apply within 7 days of harvest.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>lambda-cyhalothrin</b> Kaiso 24WG <i>RUP</i>	Potato Leafhopper: 0.015 - 0.025	Potato Leafhopper: 1 - 1.67 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Will not control mining, tunneling or boring insects once they have entered the plant. Only exposed insects (larvae and/or adults) can be controlled with foliar applications. Do not apply more than 0.12 lb ai per acre per season.
	Flea Beetles 0.02 - 0.03	Flea Beetles 1.33 - 2 fl oz	
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	Potato Leafhopper: 0.015 - 0.025	Potato Leafhopper: 0.96 - 1.6 fl oz	
	Flea Beetles 0.02 - 0.03	Flea Beetles 1.28 - 1.92 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	Potato Leafhopper: 0.016 - 0.026 + 0.033 - 0.052	Potato Leafhopper: 5 - 8 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai of lambda-cyhalothrin containing products per acre per season or more than 0.216 lb ai of chlorantraniliprole containing products per acre per season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 5 GPA for aerial application.
	Flea Beetles 0.020 - 0.029 + 0.039 - 0.059	Flea Beetles: 6 - 9 fl oz	
<b>lambda-cyhalothrin + thiamethoxam</b> Endigo ZC <i>RUP</i>	0.017 - 0.031 + 0.023 - 0.041	2.5 - 4.5 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai per acre per season of lambda-cyhalothrin containing products or more than 0.094 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or less than 3 GPA for aerial applications
<b>malathion</b> Malathion 57 EC	0.66 - 1	1.0 - 1.5pts.	PHI = 0 days.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 1	2 - 4 pts	PHI = 5 days. Do not enter treated fields within 48 hours after application.
<b>oxamyl</b> Vydate L <i>RUP</i>	0.5 - 1	2 - 4 pts	PHI = 7 days.
<b>permethrin</b> Ambush 2E Arctic 3.2EC Pounce 3.2EC Permethrin 2EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.05 - 0.2	3.2 - 12.8 fl oz	PHI = 14 days. Do not feed vines to livestock. Do not apply more than 1.6 pounds ai per acre per season.
	0.1 - 0.2	4 - 8 fl oz	
	0.1 - 0.2	4 - 8 fl oz	
	0.1 - 0.2	4 - 8 fl oz	
	0.1 - 0.2	6.4 - 12.8 fl oz	
	0.1 - 0.2	4 - 8 fl oz	
<b>phorate</b> Thimet 20-G		11.3 oz/1,000 ft of row (light or sandy soils); 17.3 oz/1,000 ft of row (heavy or clay soils)	Band application at planting. PHI = 90 days. Do not apply more than one application of Thimet 20-G per crop season.
<b>phosmet</b> Imidan WP	1	2 lbs	PHI = 7 days.
<b>thiamethoxam</b> Actara	0.023 - 0.047	1.5 - 3.0 fl oz	PHI = 14 days. Use sufficient water volume to ensure thorough coverage. Do not use less than 10 GPA for ground or 5GPA by air. Actara may be applied by chemigation. Do not apply more than 6.0 oz per acre per season.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>thiamethoxam</b> Platinum 2SC	0.078 - 0.125	5 - 8 fl oz	Soil application; see label for complete details. May be applied as: in-furrow during planting; impregnated on dry granular fertilizer before or during planting; or at plant emergence as a direct spray and incorporated into the soil with overhead irrigation within 24 hours. Only 1 soil application per season and do not exceed 0.125 lb AI/acre per season.
<b>thiamethoxam</b> Platinum 75SG	0.078 - 0.125	1.66 - 2.67	
<b>thiamethoxam</b> Platinum Ridomil Gold	0.095 - 0.121	2.2 fl oz / 1,000 ft row	Product per acre is determined by the row spacing; see label for further discussion. This product includes the fungicide mefenoxam for control of <i>Pythium</i> seedling disease and pink rot.
<b>thiamethoxam + chlorantraniliprole</b> Voliam flexi	0.047	4 oz	PHI = 14 days. Do not exceed a total of 8 oz or 0.094 lb ai of thiamethoxam containing foliar products or 0.2 lb ai of chlorantraniliprole containing products per acre per growing season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or 5 GPA for aerial applications.
<b>zeta-cypermethrin</b> Mustang Max EC Respect	Potato leafhopper: 0.02 - 0.025  Flea beetle: 0.011 - 0.025	Potato leafhopper: 3.2 - 4 fl oz  Flea beetle: 1.76 - 4.0 fl oz	PHI = 1 day. Do not apply more than 0.15 lb AI per acre per season. Do not make applications less than 4 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## VARIEGATED CUTWORM

The variegated cutworm is an occasional pest of potato in the region. These larvae are about 2 inches long when full grown. Their color ranges from black to light greenish-yellow or tan. They have a distinctive row of pale yellow spots down the middle of their backs. The variegated cutworm is a climbing cutworm, feeding in the plant canopy at night. Variegated cutworm have been responsible for below-ground feeding that damages tubers. The variegated cutworm overwinters in states to the south of North Dakota, making annual predictions of problems difficult. Moths migrate to the region during the spring and summer months. There are multiple generations of this cutworm, numbering two to three, depending on environmental conditions.

### Threshold:

Treatments would be justified when 4 or more worms per square foot are present.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL  RUP	0.0065 - 0.0125	0.8 - 1.6 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>bifenthrin + zeta- cypermethrin</b> Hero  RUP	0.025 - 0.06	2.6 - 6.1 fl oz	PHI = 21 days. Do not make applications less than 21 days apart. Do not apply more than 0.2 lb ai per acre per season. Leaves cannot be used for food or feed.
<b>cyfluthrin</b> Tombstone Tombstone Helios  RUP	0.013 - 0.025	0.8 - 1.6 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>deltamethrin</b> Delta Gold  RUP	0.012 - 0.028	1.0 - 2.4 fl oz	PHI = 3 days. Allow 3 days between applications. Do not apply more than 12.0 fl oz per acre per season.

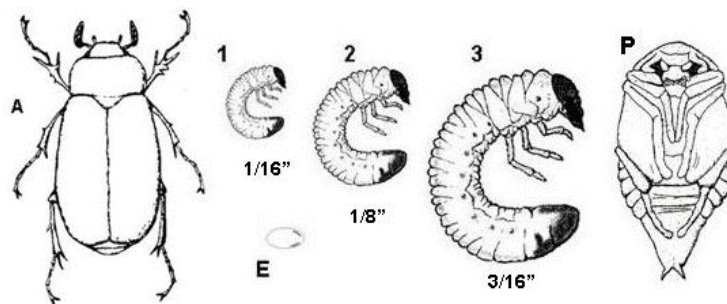
INSECTICIDE	DOSAGE IN LB	PRODUCT	RESTRICTIONS ON USE
	AI/ACRE	PER ACRE	
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Do not feed vines to livestock.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.066	2.8 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Do not apply more than 12.8 fl oz per acre per season (0.1 lb ai beta-cyfluthrin, 0.2 lb ai imidacloprid). Leverage 360 can be applied through calibrated ground, aerial, or chemigation equipment.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Do not apply more than 0.12 lb ai per acre per season. Do not apply within 7 days of harvest.
<b>lambda-cyhalothrin</b> Kaiso 24WG <i>RUP</i>	0.015 - 0.025	1 - 1.67 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Do not apply more than 0.12 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.016 - 0.026 + 0.033 - 0.052	5 - 8 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai of lambda-cyhalothrin containing products per acre per season or more than 0.216 lb ai of chlorantraniliprole containing products per acre per season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 5 GPA for aerial application.
<b>lambda-cyhalothrin + thiamethoxam</b> Endigo ZC <i>RUP</i>	0.017 - 0.031 + 0.023 - 0.041	2.5 - 4.5 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai per acre per season of lambda-cyhalothrin containing products or more than 0.094 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or less than 3 GPA for aerial applications
<b>permethrin</b> Arctic 3.2EC Pounce 3.2EC Permethrin 2EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2	4 - 8 fl oz 4 - 8 fl oz 4 - 8 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 14 days. Do not feed vines to livestock. Do not apply more than 1.6 pounds ai per acre per season.
<b>zeta-cypermethrin</b> Mustang Max EC Respect <i>RUP</i>	0.008 - 0.025	1.28 - 4 fl oz	PHI = 1 day. Do not apply more than 0.15 lb AI per acre per season. Do not make applications less than 4 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## WHITE GRUBS

White grubs that are destructive to field crops in North Dakota have a three-year life cycle. In southeast North Dakota, the most common white grub pest occurs in continuous cropping situations at sites where willow and cottonwood trees are present. In other areas of the state, white grubs are most likely to be found when rotation from grassland, pasture, or grassy weed sites occur. Most

root feeding occurs in the second year of the life cycle. In most cases, the number of second-year grubs will only be great enough to justify control once every three years.



**Life stages of *Phyllophaga implicita*:** A - adult June beetle; E - egg; grub stages with their head width in inches, 1 - first; 2 - second; 3 - third; and P - pupa.

**Thresholds:**

Treatment is recommended when sampling indicates an average of one or more white grubs per square foot are found. The following sampling procedure provides treatment decisions based on this guideline.

**Soil sampling:** Fields need to be sampled to determine grub abundance and aid in determining if control is necessary. Sampling in late summer or early fall, before a freeze, provides a more reliable estimate of populations than spring sampling just before planting. Larvae are typically present in the upper 6 inches of soil until a killing frost occurs in the fall. Take soil samples, 1 square foot in size to a depth of 8 inches. Begin taking samples 45 yards from shelterbelts. A total of 30 samples per field, randomly spaced along the shelterbelts, are necessary. If at least a single grub is found in less than 40% of the samples, treatment may be required only out 20 yards from the tree line. If 40% to 60% of the samples are infested, treatment is needed to this distance and maybe as far as 65 yards. If greater than 60% of the samples are infested, treatment may be needed out to 90 yards from the tree line.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
bifenthrin Bifenture EC Bridage 2EC Fanfare <i>RUP</i>	0.3 (at-plant)	19.2 fl oz (at-plant)	PHI = 21 days. May be applied in-furrow or as a T-band spray at planting time. May be applied as a lay-by treatment. Do not apply more than 0.5 lb ai per acre per season, including soil and foliar treatments. Apply in 10 GPA spray volume.
	0.05 - 0.15 (lay-by)	3.2 - 9.6 fl oz (lay-by)	
bifenthrin Sniper <i>RUP</i>	0.3 (at-plant)	19.2 fl oz (at-plant)	PHI = 21 days. May be applied in-furrow or as a T-band spray at planting time. May be applied as a lay-by treatment. Do not apply more than 0.5 lb ai per acre per season, including soil and foliar treatments. Apply in 10 GPA spray volume.
	0.05 (lay-by)	3.2 fl oz (lay-by)	
bifenthrin Capture LFR <i>RUP</i>	0.15 - 0.3 (at-plant)	12.75 - 25.5 fl oz (at-plant)	Do not apply more than 0.3 lb ai per acre per season as an at-plant application. Do not apply more than 0.5 lb ai per acre per season including at-plant plus foliar applications of other bifenthrin products (such as Capture 2EC). For at-plant, apply in a 8 -12 inch T-band or in furrow. Apply a minimum of 10 GPA in the band. For lay-by, incorporate at hilling for additional wireworm and white grub control.
	0.15 - 0.3 (lay-by)	12.75 - 25.5 fl oz (lay-by)	

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**WIREWORMS**

Wireworms are most likely to be problems when dry beans follows pasture or grassland. Infestations often are found in coarse textured soils (sandy loam) where moisture is abundant, perhaps in low spots of fields.

**Thresholds:**

There is no easy way to estimate wireworm infestations. Two methods are currently used.

**Soil Sampling:** Sample 20, well spaced, 1 square foot sites to a depth of 4 to 6 inches for every 40 acres being planted. If an average of 1 wireworm per square foot is found, treatment would be justified.

**Solar Baiting:** In September, establish bait stations for 2 to 3 weeks before freeze. Place bait stations randomly through the field, but representing all areas of the field. There should be 10 - 12 stations per 40 acre field. Place one cup wheat and one cup shelled corn in a 4- to 6-inch deep hole. Cover grain with soil and then an 18-inch square piece of clear plastic. Dig up the grain. If an average of one or more wireworm larvae are found per station, treatment would be justified.

**Seed Treatment:** 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>bifenthrin</b> Bifenture EC Bridage 2EC Fanfare	0.3 (at-plant) 0.05 - 0.15 (lay-by)	19.2 fl oz (at-plant) 3.2 - 9.6 fl oz (lay-by)	PHI = 21 days. May be applied in-furrow or as a T-band spray at planting time. May be applied as a lay-by treatment. Do not apply more than 0.5 lb ai per acre per season, including soil and foliar treatments. Apply in 10 GPA spray volume.
<b>bifenthrin</b> Sniper	0.3 (at-plant) 0.05 (lay-by)	19.2 fl oz (at-plant) 3.2 fl oz (lay-by)	PHI = 21 days. May be applied in-furrow or as a T-band spray at planting time. May be applied as a lay-by treatment. Do not apply more than 0.5 lb ai per acre per season, including soil and foliar treatments. Apply in 10 GPA spray volume.
<b>bifenthrin</b> Capture LFR	0.15 - 0.3 (at-plant) 0.15 - 0.3 (lay-by)	12.75 - 25.5 fl oz (at-plant) 12.75 - 25.5 fl oz (lay-by)	Do not apply more than 0.3 lb ai per acre per season as an at-plant application. Do not apply more than 0.5 lb ai per acre per season including at-plant plus foliar applications of other bifenthrin products (such as Capture 2EC). For at-plant, apply in a 8 -12 inch T-band or in furrow. Apply a minimum of 10 GPA in the band. For lay-by, incorporate at hilling for additional wireworm and white grub control.
<b>clothianidin</b> Belay 2.13SC		Seed treatment: 0.4 - 0.6 fl oz/cwt depending on seeding rate	Do not use treated seed-pieces for food, feed or fodder. Do not apply subsequent application of Belay (in-furrow or side-dress) following a Belay seed-piece treatment.
<b>imidacloprid</b> Admire Pro	refer to label	5.7 - 8.7 fl oz (depending on row-spacing)  0.17 - 0.35 fl oz/cwt (seed piece treatment)	Apply in one of the following methods: 1. In-furrow spray during planting directed on seed pieces or seed potatoes, 2. Subsurface side-dress on both sides of the row covered with 3 or more inches of soil, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, 4) Narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting, 5) seed piece treatment. There is a 12 month plant-back restriction for all crops not registered.
<b>imidacloprid</b> Mana Alias 4F	0.125 - 0.25	4.0 - 8.0 fl oz or 0.2 - 0.4 fl oz/cwt	Apply in one of the following methods: 1. In-furrow spray during planting directed on seed pieces or seed potatoes, 2. Subsurface side-dress on both sides of the row covered with 3 or more inches of soil, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, 4) Narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting. There is a 12 month plant-back restriction for all crops not registered.
<b>fipronil</b> Regent 4SC		See label for correct rate. 3.2 fl oz per acre or 0.184 fl oz per 1,000 row feet for 30 inch row spacing	PHI = 90 days. Do not plant small grains or other rotational crops within 12 months following application. Make one in-furrow application at planting time only. Do not apply more than 0.10 lb AI/acre per application. Do not apply this product through any kind of irrigation system.

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# RANGELAND and NON-CROP SITES GRASSHOPPER MANAGEMENT

## Summary of North Dakota Law Regarding Grasshopper Control Along Roadsides

### **Townships and Counties**

They are authorized to control grasshoppers infesting road rights of way under their authority (1991 law).

#### ● **Requirements**

- Pesticides **must be labeled** for use on forage crops so they **may be hayed**
- Written notice to all landowners or tenants 3 days prior to treatment
  - Date of treatment
  - Name of pesticide and restrictions on harvest and use of forage
  - Must exclude areas opposed by adjacent landowner or occupant

### **State Highway Rights of Way**

Counties may enter into agreement with DOT to control grasshoppers in state highway system rights of way. (Contact DOT district office)

#### ● **North Dakota Department of Agriculture must approve plan when state funds involved**

(Contact North Dakota Department of Agriculture at 701.328.4765)

- Request for approval form is submitted by County Pest Coordinator
- Plan must include county or township roads
- Scouting to verify economic infestation
- Treatments must be made prior to adult stage

### **Financing Summary**

#### **Counties**

Governing body may use county emergency fund (57-15-28) to pay for control costs in county road system rights of way and for cost share with townships.

#### **Maximum balance**

- 5 mills for large counties (Burleigh, Cass, Grand Forks, Ward)
- 10 mills for small counties

#### **Tax limitation for emergency purposes (57-15-06.7)**

- Tax for emergency purposes not to exceed 2 mills.

#### **Townships**

Electors may appropriate funds (57-15-19) for controlling grasshoppers in township rights of way. Total annual tax levy (for all purposes) in a civil township may not exceed 18 mills.

### **Roadside Right of Way Grasshopper Spray Program Considerations**

Treatment of grasshoppers when they are young, concentrated in hatching areas, and highly susceptible to lower rates of insecticide is a long standing management strategy.

Roadside rights of way are sometimes major hatching areas for grasshoppers. Infestations are often variable and not all roadsides are likely to be infested. Roadsides that were weedy or had enough green vegetation to attract adult grasshoppers during the previous year's egg-laying period are more likely to be infested with eggs. Roadsides adjacent to late-season crops that are themselves attractive egg-laying sites are also more heavily infested.

Numerous other areas on the farm can also be hatching areas, including:

Fencerows	Fields planted to a late-season crop last year especially
Shelterbelts	when summer fallowed this year, such as:
Rock piles	Sunflower
Grass waterways	Safflower
Weedy waste areas	Flax
Some CRP	Soybean
Alfalfa and haylands	
Last year's weedy fallow	
Last year's weedy fields	

Treatment timing can be difficult. Egg hatch normally occurs over a 4 - 6 week period and the developing grasshoppers gradually move out from their hatching areas. Spraying too early can miss later hatching grasshoppers while spraying too late allows early hatching hoppers to move into crops and escape treatment and perhaps cause serious crop damage.



### What are Reasonable Expectations

1. Roadside programs conducted when roadsides are generally infested and a major contributor as hatching areas can reduce but not eliminate the threat of grasshopper damage.
2. Farmers may be disappointed if they do not make efforts to identify, monitor, and manage other hatching areas.
3. Roadside programs may reduce, but are unlikely to eliminate, the need for additional crop protection measures in years favorable for grasshoppers.
4. Roadside programs may contribute to, but are unlikely to be responsible for, preventing grasshoppers from laying eggs and creating the potential for problems next year.

### Roadside Programs should:

1. Include scouting to determine if a sufficient percentage of roadsides are infested to warrant a roadside program. Roadside infestations are frequently spotty and other areas frequently contribute to the grasshopper problem.
2. Treatments should generally be applied prior to significant movement of grasshoppers into fields. Movement normally begins as hoppers approach the 3rd instar. Treatments after adults appear are not effective.
3. Farmers should be encouraged to scout and if necessary treat other hatching areas with threatening populations.

## GRASSHOPPERS

**Grasshopper Thresholds: Infestation Ratings:** The threatening rating is considered the action threshold for grasshoppers. 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+

Insecticides for Rangeland and Non-Crop Areas - **grazed or cut for hay**

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>carbaryl</b> Sevin	0.5 - 1.5	rate varies by formulation	Pastures: PHI = 0 days for aerial application. Rangeland: PHI = 0 days for aerial application. The lower rate (0.5 lb) is suggested for nymphs on small plants or sparse vegetation. The higher rate (1.5 lb) is suggested for mature grasshoppers or when material is applied to crops requiring greater coverage.
<b>diflubenzuron</b> Dimilin 2L <i>RUP</i>	0.008 - 0.032	0.5 - 2.0 fl oz	Dimilin (diflubenzuron) is an insect growth regulator. Applications should be timed when the majority of nymphs are 2nd to 3rd instar. This treatment is NOT effective in controlling adult grasshoppers. Allow at least 1 day after treatment before cutting grass.
<b>lambda-cyhalothrin + chlorantraniliprole</b> Voliam Xpress <i>RUP</i>	0.06 - 0.09	6.0 - 9.0 fl oz	PHI = Pasture and rangeland grass may be used for grazing or cut for forage 0 days after application. Do not cut grass to be dried and harvested for hay until 7 days after application. Apply as required by scouting, usually at 7 day or more intervals. Use minimum of 10 GPA by ground and minimum of 5GPA by air. Do not apply more than 27 oz per acre per year, or 9 oz per cutting.
<b>malathion</b> Malathion 57EC	1.0 - 1.33	1.5 - 2.0 pts	No time limitation on grazing or cutting.
<b>malathion</b> Malathion ULV	0.6	8 oz/acre	Aerial application. Applied alone or dissolved in diesel oil at 1 pt/A. No time limitation on grazing or cutting.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.0175 - 0.025	2.8 - 4.0	PHI = 0 days for forage and hay, PHI = 7 days for straw. Do not make applications less than 7 day apart for forage and hay and not less than 17 days for straw. A maximum of 0.025 lb ai per acre may be applied per cutting. For hay, a maximum of 0.10 lb ai per acre per season may be applied. For forage and straw, a maximum of 0.125 lb ai per acre per season may be applied.

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## GRASSHOPPERS

Insecticides for non-crop areas - **NOT grazed or cut for hay**

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>acephate</b> Acephate E 75 WP Acephate 75% Orthene, Address, Acephate 97UP	0.25	0.33 lb	Use for early to mid-season application. Use high volumes when spraying dense foliage. <b>DO NOT GRAZE OR FEED</b> vegetation cut from treated area.
<b>acephate</b> Orthene 97		0.25 lb (4 fl oz)  (1.5 - 2 fl oz for wasteland only)	<b>DO NOT GRAZE OR FEED TREATED VEGETATION</b> cut from treated area. Do not make more than one application per season. Use higher volumes when spraying dense foliage. Use 10 to 20 GPA by ground and 1-5 GPA by air.
<b>esfenvalerate</b> Asana XL <i>RUP</i>	0.015 - 0.03	2.9 - 5.8 fl oz	Labeled for use on non-cropland adjacent to tilled areas to control migrating insects, including armyworms. <b>DO NOT FEED TREATED CROP</b> to livestock.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	<b>DO NOT GRAZE</b> livestock in treated areas. Apply in minimum of 2 gals per acre by air or 10 gals per acre by ground.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	Labeled for control of grasshoppers on non-cropland adjacent to crops registered for the use of Warrior II. <b>FEEDING HAY OR GRAZING LIVESTOCK</b> in treated areas is <b>PROHIBITED</b> .

*RUP* - Restricted use pesticide

Rangeland

## SAFFLOWER INSECTS

Safflower may be infested from the time of emergence to maturity by various insect pests. The most susceptible periods is the bud to flower stage. Fields should be examined regularly and controls applied when infestations are damaging.

### CUTWORMS

Several species of cutworms (*Agrotis* spp.) attack safflower. Cutworms are caterpillars that live below ground and cut off seedling at or just below the soil line. Areas in the field are often barren following cutworm feeding. If sufficient plants are present, safflower can compensate for some seedling loss. If damage is severe, protection of seedlings with insecticide may be necessary. There is no known economic threshold for cutworms in North Dakota.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>zeta-cypermethrin</b> Mustang Max EC <i>RUP</i>	0.025	4 fl oz	PHI = 7 days. Do not apply more than 0.075 lb ai per acre per season. Do not make applications less than 14 days apart. Apply with ground or air equipment using sufficient water and application methods to insure through coverage of foliage. Apply in water using a minimum of 15 gallons of finished spray per acre.

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### WIREWORMS

Wireworms, although often serious pests of cereal grains in the seedling stage, seldom damage safflower. Imidacloprid and thiamethoxam are labeled as commercial seed treatment and use decisions must be made at time of seed purchase. Please 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> Gaucho 600	refer to recommended label rate		Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Dyna-Shield Imidacloprid 5	refer to recommended label rate	12.8 fl oz per cwt of seed	Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Senator 600	refer to recommended label rate	12.8 fl oz per cwt of seed	Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>thiamethoxam</b> Cruiser 5FS	refer to recommended label rate		Follow all applicable directions, restrictions and precautions on the EPA registered label.

Safflower

## SOYBEAN INSECTS

### Estimating Damage

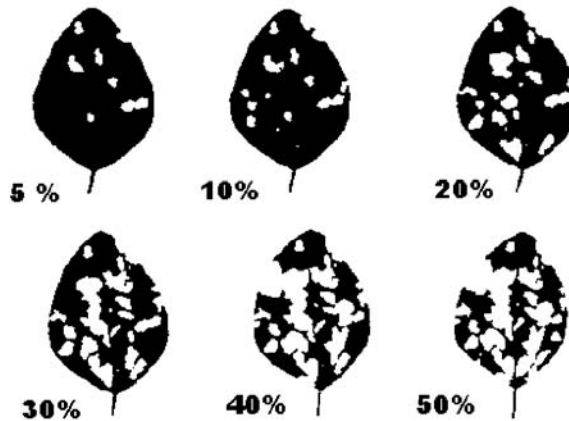
In soybeans, field scouting to assess insect populations is based on either the number of insects per foot of row, insects per plant, or the level of defoliation.

Insects per foot of row is determined by shaking plants over the inter-row space, on which a strip of cloth has been laid. Count the total number of insect pests per foot of row that fall on the cloth. If sampling a narrow row or drilled soybeans, the use of a "Texas vertical beat sheet" should be considered. The vertical beat sheet is made from a piece of galvanized metal flashing or similar stiff material, 36 inches wide, 32 inches tall and crimped at the bottom to form a collecting trough 4 inches wide. Place the device next to the row and shake the plants against the vertical surface. Insects dislodged from plants collect in the trough where they can be counted or collected.

Percent defoliation is determined by estimating the amount of leaf loss based on visual inspection of randomly selected plants.

The growth stage of the soybean plant is important. Under most conditions, moderate defoliation early in the season has little effect on final bean yield. As plants reach the flowering and pod filling stages, then defoliation poses a greater threat to yield. For example, research indicates that the soybean plant can sustain a 35% leaf loss prior to the pre-bloom period. From pod-set to maturity, the plant can tolerate only a 20% defoliation level.

### Soybean Defoliation Levels



### ARMYWORMS

Armyworms are greenish-brown with longitudinal stripes. Full grown larvae are smooth, striped and almost hairless. Armyworms feed for three to four weeks. When full grown, larvae are 1½ to 2 inches in length. Armyworm larvae have six growth stages, or instars. The armyworm's final instar lasts about 10 days and they consume large amounts of plant material during that time.

Armyworms are inactive during the day, resting under plant trash, clumps of grass or lodged plants. They feed at night or on cloudy days, crawling up on plants and consuming foliage. Due to their habit of feeding at night, armyworms may go undetected until significant damage has occurred.

Armyworms do not overwinter in the region. The moths migrate from Southern states in late spring and early summer. This helps explain the sporadic infestations that occur. When moths arrive, they prefer to lay their eggs in moist, shady areas, usually where grasses have lodged. Infestations that develop within soybean fields are often due to grassy weed problems.

Armyworms are more of a problem in small grains and corn. Damage to soybeans can occur when the armyworm's usual host plants become exhausted due to feeding or dry conditions. When their food is depleted in the hatching site, the armyworms may move in large numbers, or "armies," eating and destroying plants or crops in their path.

#### Threshold:

Control of armyworms is recommended when 25% to 30% of the foliage is destroyed or if significant injury to pods is evident. Most often in soybeans, infestations are due to migrating armyworms. Under these circumstances, treatment of a couple of swaths ahead of the migrating armyworms to establish a barrier strip is suggested to prevent further migration and injury.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acephate</b> Orthene 97 Pellets		0.75 - 1 lb	PHI = 14 days. Do not graze or cut vines for hay or forage. Do not apply more than 1.5 lbs per acre per season. For rates up to 0.5 lb per acre, at least 3 days must pass between applications. For rates up to 0.5 to 1 lb per acre, at least 7 days must pass between applications.
<b>Bacillus thuringiensis</b> DiPel DF For <b>Organic</b> Production		1 - 2 lb	No preharvest interval. 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.
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0125 - 0.022	1.6 - 2.8 fl oz	PHI = 21 days. Maximum of 11.2 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>bifenthrin</b> Tundra EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 18 days. Do not apply more than 0.3 lb active per acre per season.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 oz	PHI = 21 days. Do not apply more than 0.4 lb ai per acre per season. Do not make applications less than 30 days apart. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
<b>bifenthrin + imidacloprid</b> Swagger <i>RUP</i>	0.06 - 0.095	7.6 - 12.2 fl oz	PHI = 18 days. Apply a maximum of two applications per season. 30 day minimum between applications. Do not apply more than 24.4 oz of Swagger per acre per season (0.14 lb ai bifenthrin, 0.3 lb ai imidacloprid per acre per season).
<b>carbaryl</b> Sevin	1 - 1.5	rate varies by formulation	PHI = 21 days or 14 days of grazing or harvest for forage.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Yuma 4E <i>RUP</i>	0.5 - 1	1 - 2 pts (1 - 1.5 pts for Chlorpyrifos 4E AG)	PHI = 28 days. Do not apply more than 6 pints of chlorpyrifos products per acre per season or more than 3 applications per year. Maximum single application rate is 1 lb ai per acre. Do not make a second application within 14 days of first application. Do not allow meat or dairy animals to graze in treated areas or otherwise feed treated soybean foliage, hay, and straw to meat or dairy animals.
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.22 - 0.51 + 0.011 - 0.026	11 - 26 fl oz	PHI = 30 days. Do not make more than 3 applications or apply more than 59 fl oz per acre per season. Do not make a second application within 14 days of the first application. Do not allow meat or dairy animals to graze in treated area or feed treated soybean forage, hay, and straw to animals.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.044	1.6 - 2.8 fl oz	PHI = 45 days. Maximum of 11.2 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.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.018 - 0.028	1.5 - 2.4 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 21 days. Avoid application during heat of day. Do not apply more than 8.5 fl oz per acre per season. Do not allow livestock to graze treated forage or feed treated hay to livestock.
<b>diflubenzuron</b> Dimilin 2L <i>RUP</i>	0.062	4 fl oz	PHI = 21 days. Do not make more than 2 applications per season. Apply when larvae are small (<0.5 inches). Use 9 to 35 GPA total volume by ground, 3 to 5 GPA total volume by air.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not feed or graze livestock on treated fields. Do not apply more than 0.2 lb active per acre per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0125 - 0.015	3.2 - 3.84 fl oz	PHI = 30 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 (1 <sup>st</sup> and 2 <sup>nd</sup> instars) <i>RUP</i>	0.066	2.8 fl oz	PHI = currently 45 days. Please check the most current EPA label for any change in PHI. Minimum interval between applications = 7 days. Do not apply more than 9.0 fl oz per acre per season (0.07 lb ai beta-cyfluthrin, 0.14 lb ai imidacloprid). Leverage 360 can be applied through calibrated ground, aerial, or chemigation equipment.
<b>indoxacarb</b> Steward EC	0.055 - 0.11	5.6 - 11.3 fl oz	PHI = 21 days. Minimum interval between treatments is 5 days. Do not apply more than 45 fl oz per acre per season. Do not feed or graze livestock on treated fields.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.025 - 0.03	3.20 - 3.84 fl oz	PHI = 30 days for Silencer and Warrior. PHI = 45 days for Grizzly Z and Lambda-Cy. Do not allow graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.06 lb ai (7.68 fl oz) per acre per season. Use higher rates for larger larvae. When applying by air, apply in a minimum of 2 gals of water per acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.025 - 0.03	1.67 - 2.0 oz	PHI = 45 days. See other notes on restrictions above.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.025 - 0.03	1.60 - 1.92 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin + thiamethoxam</b> Endigo ZC <i>RUP</i>	0.024 - 0.031 + 0.032 - 0.041	3.5 - 4.5 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season of lambda-cyhalothrin containing products, or more than 0.125 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 3 GPA for aerial application. Do not graze or feed treated soybean for forage, straw or hay for livestock feed. Do not apply Endigo ZC within 45 days of planting soybean treated with a neonicotinoid.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225 - 0.3	0.75 - 1 pt	PHI = 14 days. Do not graze or harvest treated soybean within 3 days for forage, or 12 days for hay. Do not apply more than 1.35 lb ai per acre per season, or make more than 3 applications per crop. REI = 48 hours.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>methoxyfenozide</b> Intrepid (IGR)	0.06 - 0.12	4 - 8 fl oz	PHI = 7days of harvest of hay and forage or within 14 days of harvest of seed. Do not apply more than 64 fl oz per acre per season. Apply at first sign of feeding injury or when infestations reach threshold levels.
<b>spinetoram (microbial)</b> Radiant SC	0.016 - 0.031	2 - 4 fl oz	PHI = 28 days. Do not apply more than 14 fl oz (0.109 lb ai) per acre per year. Do not make more than 4 applications per calendar year. Do not make applications less than 4 days apart.
<b>spinosad (microbial)</b> Tracer	0.047 - 0.062	1.5 - 2 fl oz	PHI = 28 days. Do not feed treated forage or hay to meat or dairy animals.
<b>thiodicarb</b> Larvin brand 3.2 <i>RUP</i>	0.25 - 0.75	10 - 30 fl oz	PHI = 28 days. Do not feed forage, hay or straw to livestock. Do not exceed 0.75 lb AI per acre per application or 3.0 lb AI per acre per season. Do not apply more than 0.75 lb AI per acre in any 7 day period.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC <i>RUP</i>	0.02 0- 0.025	3.2 - 4 fl oz	PHI = 21 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 7 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.
<b>zeta-cypermethrin</b> Respect <i>RUP</i>	0.02 0- 0.025	3.2 - 4 fl oz	

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## BEAN LEAF BEETLE

Bean leaf beetles have been increasing in North Dakota over the past years. Adult bean leaf beetles emerge from overwintering sites and moving into soybean or dry bean fields. The adults are yellow to reddish-brown and three to four black spots with a black border on wing covers. Adults emerge from overwintering, moving into bean fields as the seedlings emerge. The white larvae develop in the soil, feeding on the roots and nodules. New adults emerging in August feed on foliage and pods. Feeding injury to leaves appears as small round holes between the leaf veins. Injury to pods appears as lesions similar in size and shape to leaf-feeding holes. The injury to pods results in secondary infections by fungi and bacteria, causing rotting and discoloration.

### Threshold:

Treatment thresholds from other regions are 3 to 7 beetles per sweep or based on defoliation -- 50% defoliation during early vegetative, 40% defoliation during pre-bloom, 35% defoliation during bloom and 20-25% defoliation or 10% pod feeding (or the presence of clipped pods) or 0.5 beetle/plant during pod set to fill. Late season feeding on the foliage and pods by the new adults that emerge in August appears to be more important than early season feeding. This may increase the risk of virus transmission and cause secondary infections (rotting and discoloration) from fungi and bacteria.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>acephate</b> Orthene 97 Pellets		0.75 - 1 lb	PHI = 14 days. Do not graze or cut vines for hay or forage. Do not apply more than 1.5 lbs per acre per season. For rates up to 0.5 lb per acre, at least 3 days must pass between applications. For rates up to 0.5 to 1 lb per acre, at least 7 days must pass between applications.
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0125 - 0.022	1.6 - 2.8 fl oz	PHI = 21 days. Maximum of 11.2 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>bifenthrin</b> Tundra EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 18 days. Do not apply more than 0.3 lb active per acre per season.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.025 - 0.06	2.6 - 6.1 oz	PHI = 21 days. Do not apply more than 0.4 lb ai per acre per season. Do not make applications less than 30 days apart. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
<b>bifenthrin + imidacloprid</b> Swagger <i>RUP</i>	0.06 - 0.095	7.6 - 12.2 fl oz	PHI = 18 days. Apply a maximum of two applications per season. 30 day minimum between applications. Do not apply more than 24.4 oz of Swagger per acre per season (0.14 lb ai bifenthrin, 0.3 lb ai imidacloprid per acre per season).
<b>carbaryl</b> Sevin	0.5 - 1.5	rate varies by formulation	PHI = 21 days or 14 days of grazing or harvest for forage.
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.31 - 0.74 + 0.016 - 0.038	16 - 38 fl oz	PHI = 30 days. Do not make more than 3 applications or apply more than 59 fl oz per acre per season. Do not make a second application within 14 days of the first application. Do not allow meat or dairy animals to graze in treated area or feed treated soybean forage, hay, and straw to animals.
<b>chlorpyrifos</b> Chlorpyrifos 4E Ag Lorsban 4E Lorsban Advanced Yuma 4E <i>RUP</i>	0.5 - 1	1 - 2 pt	PHI = 28 days. Do not apply more than 6 pints of chlorpyrifos products per acre per season or more than 3 applications per year. Maximum single application rate is 1 lb ai per acre. Do not make a second application within 14 days of first application. Do not allow meat or dairy animals to graze in treated areas or otherwise feed treated soybean foliage, hay, and straw to meat or dairy animals.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>clothianidin</b> Belay	0.05 - 0.1	3 - 6 fl oz	PHI = 21 days. Do not apply foliar treatments less than 7 days apart. Do not apply more than 0.2 lb ai per acre per season, regardless of formulation or type of application (foliar or seed treatment). Do not make foliar applications of Belay in fields treated with a neonicotinoid seed treatment within 45 days after planting. Do not graze or feed soybean forage and hay to livestock.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.044 0.016 - 0.025	1.6 - 2.8 fl oz 1.0 - 1.6 fl oz*	PHI = 45 days. Maximum of 11.2 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. *Reduced rate for soybeans between the growth stages VC - V2 only.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.018 - 0.028	1.5 - 2.4 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 21 days. Avoid application during heat of day. Do not apply more than 8.5 fl oz per acre per season. Do not allow livestock to graze treated forage or feed treated hay to livestock.
<b>dimethoate</b> Digon 400 Dimethoate 400 Dimethoate 2.67 EC	0.5 - 0.67	1 - 1 1/3 pt	PHI = 21 days. Do not feed or graze within 5 days of last application. Do not enter treated fields without protective clothing until sprays have dried.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not feed or graze livestock on treated fields. Do not apply more than 0.2 lb active per acre per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.0125	1.92 - 3.2 fl oz	PHI = 30 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.



INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate	1.6 - 3.2 fl oz per cwt of seed	Apply as a commercial seed treatment only. Do not graze or feed livestock on soybean forage or hay. To suppress the spread of certain viruses by bean leaf beetle (control of overwintering population). Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Gaucho 600	refer to recommended label rate	1.6 - 3.2 fl oz per cwt of seed	Apply as an on-farm or commercial seed treatment at planting time. Do not graze or feed livestock on soybean forage or hay. To suppress the spread of certain viruses by bean leaf beetle (control of overwintering population). Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Enhance AW	refer to recommended label rate	5 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. Do not graze or feed livestock on soybean forage or hay. Follow all applicable directions, restrictions and precautions on the EPA registered label. For control of overwintering and early season bean leaf beetles.
<b>imidacloprid</b> Latitude	refer to recommended label rate	4 oz per cwt of seed	Apply as an on-farm seed treatment at planting time. Follow all applicable directions, restrictions and precautions on the EPA registered label. For control of overwintering and early season bean leaf beetles.
<b>imidacloprid</b> Mana Alias 4F	0.047	1.5 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum of 4.5 fl oz per acre (0.14 lb ai per acre) per crop season.
<b>imidacloprid</b> Nuprid 1.6 F	0.047	3.75 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum of 11.25 fl oz per acre (0.14 lb ai per acre) per crop season.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.066	2.8 fl oz	PHI = currently 45 days. Please check the most current EPA label for any change in PHI. Minimum interval between applications = 7 days. Do not apply more than 9.0 fl oz per acre per season (0.07 lb ai beta-cyfluthrin, 0.14 lb ai imidacloprid). Leverage 360 can be applied through calibrated ground, aerial, or chemigation equipment.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 30 days for Silencer and Warrior. PHI = 45 days for Grizzly Z and Lambda-Cy. Do not allow graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.06 lb ai (7.68 fl oz) per acre per season. Use higher rates for larger larvae. When applying by air, apply in a minimum of 2 gals of water per acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.015 - 0.025	1.0 - 1.67 oz	PHI = 45 days. See other notes on restrictions above.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin + thiamethoxam</b> Endigo ZC <i>RUP</i>	0.024 - 0.031 + 0.032 - 0.041	3.5 - 4.5 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season of lambda-cyhalothrin containing products, or more than 0.125 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 3 GPA for aerial application. Do not graze or feed treated soybean for forage, straw or hay for livestock feed. Do not apply Endigo ZC within 45 days of planting soybean treated with a neonicotinoid.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>methomyl</b> Lannate LV <i>RUP</i>	0.23 - 0.45	0.75 - 1.5 pts	PHI = 14 days. Do not graze or harvest treated soybean within 3 days for forage, or 12 days for hay. Do not apply more than 1.35 lb ai per acre per season, or make more than 3 applications per crop. REI = 48 hours.
<b>methyl parathion</b> Pencap-M <i>RUP</i>	0.5 - 0.75	2 - 3 pts.	PHI = 20 days of harvest or grazing. Do not apply more than twice per season. Do not enter treated fields within 48 hours after application.
<b>permethrin</b> Pounce 3.2 EC Arctic 3.2EC Ambush Permethrin 3.2 EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.05 to 0.1	2 - 4 fl oz 2 - 4 fl oz 3.2 - 6.4 fl oz 2 - 4 fl oz 3.2 - 6.4 fl oz 2 - 4 fl oz	PHI = 60 days. Do not apply more than 0.4 pounds ai per acre per season. Do not graze or feed soybean forage or hay. For Pounce, apply a minimum of 1 gal of finished spray per acre by air or 5 gals by ground. For Ambush, apply a minimum of 2 gals of finished spray/a by air or 10 gals by ground.
<b>thiodicarb</b> Larvin brand 3.2 <i>RUP</i>	0.45 - 0.75	18 - 30 fl oz	PHI = 28 days. Do not feed forage, hay or straw to livestock. Do not exceed 0.75 lb AI per acre per application or 3.0 lb AI per acre per season. Do not apply more than 0.75 lb AI per acre in any 7 day period.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.0175 - 0.025	2.8 - 4 fl oz	PHI = 21 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 7 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## CUTWORMS

Several cutworm species affect regional crops. The dingy cutworm, *Feltia jaculifera*, overwinters as a partially grown larva and is one of the first cutworm species to cause problems during crop emergence from early to mid-May. The moth of the dingy cutworm is known to lay her eggs on sunflower heads from mid-July through September. Soybeans and other crops following sunflowers in rotation are at greatest risk of injury by this cutworm. Other cutworms, the red-backed, *Exoa ochregaster*, and the darksided, *Exoa messoria*, overwinter as eggs which hatch in mid to late May. Eggs are laid in the fall and survive in weedy, wet and reduced tillage areas. Feeding injury by these cutworms normally occurs in late May to early June.

Most damage by cutworms occurs when soybean 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 soybean 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:

Economic thresholds for cutworm treatment decisions are not well established. Treatment guidelines used over the years include when one cutworm or more is found per 3 feet of row and the larvae are small (<3/4 inch long). Another guideline is when 20% of plants are cut or when gaps of 1 foot or more exist in the plant row. When making a final decision, consider that surviving soybeans are able to compensate for early stand reductions because of the plant's long growth period.

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 = 21 days. Maximum of 11.2 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>bifenthrin</b> Tundra EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 18 days. Do not apply more than 0.3 lb active per acre per season.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.025 - 0.06	2.6 - 6.1 oz	PHI = 21 days. Do not apply more than 0.4 lb ai per acre per season. Do not make applications less than 30 days apart. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
<b>bifenthrin + imidacloprid</b> Swagger <i>RUP</i>	0.06 - 0.095	7.6 - 12.2 fl oz	PHI = 18 days. Apply a maximum of two applications per season. 30 day minimum between applications. Do not apply more than 24.4 oz of Swagger per acre per season (0.14 lb ai bifenthrin, 0.3 lb ai imidacloprid per acre per season).
<b>carbaryl</b> Sevin	1 - 1.5	rate varies by formulation	PHI = 21 days of harvest or 14 days of grazing or harvest for forage. For cutworm control, this product is effective against species which feed on the upper portions of the plants.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Yuma 4E <i>RUP</i>	0.5 - 1	1 - 2 pts	PHI = 28 days. Do not apply more than 6 pints of chlorpyrifos products per acre per season or more than 3 applications per year. Maximum single application rate is 1 lb ai per acre. Do not make a second application within 14 days of first application. Do not allow meat or dairy animals to graze in treated areas or otherwise feed treated soybean foliage, hay, and straw to meat or dairy animals.
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.22 - 0.51 + 0.011 - 0.026	11 - 26 fl oz	PHI = 30 days. Do not make more than 3 applications or apply more than 59 fl oz per acre per season. Do not make a second application within 14 days of the first application. Do not allow meat or dairy animals to graze in treated area or feed treated soybean forage, hay, and straw to animals.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.013 - 0.025	0.8 - 1.6 fl oz	PHI = 45 days. Maximum of 11.2 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>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.018	1.0 - 1.5 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 21 days. Avoid application during heat of day. Do not apply more than 8.5 fl oz per acre per season. Do not allow livestock to graze treated forage or feed treated hay to livestock.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not feed or graze livestock on treated fields. Do not apply more than 0.2 lb active per acre per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.0125	1.92 - 3.2 fl oz	PHI = 30 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.066	2.8 fl oz	PHI = currently 45 days. Please check the most current EPA label for any change in PHI. Minimum interval between applications = 7 days. Do not apply more than 9.0 fl oz per acre per season (0.07 lb ai beta-cyfluthrin, 0.14 lb ai imidacloprid). Leverage 360 can be applied through calibrated ground, aerial, or chemigation equipment.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 30 days for Silencer and Warrior. PHI = 45 days for Grizzly Z and Lambda-Cy. Do not allow graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.06 lb ai (7.68 fl oz) per acre per season. Use higher rates for larger larvae. When applying by air, apply in a minimum of 2 gals of water per acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.015 - 0.025	1.0 - 1.67 oz	PHI = 45 days. See other notes on restrictions above.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin + thiamethoxam</b> Endigo ZC <i>RUP</i>	0.017 - 0.024 + 0.023 - 0.032	2.5 - 3.5 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season of lambda-cyhalothrin containing products, or more than 0.125 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 3 GPA for aerial application. Do not graze or feed treated soybean for forage, straw or hay for livestock feed. Do not apply Endigo ZC within 45 days of planting soybean treated with a neonicotinoid.
<b>permethrin</b> Pounce 3.2 EC Arctic 3.2EC Ambush Permethrin 3.2 EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.05 to 0.1	2 - 4 fl oz 2 - 4 fl oz 3.2 - 6.4 fl oz 2 - 4 fl oz 3.2 - 6.4 fl oz 2 - 4 fl oz	PHI = 60 days. Do not apply more than 0.4 pounds ai per acre per season. Do not graze or feed soybean forage or hay. For Pounce, apply a minimum of 1 gal of finished spray per acre by air or 5 gals by ground. For Ambush, apply a minimum of 2 gals of finished spray/a by air or 10 gals by ground.
<b>thiodicarb</b> Larvin brand 3.2 <i>RUP</i>	0.5 - 0.75	20 - 30 fl oz	PHI = 28 days. Do not feed forage, hay or straw to livestock. Do not exceed 0.75 lb AI per acre per application or 3.0 lb AI per acre per season. Do not apply more than 0.75 lb AI per acre in any 7 day period.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.008 - 0.025	1.28 - 4 fl oz	PHI = 21 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 7 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## FOLIAGE FEEDING CATERPILLARS

### Green Cloverworm, Cabbage Looper, Velvetbean Caterpillar, Thistle Caterpillar and Alfalfa Webworm

Populations of these caterpillars have been negligible in North Dakota and little treatment to control them has been required. Sampling for these insects is accomplished through the use of a drop cloth or a vertical beat sheet, placed between two rows of plants. The larvae are dislodged from the plants and counted on the cloth or collection tray to arrive at an estimate of the number per row feet.

**Green cloverworm:** These caterpillars are green with two narrow, white stripes down the side. When mature, the worms are 1 ¼ inches long. These caterpillars have only three pairs of fleshy prolegs on the abdomen, plus a pair of prolegs on the back segment. When moving, the worms move by arching the middle of the body, or "looping." Young worms scrape leaf tissue creating a transparent skin, or "window," on the leaf surface. Older cloverworms eat holes in the leaves.

**Cabbage looper:** These caterpillars are light to dark green, with lighter colored stripes along the side and on the top, running the length of the body. When mature, the worms are 1 ½ inches long. These caterpillars have only two pairs of fleshy prolegs on the abdomen, plus the pair on the back tip. When moving, the caterpillars move by arching the middle of the

body, or “looping.” These worms feed on leaves in the interior and lower portion of the plant. As defoliation occurs, worms feed higher in the plant. Feeding injury is similar to the cloverworm.

**Velvetbean caterpillar:** This insect does not overwinter in the region; instead, moths migrate from Southern locations. These caterpillars have dark lines bordered by lighter colored, narrower lines running the length of the body. The background color ranges from a pale yellow-green to brown or black. These larvae have four pairs of fleshy prolegs to distinguish them from the cloverworm and the looper. Young velvetbean caterpillars feed on the underside of leaves in the upper portion of the plant. Older larvae consume the entire leaf, except for the leaf veins.

**Thistle caterpillar:** This insect is the larva of the butterfly known as the Painted Lady. This butterfly does not overwinter in the region, but migrates from Southern locations each spring. These caterpillars are brown to black in color with yellow stripes along each side of the body. They are covered with spiny hairs that give the caterpillar a prickly appearance. Full grown larvae are about 1 ½ inches long. The caterpillars feed on the leaves, webbing them together at the feeding site.

**Alfalfa webworm:** These larvae are 1 inch when full grown. They are greenish to nearly black with a light stripe that runs down the middle of the back. There are three dark spots, each with hairs, on the side of each segment. These larvae feed for about 3+ weeks. Infestations are characterized by light webbing over the leaves. Beneath the web is where the larvae feed, consuming the leaves. These larvae move very rapidly, forward or backward, when disturbed.

**Threshold:**

Rather than using thresholds for individual defoliating insect species present in the field consider total leaf area lost as a threshold when defoliators are actively feeding: vegetative 50%, bloom 40%, bloom-pod fill 20% and pod fill-harvest 35%.

An average infestation of 4 to 8 larvae per row foot typically caused 20-30% defoliation.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acephate</b> Orthene 97 Pellets		0.75 - 1 lb	PHI = 14 days. Do not graze or cut vines for hay or forage. Do not apply more than 1.5 lbs per acre per season. For rates up to 0.5 lb per acre, at least 3 days must pass between applications. For rates up to 0.5 to 1 lb per acre, at least 7 days must pass between applications.
<b>Bacillus thuringiensis</b> DiPel DF For Organic Production		0.5 - 1 lb	No preharvest interval. 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.
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0125 - 0.022	1.6 - 2.8 fl oz	PHI = 21 days. Maximum of 11.2 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>bifenthrin</b> Tundra EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 18 days. Do not apply more than 0.3 lb active per acre per season.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.025 - 0.06	2.6 - 6.1 oz	PHI = 21 days. Do not apply more than 0.4 lb ai per acre per season. Do not make applications less than 30 days apart. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
<b>bifenthrin + imidacloprid</b> Swagger <i>RUP</i>	0.06 - 0.095	7.6 - 12.2 fl oz	PHI = 18 days. Apply a maximum of two applications per season. 30 day minimum between applications. Do not apply more than 24.4 oz of Swagger per acre per season (0.14 lb ai bifenthrin, 0.3 lb ai imidacloprid per acre per season).
<b>carbaryl</b> Sevin	0.5 to 1.5	rate varies by formulation	PHI = 21 days or 14 days of grazing or harvest for forage.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Yuma 4E <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	PHI = 28 days. Do not apply more than 6 pints of chlorpyrifos products per acre per season or more than 3 applications per year. Maximum single application rate is 1 lb ai per acre. Do not make a second application within 14 days of first application. Do not allow meat or dairy animals to graze in treated areas or otherwise feed treated soybean foliage, hay, and straw to meat or dairy animals.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.22 - 0.51 + 0.011 - 0.026	11 - 26 fl oz	PHI = 30 days. Do not make more than 3 applications or apply more than 59 fl oz per acre per season. Do not make a second application within 14 days of the first application. Do not allow meat or dairy animals to graze in treated area or feed treated soybean forage, hay, and straw to animals.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.044	1.6 - 2.8 fl oz	PHI = 45 days. Maximum of 11.2 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>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.018 (0.018 - 0.028 for cabbage looper)	1.0 - 1.5 fl oz (1.5 - 2.4 fl oz for cabbage looper)	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 21 days. Avoid application during heat of day. Do not apply more than 8.5 fl oz per acre per season. Do not allow livestock to graze treated forage or feed treated hay to livestock.
<b>dimethoate</b> Digon 400 Dimethoate 400 Dimethoate 2.67 EC	0.5 - 0.67	1 - 1 1/8 pt	PHI = 21 days. Do not feed or graze within 5 days of last application. Do not enter treated fields without protective clothing until sprays have dried.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.015 to 0.03	2.9 to 5.8 fl oz	PHI = 21 days. Do not feed or graze livestock on treated fields. Do not apply more than 0.2 lb active per acre per season.
<b>diflubenzuron</b> Dimilin 2L <i>RUP</i>	0.031 - 0.062	2 - 4 fl oz	PHI = 21 days. Do not make more than 2 applications per season. Allow 30 days between application intervals. Apply when larvae are small (<0.5 inches). Use 9 to 35 GPA total volume by ground, 3 to 5 GPA total volume by air.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0125 - 0.015	3.2 - 3.84 fl oz	PHI = 30 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.066	2.8 fl oz	PHI = currently 45 days. Please check the most current EPA label for any change in PHI. Minimum interval between applications = 7 days. Do not apply more than 9.0 fl oz per acre per season (0.07 lb ai beta-cyfluthrin, 0.14 lb ai imidacloprid). Leverage 360 can be applied through calibrated ground, aerial, or chemigation equipment.
<b>indoxacarb</b> Steward EC	0.055 - 0.11	5.6 - 11.3 fl oz	PHI = 21 days. Minimum interval between treatments is 5 days. Do not apply more than 45 fl oz per acre per season. Do not feed or graze livestock on treated fields.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 30 days for Silencer and Warrior. PHI = 45 days for Grizzly Z and Lambda-Cy. Do not allow graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.06 lb ai per acre per season. Use higher rates for larger larvae. When applying by air, apply in a minimum of 2 gals of water per acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.015 - 0.025	1.0 - 1.67 oz	PHI = 45 days. See other notes on restrictions above.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin + thiamethoxam</b> Endigo ZC <i>RUP</i>	0.017 - 0.024 + 0.023 - 0.032	2.5 - 3.5 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season of lambda-cyhalothrin containing products, or more than 0.125 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 3 GPA for aerial application. Do not graze or feed treated soybean for forage, straw or hay for livestock feed. Do not apply Endigo ZC within 45 days of planting soybean treated with a neonicotinoid.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.11 to 0.45	0.4 to 1.5 pts	PHI = 14 days. Do not graze or harvest treated soybean within 3 days for forage, or 12 days for hay. Do not apply more than 1.35 lb ai per acre per season, or make more than 3 applications per crop. REI = 48 hours.
<b>methoxyfenozide</b> Intrepid	0.06 - 0.12	4 - 8 fl oz	PHI = 7 days of harvest of hay and forage or within 14 days of harvest of seed. Do not apply more than 64 fl oz per acre per season. Apply at first sign of feeding injury or when infestations reach threshold levels.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5	2 pts.	PHI = 20 days of harvest or grazing. Do not apply more than twice per season. Do not enter treated fields within 48 hours after application.
<b>permethrin</b> Pounce 3.2 EC Arctic 3.2E Ambush Permethrin 3.2 EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.05 to 0.1	2 - 4 fl oz 2 - 4 fl oz 3.2 - 6.4 fl oz 2 - 4 fl oz 3.2 - 6.4 fl oz 2 - 4 fl oz	PHI = 60 days. Do not apply more than 0.4 pounds ai per acre per season. Do not graze or feed soybean forage or hay. For Pounce, apply a minimum of 1 gal of finished spray per acre by air or 5 gals by ground. For Ambush, apply a minimum of 2 gals of finished spray/a by air or 10 gals by ground.
<b>spinetoram (microbial)</b> Radiant SC	0.016 - 0.031	2 - 4 fl oz	PHI = 28 days. Do not apply more than 14 fl oz (0.109 lb ai) per acre per year. Do not make more than 4 applications per calendar year. Do not make applications less than 4 days apart.
<b>spinosad (microbial)</b> Tracer	0.031 - 0.062	1 - 2 fl oz	PHI = 28 days. Do not feed treated forage or hay to meat or dairy animals.
<b>thiodicarb</b> Larvin brand 3.2 <i>RUP</i>	0.25 - 0.75	10 - 30 fl oz	PHI = 28 days. Do not feed forage, hay or straw to livestock. Do not exceed 0.75 lb AI per acre per application or 3.0 lb AI per acre per season. Do not apply more than 0.75 lb AI per acre in any 7 day period.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.0175 - 0.025	2.8 - 4 fl oz	PHI = 21 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 7 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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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. Soybean growers should expect to find grasshoppers feeding first along bean field margins adjacent to non-crop sites where the nymphs are hatching. Later infestations may develop when grasshopper adults migrate from harvested small grain fields. Grasshoppers will feed upon leaves and pods, chewing holes in them. A result of these migrations is soybean fields becoming sites for significant egg laying.

**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 soybeans will be the heaviest on the field margins. Treating these areas may lessen the total numbers of grasshoppers successfully entering a field.

Soybeans are most sensitive to defoliation during pod development (growth stages R4 to R6). During this time, plants can only tolerate up to 20% defoliation. Of greater concern would be direct feeding damage to pods and seeds. Grasshoppers are able to chew directly through the pod walls and damage seed directly. If more than 5% to 10% of the pods are injured by grasshoppers, an insecticide application would be recommended.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acephate</b> Orthene 97 Pellets		0.25 - 0.5 lb	PHI = 14 days. Do not graze or cut vines for hay or forage. Do not apply more than 1.5 lbs per acre per season. For rates up to 0.5 lb per acre, at least 3 days must pass between applications. For rates up to 0.5 to 1 lb per acre, at least 7 days must pass between applications.
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0155 - 0.022	2.0 - 2.8 fl oz	PHI = 21 days. Maximum of 11.2 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>bifenthrin</b> Tundra EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 18 days. Do not apply more than 0.3 lb active per acre per season.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.025 - 0.06	2.6 - 6.1 oz	PHI = 21 days. Do not apply more than 0.4 lb ai per acre per season. Do not make applications less than 30 days apart. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
<b>bifenthrin + imidacloprid</b> Swagger <i>RUP</i>	0.06 - 0.095	7.6 - 12.2 fl oz	PHI = 18 days. Apply a maximum of two applications per season. 30 day minimum between applications. Do not apply more than 24.4 oz of Swagger per acre per season (0.14 lb ai bifenthrin, 0.3 lb ai imidacloprid per acre per season).
<b>carbaryl</b> Sevin	1 - 1.5	rate varies by formulation	PHI = 21 days or 14 days of grazing or harvest for forage. Recommended use rates vary according the age of the grasshoppers.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Yuma 4E <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	Low rate effective on 1st and 2nd instar nymphs. PHI = 28 days. Do not apply more than 6 pints of chlorpyrifos products per acre per season or more than 3 applications per year. Maximum single application rate is 1 lb ai per acre. Do not make a second application within 14 days of first application. Do not allow meat or dairy animals to graze in treated areas or otherwise feed treated soybean foliage, hay, and straw to meat or dairy animals.



<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.12 - 0.25 + 0.006 - 0.013	6 - 13 fl oz	PHI = 30 days. Do not make more than 3 applications or apply more than 59 fl oz per acre per season. Do not make a second application within 14 days of the first application. Do not allow meat or dairy animals to graze in treated area or feed treated soybean forage, hay, and straw to animals.
<b>chlorpyrifos + zeta- cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.031 - 0.044	2.0 - 2.8 fl oz	PHI = 45 days. Maximum of 11.2 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>deltamethrin</b> Delta Gold <i>RUP</i>	0.018 - 0.028	1.5 - 2.4 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 21 days. Avoid application during heat of day. Do not apply more than 8.5 fl oz per acre per season. Do not allow livestock to graze treated forage or feed treated hay to livestock.
<b>diflubenzuron</b> Dimilin 2L <i>RUP</i>	0.031	2 fl oz	PHI = 21 days. Do not make more than 2 applications per season. Allow 30 days between application intervals. For best results, apply when grasshoppers reach the 2 <sup>nd</sup> to 3 <sup>rd</sup> nymphal stage of development (not effective on adult grasshoppers). Use 9 to 35 GPA total volume by ground, 3 to 5 GPA total volume by air.
<b>dimethoate</b> Digon 400 Dimethoate 400 Dimethoate 2.67 EC	0.5 - 0.67	1 - 1 1/3 pt	PHI = 21 days. Do not feed or graze within 5 days of last application. Do not enter treated fields without protective clothing until sprays have dried.
<b>esfenvalerate</b> Adjourn <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not feed or graze livestock on treated fields. Do not apply more than 0.2 lb active 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>	0.0125 - 0.015	3.2 - 3.84 fl oz	PHI = 30 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
<b>imidacloprid + beta- cyfluthrin</b> Leverage 360 <i>RUP</i>	0.066	2.8 fl oz	PHI = currently 45 days. Please check the most current EPA label for any change in PHI. Minimum interval between applications = 7 days. Do not apply more than 9.0 fl oz per acre per season (0.07 lb ai beta-cyfluthrin, 0.14 lb ai imidacloprid). Leverage 360 can be applied through calibrated ground, aerial, or chemigation equipment.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.025 - 0.03	3.2 - 3.84 fl oz	PHI = 30 days for Silencer and Warrior. PHI = 45 days for Grizzly Z and Lambda-Cy. Do not allow graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.06 lb ai per acre per season. Use higher rates for larger larvae. When applying by air, apply in a minimum of 2 gals of water per acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.025 - 0.03	1.67 - 2.0 oz	PHI = 45 days. See other notes on restrictions above.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.025 - 0.03	1.60 - 1.92 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin + thiamethoxam</b> Endigo ZC <i>RUP</i>	0.024 - 0.031 + 0.032 - 0.041	3.5 - 4.5 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season of lambda-cyhalothrin containing products, or more than 0.125 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 3 GPA for aerial application. Do not graze or feed treated soybean for forage, straw or hay for livestock feed. Do not apply Endigo ZC within 45 days of planting soybean treated with a neonicotinoid.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 0.75	2 - 3 pts	PHI = 20 days of harvest or grazing. Do not apply more than twice per season. Do not enter treated fields within 48 hours after application. Fields must be posted.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.02 - 0.025	3.2 - 4 fl oz	PHI = 21 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 7 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## POTATO LEAFHOPPER

The adult is wedge-shaped and pale green in color. Adults are very active, jumping or flying when disturbed. Nymphs are wingless. Both adults and nymphs run backwards or sideways rapidly when disturbed. Nymphs feed on the underside of the leaf, usually completing their growth on the leaves near where they hatched. Large numbers of adults may appear early in the season, but their presence is dependent on migration from the eastern United States.

Soybeans with moderate to dense pubescence, or plant hairs, are tolerant to leafhopper infestations. The short plant hairs form a barrier that discourages leafhoppers from feeding and ovipositing eggs on plant tissue. When feeding does occur, damage by leafhoppers is referred to as hopper-burn. Foliage becomes dwarfed, crinkled and curled. Small triangular brown areas appear at the tips of leaves, gradually spreading around the entire leaf margin. Potential damage to soybeans by potato leafhopper is based on very limited research data. Damage would be more likely when drier growing conditions occur.

### Threshold:

The threshold for basing spray decisions is when an average of 5 leafhoppers (adults + nymphs) per plant are found in the vegetative stages, and 9 leafhoppers (adults + nymphs) per plant in early bloom stages. A treatment should be considered when visible injury symptoms are combined with large leafhopper populations.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>acephate</b> Orthene 97 Pellets		0.5 - 1 lb	PHI = 14 days. Do not graze or cut vines for hay or forage. Do not apply more than 1.5 lbs per acre per season. For rates up to 0.5 lb per acre, at least 3 days must pass between applications. For rates up to 0.5 to 1 lb per acre, at least 7 days must pass between applications.
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0065 - 0.0125	0.8 - 1.6 fl oz	PHI = 21 days. Maximum of 11.2 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>bifenthrin</b> Tundra EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 18 days. Do not apply more than 0.3 lb active per acre per season.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 oz	PHI = 21 days. Do not apply more than 0.4 lb ai per acre per season. Do not make applications less than 30 days apart. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
<b>bifenthrin + imidacloprid</b> Swagger <i>RUP</i>	0.06 - 0.095	7.6 - 12.2 fl oz	PHI = 18 days. Apply a maximum of two applications per season. 30 day minimum between applications. Do not apply more than 24.4 oz of Swagger per acre per season (0.14 lb ai bifenthrin, 0.3 lb ai imidacloprid per acre per season).
<b>carbaryl</b> Sevin	1	rate varies by formulation	PHI = 21 days or 14 days of grazing or harvest for forage.
<b>chlorpyrifos</b> Lorsban Advanced <i>RUP</i>	0.5 - 1	1 -2 pt	PHI = 28 days. Do not apply more than 6 pints of chlorpyrifos products per acre per season or more than 3 applications per year. Maximum single application rate is 1 lb ai per acre. Do not make a second application within 14 days of first application. Do not allow meat or dairy animals to graze in treated areas or otherwise feed treated soybean foliage, hay, and straw to meat or dairy animals.
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.31 - 0.74 + 0.016 - 0.038	16 - 38 fl oz	PHI = 30 days. Do not make more than 3 applications or apply more than 59 fl oz per acre per season. Do not make a second application within 14 days of the first application. Do not allow meat or dairy animals to graze in treated area or feed treated soybean forage, hay, and straw to animals.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>clothianidin</b> Belay	0.05 - 0.1	3 - 6 fl oz	PHI = 21 days. Do not apply foliar treatments less than 7 days apart. Do not apply more than 0.2 lb ai per acre per season, regardless of formulation or type of application (foliar or seed treatment). Do not make foliar applications of Belay in fields treated with a neonicotinoid seed treatment within 45 days after planting. Do not graze or feed soybean forage and hay to livestock.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.013 - 0.025	0.8 - 1.6 fl oz	PHI = 45 days. Maximum of 11.2 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>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.018	1.0 - 1.5 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 21 days. Avoid application during heat of day. Do not apply more than 8.5 fl oz per acre per season. Do not allow livestock to graze treated forage or feed treated hay to livestock.
<b>dimethoate</b> Digon 400 Dimethoate 400 Dimethoate 2.67 EC	0.5 - 0.67	1 - 1 ½ pt	PHI = 21 days. Do not feed or graze within 5 days of last application. Do not enter treated fields without protective clothing until sprays have dried.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.015 to 0.03	2.9 to 5.8 fl oz	PHI = 21 days. Do not feed or graze livestock on treated fields. Do not apply more than 0.2 lb active per acre per season.
<b>imidacloprid</b> Mana Alias 4F	0.047	1.5 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum of 4.5 fl oz per acre (0.14 lb ai per acre) per crop season.
<b>imidacloprid</b> Nuprid 1.6 F	0.047	3.75 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum of 11.25 fl oz per acre (0.14 lb ai per acre) per crop season.
<b>imidacloprid + beta-cyfluthrin</b> Leverage 360 <i>RUP</i>	0.066	2.8 fl oz	PHI = currently 45 days. Please check the most current EPA label for any change in PHI. Minimum interval between applications = 7 days. Do not apply more than 9.0 fl oz per acre per season (0.07 lb ai beta-cyfluthrin, 0.14 lb ai imidacloprid). Leverage 360 can be applied through calibrated ground, aerial, or chemigation equipment.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.0125	1.92 - 3.2 fl oz	PHI = 30 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 30 days for Silencer and Warrior. PHI = 45 days for Grizzly Z and Lambda-Cy. Do not allow graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.06 lb ai (7.68 fl oz) per acre per season. Use higher rates for larger larvae. When applying by air, apply in a minimum of 2 gals of water per acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.015 - 0.025	1.0 - 1.67 oz	PHI = 45 days. See other notes on restrictions above.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.25	0.96 - 1.60 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin + thiamethoxam</b> Endigo ZC <i>RUP</i>	0.017 - 0.024 + 0.023 - 0.032	2.5 - 3.5 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season of lambda-cyhalothrin containing products, or more than 0.125 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 3 GPA for aerial application. Do not graze or feed treated soybean for forage, straw or hay for livestock feed. Do not apply Endigo ZC within 45 days of planting soybean treated with a neonicotinoid.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 0.75	2 - 3 pts.	PHI = 20 days of harvest or grazing. Do not apply more than twice per season. Do not enter treated fields within 48 hours after application.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>permethrin</b> Pounce 3.2 EC Arctic 3.2EC Ambush Permethrin 3.2 EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.05 to 0.1	2 - 4 fl oz 2 - 4 fl oz 3.2 - 6.4 fl oz 2 - 4 fl oz 3.2 - 6.4 fl oz 2 - 4 fl oz	PHI = 60 days. Do not apply more than 0.4 pounds ai per acre per season. Do not graze or feed soybean forage or hay. For Pounce, apply a minimum of 1 gal of finished spray per acre by air or 5 gals by ground. For Ambush, apply a minimum of 2 gals of finished spray/a by air or 10 gals by ground.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.0175 - 0.025	2.8 - 4 fl oz	PHI = 21 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 7 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

*RUP* - Restricted use pesticide

## SEED CORN MAGGOT

Seedcorn maggot attacks soybean seed, preventing sprouting or weakening the seedlings. The yellowish white maggot is found burrowing in the seed, emerging stem or the cotyledon leaves. Damage to the seedlings results in a condition called "snakeheads," or plants without cotyledon leaves.

The adult flies emerge in spring when soil temperatures reach 50° F. They deposit eggs in soil where there is abundant organic matter and decaying crop residue, or on the seed or seedling. Injury from seedcorn maggots is usually most severe during wet, cold springs and in fields with high organic matter soils. When cool, wet conditions occur during planting, the slow emergence of the seedling extends the period of time it is vulnerable to feeding by the maggot.

### Threshold:

When conditions are wet and cool, or when planting into high crop residue conditions, seed treatments provide the best defense against injury. For additional information on seed treatments, refer to page 7.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>clothianidin</b> Inovate System	refer to recommended label rate	refer to recommended label rate	Inovate system is a combination of clothianidin and fungicides. Refer to EPA registered labels for directions, precautions and restrictions.
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate	1.6 - 3.2 fl oz per cwt of seed	Apply as a commercial seed treatment only. Do not graze or feed livestock on soybean forage or hay. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Enhance AW	refer to recommended label rate	5 oz per cwt of seed	Apply as an on-farm seed treatment at planting time. Do not graze or feed livestock on soybean forage or hay. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Latitude	refer to recommended label rate	4 oz per cwt of seed	Apply as an on-farm seed treatment at planting time. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>permethrin</b>	see specific labels for rates		Products currently available are: Assault 25®. Treated seed must not be used for, or mixed with, food or animal feed, or processed for oil.
<b>thiamethoxam</b> Cruiser 5FS	refer to recommended label rate	1.28 fl oz per cwt of seed	Use as a seed treatment only. May be applied through either open or closed systems. Do not apply a neonicotinoid insecticide within 45 days of planting soybean seed treated with Cruiser 5FS. Follow all applicable directions, restrictions and precautions on the EPA registered label.

## SOYBEAN APHID

A new aphid pest feeding on soybeans was found in the Midwestern states of Michigan, Illinois, Wisconsin, Iowa, and Minnesota in late July and early August 2000. It was confirmed that this aphid was the **soybean aphid**, *Aphis glycines*, an aphid native to Asia but never reported in the United States prior to this discovery. Soybean aphid was found in North Dakota in August 2001. The aphid is generally established in the eastern half of the state, but there are still many questions about the population levels surviving through the winter.

The soybean aphid is light yellow with black cornicles ("tail-pipes") and a pale colored cauda (tail projection). As with other aphids, the soybean aphid is small, about the size of a pinhead. Nymphs are smaller.

Aphids suck fluid from plants. When infestations are large, infested leaves are wilted or curled. The aphids excrete honeydew, a sweet substance that accumulates on surfaces of lower leaves and promotes the growth of sooty mold. This aphid colonizes tender leaves and branches from seedling to blooming. Later, as the growing point slows, the aphids slow their reproductive rate, move down to the middle and lower part of the plant, and feed on the undersides of leaves. Toward the end of the season, the colonies begin to rapidly increase in number again. These increases are followed by a migration to the overwintering, alternate host, buckthorn. Future observations will lead to a better understanding of what soybean aphid will do in the United States.

### Threshold:

Currently, the guidelines for making soybean aphid treatment decisions are:

- Begin scouting soybean fields at the V3 to V4 stage to determine if soybean aphids are present in fields. No treatment is recommended at this time and is discouraged so insecticides do not reduce the presence of predators and parasites.
- The critical growth stage for making most soybean aphid treatment decisions appears to be the late vegetative to early reproductive stages (Vn to R3). Assessing aphid populations at this time is critical. Typically aphid treatments occur from mid-July to mid-August.
- **Economic Thresholds** are based on the following growth stages:
  - R1 to R5 (beginning seed) = 250 aphids/plant when populations are actively increasing in 80% of field
  - R6 (full seed) = No treatment necessary. Research trials throughout the north central states have not demonstrated a yield benefit to treating soybean for soybean aphid management at the R6 and beyond stages.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acephate</b> Orthene 97 Pellets		0.75 - 1 lb	PHI = 14 days. Do not graze or cut vines for hay or forage. Do not apply more than 1.5 lbs per acre per season. For rates up to 0.5 lb per acre, at least 3 days must pass between applications. For rates up to 0.5 to 1 lb per acre, at least 7 days must pass between applications.
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0065 - 0.0125	2.0 - 2.8 fl oz	PHI = 21 days. Maximum of 11.2 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>bifenthrin</b> Tundra EC <i>RUP</i>	0.033 - 0.10	2.1 - 6.4 fl oz	PHI = 18 days. Do not apply more than 0.3 lb active per acre per season.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 oz	PHI = 21 days. Do not apply more than 0.4 lb ai per acre per season. Do not make applications less than 30 days apart. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
<b>bifenthrin + imidacloprid</b> Swagger <i>RUP</i>	0.06 - 0.095	7.6 - 12.2 fl oz	PHI = 18 days. Apply a maximum of two applications per season. 30 day minimum between applications. Do not apply more than 24.4 oz of Swagger per acre per season (0.14 lb ai bifenthrin, 0.3 lb ai imidacloprid per acre per season).
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Yuma 4E <i>RUP</i>	0.5 - 1	1 - 2 pt	PHI = 28 days. Do not apply more than 6 pints of chlorpyrifos products per acre per season or more than 3 applications per year. Maximum single application rate is 1 lb ai per acre. Do not make a second application within 14 days of first application. Do not allow meat or dairy animals to graze in treated areas or otherwise feed treated soybean foliage, hay, and straw to meat or dairy animals.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.22 - 0.51 + 0.011 - 0.026	11 - 26 fl oz	PHI = 30 days. Do not make more than 3 applications or apply more than 59 fl oz per acre per season. Do not make a second application within 14 days of the first application. Do not allow meat or dairy animals to graze in treated area or feed treated soybean forage, hay, and straw to animals.
<b>chlorpyrifos + zeta- cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>clothianidin</b> Belay	0.05 - 0.1	3 - 6 fl oz	PHI = 21 days. Do not apply foliar treatments less than 7 days apart. Do not apply more than 0.2 lb ai per acre per season, regardless of formulation or type of application (foliar or seed treatment). Do not make foliar applications of Belay in fields treated with a neonicotinoid seed treatment within 45 days after planting. Do not graze or feed soybean forage and hay to livestock.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.013 - 0.044	2.0 - 2.8 fl oz	PHI = 45 days. Maximum of 11.2 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>deltamethrin</b> Delta Gold <i>RUP</i>	0.018 - 0.028	1.5 - 2.4 fl oz	Apply a minimum of 2 GPA of water by air and 5 GPA of water by ground. PHI = 21 days. Avoid application during heat of day. Do not apply more than 8.5 fl oz per acre per season. Do not allow livestock to graze treated forage or feed treated hay to livestock.
<b>dimethoate</b> Digon 400 Dimethoate 400 Dimethoate 2.67 EC	0.5 - 0.67	1 - 1 1/3 pt	PHI = 21 days. Do not feed or graze within 5 days of last application. Do not enter treated fields without protective clothing until sprays have dried.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 to 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not feed or graze livestock on treated fields. Do not apply more than 0.2 lb active per acre per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.0125	1.92 - 3.2 fl oz	PHI = 30 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate	1.6 - 3.2 fl oz per cwt of seed	Apply as a commercial seed treatment. Do not graze or feed livestock on soybean forage or hay. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Enhance AW	refer to recommended label rate	5 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. Do not graze or feed livestock on soybean forage or hay. Follow all applicable directions, restrictions and precautions on the EPA registered label. For protection against early season soybean aphid infestations.
<b>imidacloprid</b> Mana Alias 4F	0.047	1.5 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum of 4.5 fl oz per acre (0.14 lb ai per acre) per crop season.
<b>imidacloprid</b> Nuprid 1.6 F	0.047	3.75 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum of 11.25 fl oz per acre (0.14 lb ai per acre) per crop season.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>imidacloprid + beta- cyfluthrin</b> Leverage 360 <i>RUP</i>	0.066	2.8 fl oz	PHI = currently 45 days. Please check the most current EPA label for any change in PHI. Minimum interval between applications = 7 days. Do not apply more than 9.0 fl oz per acre per season (0.07 lb ai beta-cyfluthrin, 0.14 lb ai imidacloprid). Leverage 360 can be applied through calibrated ground, aerial, or chemigation equipment.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 30 days for Silencer and Warrior. PHI = 45 days for Grizzly Z and Lambda-Cy. Do not allow graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.06 lb ai per acre per season. Use higher rates for larger larvae. When applying by air, apply in a minimum of 2 gals of water per acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.015 - 0.025	1.0 - 1.67 oz	PHI = 45 days. See other notes on restrictions above.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin + thiamethoxam</b> Endigo ZC <i>RUP</i>	0.017 - 0.024 + 0.023 - 0.032	2.5 - 3.5 fl oz	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season of lambda-cyhalothrin containing products, or more than 0.125 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 3 GPA for aerial application. Do not graze or feed treated soybean for forage, straw or hay for livestock feed. Do not apply Endigo ZC within 45 days of planting soybean treated with a neonicotinoid.
<b>methomyl</b> Lannate LV <i>RUP</i> 2(ee) EPA Reg. No. 352-384	0.23 - 0.3	0.75 - 1 pt	PHI = 14 days. Do not graze or harvest treated soybean within 3 days for forage, or 12 days for hay. Do not apply more than 1.35 lb ai per acre per season, or make more than 3 applications per crop. REI = 48 hours.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.25 - 0.75	1 - 3 pts	PHI = 20 days. Do not make more than 2 applications per season.
<b>permethrin</b> Pounce 3.2 EC Arctic 3.2EC <i>RUP</i>	0.1 - 0.2	4 - 8 fl oz	PHI = 60 days. Do not feed or graze livestock on treated plants.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.0175 - 0.025	2.8 - 4 fl oz	PHI = 21 days. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.15 lb AI per acre per season including at-planting plus foliar applications. Do not make applications less than 7 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## SPIDER MITES

Mites are small and magnification is required to see them. A quick sampling procedure to determine whether mites are present is to hold a piece of white paper below leaves then slap them to dislodge the mites. Or, pulling plants and examining the underside of the leaves from the bottom of plants upwards. The mites appear as tiny dust specks; however, they will move after being knocked off the leaf. Feeding damage by mites first appears as small yellow spots ("stipples"). As feeding activity increases, leaves become yellow, bronzed or brown, and eventually shed from the plant. Be sure to scout during full pod (R4) through beginning seed (R5) stages since these crop stages are the most important contributors to soybean yield.



Mites usually become a problem when hot, dry weather occurs. Infestations typically are first noted near field edges. These environmental conditions stress the plant, whether mites are present or not. If conditions continue, treating for mites is no guarantee plants will recover. In addition, products labeled for mite control often do not give adequate control and the population of mites may rebound quickly to pretreatment levels or higher. When rain and humidity are present, natural reductions in mite populations occur due to infection by a fungal pathogen. Conditions that are good for the development of the pathogen are temperatures cooler than 85° F, with at least 90% R.H. for 12 to 24 hours.

**Threshold:**

Deciding whether to treat is difficult. There is no specific threshold that has been developed for two-spotted spider mite in soybean. Sample plants at least 100 feet into the field and walk in a “U” pattern sampling two plants per location at 20 different locations. Assess mite damage using the following scale from the University of Minnesota:

- 0 - No spider mites or injury observed.
- 1 - Minor stippling on lower leaves, no premature yellowing observed.
- 2 - Stippling common on lower leaves, small areas or scattered plants with yellowing.
- 3 - Heavy stippling on lower leaves with some stippling progressing into middle canopy. Mites present in middle canopy with scattered colonies in upper canopy. Lower leaf yellowing common. Small areas with lower leaf loss

**(Spray Threshold)**

- 4 - Lower leaf yellowing readily apparent. Leaf drop common. Stippling, webbing and mites common in middle canopy. Mites and minor stippling present in upper canopy. **(Economic Loss)**
- 5 - Lower leaf loss common, yellowing or browning moving up plant into middle canopy, stippling and distortion of upper leaves common. Mites present in high levels in middle and lower canopy.

Remember to use an organophosphate insecticide (e.g. Lorsban, Dimethoate) over a pyrethroid insecticide to avoid flaring mite populations. Reasons for the increase in mite populations include: disruption of the natural enemies that control spider mites (predatory mites); increased movement of mites out of fields, and increased reproductive rates of female mites. Early detection facilitates timely and effective rescue treatments. Current insecticides for soybeans provide short-term protection, maybe 7 days, from the pest. Fields will need to be re-monitored continually for resurging populations. The efficacy of an insecticide can be improved significantly with sufficient coverage (>18 GPA of water) and application at high pressure to penetrate foliage. Edge treatments are not effective in controlling mites since mites have already moved throughout the field before visual symptoms are observed.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>bifenthrin</b> Tundra EC <i>RUP</i>	0.08 - 0.10	5.12 - 6.4 fl oz	PHI = 18 days. Do not apply more than 0.3 lb active per acre per season.
<b>bifenthrin + zeta-cypermethrin</b> Hero <i>RUP</i>	0.10	10.3 oz	PHI = 21 days. Do not apply more than 0.4 lb ai per acre per season. Do not make applications less than 30 days apart. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Yuma 4E <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	PHI = 28 days. Do not apply more than 6 pints of chlorpyrifos products per acre per season or more than 3 applications per year. Maximum single application rate is 1 lb ai per acre. Do not make a second application within 14 days of first application. Do not allow meat or dairy animals to graze in treated areas or otherwise feed treated soybean foliage, hay, and straw to meat or dairy animals. If large numbers of newly hatched nymphs are present 3-5 days after application, make a follow-up application with a non-chlorpyrifos product that is effective against mites.
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.22 - 0.51 + 0.011 - 0.026	11 - 26 fl oz	PHI = 30 days. Do not make more than 3 applications or apply more than 59 fl oz per acre per season. Do not make a second application within 14 days of the first application. Do not allow meat or dairy animals to graze in treated area or feed treated soybean forage, hay, and straw to animals.
<b>dimethoate</b> Digon 400 Dimethoate 400, Dimethoate 2.67 EC	0.5 - 0.67	1 - 1.33 pt	PHI = 21 days. Do not feed or graze within 5 days of last application. Do not enter treated fields without protective clothing until sprays have dried.

**Soybean**

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.03	3.84 fl oz (suppression only)	PHI = 30 days for Silencer and Warrior. PHI = 45 days for Grizzly Z and Lambda-Cy. Do not allow graze or harvest treated soybean forage, straw or hay for livestock feed. Do not apply more than 0.06 lb ai (7.68 fl oz) per acre per season. Use higher rates for larger larvae. When applying by air, apply in a minimum of 2 gals of water per acre.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.03	2.0 oz (suppression only)	PHI = 45 days. See other notes on restrictions above.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.03	1.92 fl oz (suppression only)	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> <b>+ thiamethoxam</b> Endigo ZC (suppression only) <i>RUP</i>	0.027 - 0.031 + 0.036 - 0.041	4.0 - 4.5 fl oz (suppression only)	PHI = 30 days. Do not apply more than 0.06 lb ai per acre per season of lambda-cyhalothrin containing products, or more than 0.125 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 3 GPA for aerial application. Do not graze or feed treated soybean for forage, straw or hay for livestock feed. Do not apply Endigo ZC within 45 days of planting soybean treated with a neonicotinoid.

*RUP* - Restricted use pesticide

## WIREWORMS

To decide whether wireworms are a potential problem, refer to the discussion in the corn insects section. Imidacloprid and thiamethoxam are labeled as active ingredients for 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>abamectin + thiamethoxam</b> Avicta Complete Beans <i>RUP</i>	refer to label	refer to label	Avicta Complete Beans is a combination of Avicta 500FS and one of the following: CruiserMaxx; Cruiser Maxx and Apron XL; Cruiser, Apron XL and Maxim 4FS; Cruiser and ApronMaxx. Please consult individual product labels for use directions.
<b>clothianidin</b> Inovate System	refer to recommended label rate	refer to recommended label rate	Inovate system is a combination of clothianidin and fungicides. Refer to EPA registered labels for directions, precautions and restrictions.
<b>imidacloprid</b> Gaucho 600	refer to recommended label rate	refer to recommended label rate	Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Enhance AW	refer to recommended label rate	5 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. Do not graze or feed livestock on soybean forage or hay. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>thiamethoxam</b> Cruiser 5FS	refer to recommended label rate	1.28 fl oz per cwt of seed	Use as a seed treatment only. May be applied through either open or closed systems. Do not apply a neonicotinoid insecticide within 45 days of planting soybean seed treated with Cruiser 5FS. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>thiamethoxam</b> CruiserMaxx Pluss	refer to recommended label rate	3.2 fl oz per cwt of seed	Use as a seed treatment only. Do not apply a neonicotinoid insecticide to any crop which has been grown from CruiserMaxx Plus treated seed. Follow all applicable directions, restrictions and precautions on the EPA registered label.

## SUGARBEET INSECTS

Other resources available through NDSU Extension Service:

Internet Document: Insects Affecting Sugarbeets in North Dakota (<http://www.sreb.org/brochures/ndinsects/ndinsects.htm>)  
 Publications: Sugarbeet Production Guide  
 Sugarbeet Research and Extension Reports  
 Sugarbeet Insects (color I.D. plates)

Calendar of Sugarbeet Insect Activity in the Red River Valley											
April	May			June			July			August	
	Flea Beetles										
	Springtails										
	White Grubs										
	Wireworms										
			Cutworms - Dingy, Dark-sided, and Redbacked								
			Beet Webworm - adults								
			Beet Webworm - larvae								
			Sugarbeet Root Maggot - adults								
			Sugarbeet Root Maggot - larvae								
										Tarnished Plant ( <i>Lygus</i> ) Bugs	
										Cutworms - Black and Variegated	

### BEET WEBWORM

Beet webworms rarely occur in significant numbers in Red River Valley sugarbeet fields. Larvae are slender caterpillars and are very active when disturbed. Early-stage larvae are dark green. Older larvae are olive green and have a dark band flanked on each side by two light-colored stripes running down the center of their back. Full-grown larvae can be up to 1½ inches long. Adults are mottled tan and brown moths with smoky grayish wing margins. The moths first appear in late May and early June. Larvae usually cause problems during the first 3 weeks of June. A second brood is also possible during late August and September.

**Threshold:**

Treatment is recommended if 1 to 2 webworms are present on 50% to 75% of sampled leaves.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>esfenvalerate</b> Adjourn Asana XL  <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	Do not exceed 0.15 lb ai/acre per season. Apply with a minimum of 2 gal per acre. PHI = 21 days.
<b>carbaryl</b> Sevin	1 - 1.5	variable	PHI = 28 days. Repeat application as necessary up to 2 times, but not more often than every 14 days. Do not apply more than 3 lb of active ingredient per acre per crop.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Warhawk Yuma 4E  <i>RUP</i>	0.5 - 1	1 - 2 pts	Do not apply more than 6 pt/acre (broadcast basis) or make more than 3 applications per season. Do not allow meat or dairy animals to graze in treated area or harvest treated beet tops as feed for meat or dairy animals within 30 days of last treatment. PHI = 30 days.
<b>methomyl</b> Lannate LV  <i>RUP</i>	0.22 - 0.9	0.75 - 3 pts	PHI = 7 days. Do not feed tops to livestock within 30 days of last application. Field re-entry interval is 48 hours. Do not apply more than 4.5 lb active ingredient per acre per crop. Do not make more than 10 applications per crop.
<b>methyl parathion</b>  <i>RUP</i>	0.25 - 0.38	0.5 - 0.75 pt	PHI = 20 days; or 60 days of feeding tops to animals. Do not enter fields for 48 hours after application.

*RUP* - Restricted use pesticide

## CUTWORMS

Major cutworm pests of sugarbeets in the Red River Valley include the **Darksided and Redbacked cutworms**. Eggs of both species hatch into larvae during late May and early June. Early detection of larval feeding activity is essential to a good control program. Fields should be checked for wilting or dead plants at frequent intervals during periods of cutworm activity. Cutworms will generally be found within 1 to 2 inches of the soil surface near the base of wilting plants. Most feeding activity occurs at night. Young sugarbeet plants are often cut off near ground level. During periods of dry weather, larvae prefer feeding just below the soil surface as they move along the row. They will feed above the surface on leaves and petioles during periods of excessive soil moisture.

Variiegated and black cutworm infestations also caused problems in late July and August. These insects migrate into our region as moths during the spring and are capable of multiple generations within a single growing season. Variiegated cutworm larvae have a distinctive row of pale yellow spots down the middle of their backs. They are a climbing cutworm species that primarily feeds in the plant canopy during evening hours. Because they feed above ground, insecticide treatment can be effective in controlling economic populations of variiegated cutworms. Black cutworms can feed more than 2 inches below ground in later growth stages when soils are too warm near the surface. Therefore, late-season control of these cutworms can be difficult to achieve.

Insecticides generally require some moisture after application for optimal performance. Very light rain showers or heavy dew is generally sufficient. It is desirable to apply insecticides during late afternoon. This maximizes the amount of insecticide material present during the first nighttime hours following application when larvae are often most active. Applications may be repeated as necessary during peak cutworm feeding. Liquid formulations generally provide better control of cutworms, especially during very dry periods. If severe crusting is evident in the field, the crust should be broken up prior to or during the insecticide application.

### Threshold:

Cutworm control in young beets is suggested when 4 to 5% cutting of seedlings observed in fields. Control is recommended when a population of 3 to 5 larvae per square foot is observed in late summer when the plant canopy is developed.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
carbaryl Sevin	1.5	variable	This treatment is most effective against cutworms feeding on upper portions of plants. Repeat application as necessary up to 2 times but not more often than every 14 days. PHI = 28 days. Do not apply more than 3 lb of active ingredient per acre per crop.
chlorpyrifos Lorsban 15G <i>RUP</i>	1.5 - 2.0	10.0 - 13.3 lb (6.6 - 9 oz/1,000 row ft)	Granules must be applied behind furrow openers and ahead of press wheels as a 4- to 5-inch band at planting. <b>Do not apply in-furrow or modified in-furrow.</b> Lightly incorporate with chains or tines behind press wheels for best results. <b>Do not apply granules in direct contact with the seed.</b> Do not make more than 1 application per year.
chlorpyrifos Chlorpyrifos 4E AG Govern 4E Lorsban 4E Lorsban Advanced Nufos 4E Warhawk 4E Whirlwind 4E Yuma 4E <i>RUP</i>	Foliar broadcast: 1  Band: 0.67	Foliar broadcast: 2 pts  Band: 1½ pt	PHI = 30 days. Do not apply more than 6 pt/acre (broadcast basis) or make more than 3 applications of chlorpyrifos-containing products per season. Maximum single application rate is 0.94 lg ai per acre. Do not allow meat or dairy animals to graze in treated area or harvest treated beet tops as feed for meat or dairy animals within 30 days of last treatment.
clothianidin + beta- Cyfluthrin Poncho Beta (seed treatment)	refer to recommended label rate	5.07 fl oz per unit of seed (a unit is 100,000 seeds)	Follow all applicable directions, restrictions and precautions on the EPA registered label.
esfenvalerate Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 21 days. Do not exceed 0.15 lb ai/acre per season as an at-plant treatment or 0.25 lb ai/acre per season. Apply with a minimum of 2 gal per acre.
esfenvalerate Asana XL <i>RUP</i>	0.0023 lbs a.i. per 1000 feet of row	0.45 fl oz per 1,000 feet of row	Use for sugarbeets at plant. PHI = 21. Apply as in in-furrow, T-band, or band treatment using a minimum 4" band. See label for specific rate information. Do not exceed 0.05 lbs a.i. per season as an at-plant application. Do not apply more than 0.25 lbs a.i. per acre per season including at-plant plus foliar applications of Asana XL.
<b>FOR SUGAR BEETS AT-PLANT ONLY</b>			

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>methomyl</b> Lannate LV <i>RUP</i>	0.45	1.5 pt	Apply for variegated cutworm control. PHI = 7 days. Do not feed tops to livestock within 30 days of last application. Field re-entry interval is 48 hours. Do not apply more than 4.5 lb active ingredient per acre per crop. Do not make more than 10 applications per crop.
<b>methyl parathion</b> <i>RUP</i>	0.25 - 0.38	0.5 - 0.75 pt	PHI = 20 days; or 60 days of feeding tops to animals. Do not enter fields for 48 hours after application.
<b>zeta-cypermethrin</b> Mustang Max <i>RUP</i>	Foliar: 0.014 - 0.025  At plant: 0.025	Foliar: 2.24 - 4 oz  At plant: 4 oz	PHI = 50 days for tops and roots. Apply as foliar application or in-furrow using a 3- to 4-inch T-band (band over the open furrow) at planting in a minimum of 3 to 5 gals of finished spray per acre. Do not apply more than 0.075 lb active ingredient per acre per season. Registered for 24 (c) special local need sale and use in sugarbeet in MN (SLN no. MN-100001), MT (SLN no. MT-100001), and ND (SLN no. ND-100003). ND SLN expires December 31, 2015.

*RUP* - Restricted use pesticide

## FLEA BEETLES

The flea beetles most frequently found feeding on beets are shiny black in color and about 1/8 inch in length. All flea beetles are oval-shaped and have enlarged hind legs. When approached or disturbed, they readily jump to escape. Flea beetles overwinter as adults and emerge in late April and May. They feed first on suitable weeds such as winter annuals, and move to field crops as weed hosts are depleted and crop plants begin emerging. Foliar feeding injury from flea beetles consists of small, rounded holes, and gives leaves a shot-hole appearance. Severe shot-holing damage can result in stunting, wilting, and even death of seedling plants. Plant responses will be most dramatic during periods of hot and dry weather.

### Threshold:

Treatment is usually justified if flea beetles threaten to reduce sugarbeet plant stands to below 35,000 plants/acre.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>carbaryl</b> Sevin	1 - 1.5	variable	Repeat application as necessary up to 2 times but not more often than every 14 days. PHI = 28 days. Do not apply more than 3 lb of active ingredient per acre per crop.
<b>chlorpyrifos</b> Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	Foliar broadcast: 1  Band: 0.67	Foliar broadcast: 2 pts  Band: 1½ pt	PHI = 30 days. Do not apply more than 6 pt/acre (broadcast basis) or make more than 3 applications per season. Maximum single application rate is 0.94 lg ai per acre. Do not allow meat or dairy animals to graze in treated area or harvest treated beet tops as feed for meat or dairy animals within 30 days of last treatment.
<b>clothianidin + beta-cyfluthrin</b> Poncho Beta (seed treatment)	refer to recommended label rate	5.07 fl oz per unit of seed (a unit is 100,000 seeds)	Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>esfenvalerate</b> Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	Do not exceed 0.15 lb ai/acre per season. Apply with a minimum of 2 gal per acre. PHI = 21 days.
<b>imidacloprid</b> Advise 2FL	0.09 - 0.18	6 - 12 fl oz	Apply directly below each seed furrow during bedding immediately prior to planting or at planting time. Do not exceed 12 fl oz (0.18 lb ai) per acre per season on any row spacing.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>methomyl</b> Lannate LV <i>RUP</i>	0.22 - 0.9	0.75 - 3 pts	PHI = 7 days. Do not feed tops to livestock within 30 days of last application. Field re-entry interval is 48 hours. Do not apply more than 4.5 pounds active ingredient per acre per crop. Do not make more than 10 applications per crop.
<b>methyl parathion</b> <i>RUP</i>	0.25 - 0.38	0.5 - 0.75 pt	PHI = 20 days; or 60 days of feeding tops to animals. Do not enter fields for 48 hours after application.
<b>zeta-cypermethrin</b> Mustang Max <i>RUP</i>	0.014 - 0.025	2.24 - 4 oz	PHI = 50 days of harvesting tops or roots. Apply using a minimum of 2 gals of water per acre by air or 10 gals per acre by ground. Do not apply more than 0.75 lb active ingredient per acre per season. Registered for 24 (c) special local need sale and use in sugarbeet in MN (SLN no. MN-100001), MT (SLN no. MT-100001), and ND (SLN no. ND-100003). ND SLN expires December 31, 2015.

*RUP* - Restricted use pesticide

## GRASSHOPPERS

In the Northern Plains, grasshopper eggs hatch normally begins in late April to early May. Most grasshoppers emerge from eggs deposited in uncultivated ground. Sugarbeet growers should expect to find grasshopper feeding first along field margins adjacent to these sites. Beets in fields that follow late-season crops may have hatching throughout the field and should be monitored carefully if adults deposited eggs in the field during the previous fall. Later infestations may develop when grasshopper adults migrate from harvested small grain fields.

### Threshold:

Grasshopper control is advised whenever 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. (For more information on infestation ratings, see the discussion under Grasshoppers in Small Grain Insects)

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<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, <b>ONLY</b> . 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 exceed 0.15 lb ai/acre per season. Apply with a minimum of 2 gal per acre.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Nufos 4E Warhawk Yuma 4E <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	PHI = 30 days. Do not apply more than 6 pt/acre (broadcast basis) or make more than 3 applications per season. Maximum single application rate is 0.94 lg ai per acre. Do not allow meat or dairy animals to graze in treated area or harvest treated beet tops as feed for meat or dairy animals within 30 days of last treatment.
<b>methyl parathion</b> <i>RUP</i>	0.25 - 0.38	0.5 - 0.75 pt	PHI = 20 days; or 60 days of feeding tops to animals. Do not enter fields for 48 hours after application.
<b>zeta-cypermethrin</b> Mustang Max <i>RUP</i>	0.014 - 0.025	2.24 - 4 fl oz	PHI = 50 days of harvesting tops or roots. Apply using a minimum of 2 gals of water per acre by air or 10 gals per acre by ground. Do not apply more than 0.75 lb active ingredient per acre per season. Registered for 24 (c) special local need sale and use in sugarbeet in MN (SLN no. MN-100001), MT (SLN no. MT-100001), and ND (SLN no. ND-100003). ND SLN expires December 31, 2015.

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## LYGUS BUG (TARNISHED PLANT BUG)

Tarnished plant bugs, commonly referred to as “Lygus bugs”, have caused late-season injury to Red River Valley sugarbeets since 1998. Most feeding injury appears on new leaves and stems emerging from the sugarbeet plant crown. Feeding symptoms include curling and wilting of leaves, feeding scars on leaf petioles, seepage of a black exudate from petioles of young leaves, and blackening of the new growth near the center of the crown. Multiple generations of Lygus bugs can develop during the growing season, especially if extended periods of unseasonably warm weather prevail during spring and early summer. Populations usually build up in other host plant habitats (e.g., alfalfa, canola, small-seeded broadleaf weeds), then adults migrate to beets in late-July through August. Lygus bugs are sporadic pests in this region and their biological profile is not understood well enough to anticipate when or where future problems could arise.

### Threshold:

Treatment with an insecticide may be justified if an infestation **exceeds** 1 Lygus bug per plant (adults and nymphs combined) after checking 30 to 50 plants in a field. Significant economic loss is likely to occur if an infestation reaches 4 Lygus bugs per plant. Lygus bugs usually infested beets during August. Therefore consideration of pre-harvest interval may be a critical factor in choosing an insecticide. A number of insecticides that are approved for use on sugarbeets have Tarnished plant bug or *Lygus* as a target pest in their labels for other crops; however, Tarnished plant bug is not listed as a target pest in the *sugarbeet* portion of those labels. **These insecticides include Asana, carbaryl (Sevin), Lannate, Lorsban, and malathion. It is legal to apply an insecticide if it is labeled for use in the crop;** however, if the target pest is not listed for that crop, efficacy is not implied by the manufacturer and growers who choose to use the product assume their own liability for any unsatisfactory performance.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>naled</b> Dibrom 8 Emulsive	0.94	1 pt	PHI = 2 days. Apply by air in 1 to 5 gals of water per acre. Do not apply more than 5 pt per acre per season. Allow 7 days between successive applications. Do not make more than 5 applications per season. <b>Issued by manufacturer as a FIFRA Section 2 (ee) recommendation for use within the following states: ND, MN, MT, WY, NE, SD, CO, ID, WA, and OR</b>
<b>chlorpyrifos</b> Govern 4E Lorsban 4E Lorsban Advanced Warhawk 4E Whirlwind 4E Yuma 4E  <i>RUP</i>	0.5	1 pt	PHI = 30 days. Do not apply more than 6 pt/acre (broadcast basis) or make more than 3 applications per season. Maximum single application rate is 0.94 lb ai per acre. Do not allow meat or dairy animals to graze in treated area or harvest treated beet tops as feed for meat or dairy animals within 30 days of last treatment.

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## SPRINGTAILS

Springtails that damage RRV sugarbeet fields are tiny (1/32 to 3/32 inch long), wingless, white- to cream-colored insects with fleshy, forward-pointed antennae. They spend their entire life below the soil surface, and are most harmful to seedlings. Plant injury ranges from a few brown feeding punctures to extensive root scarring. Field symptoms include wilted plants and plant stand losses. *Fine-textured* (i.e., clay or silty clay) soils with *high organic matter content* are conducive to springtail problems. *Early-planted fields, especially where soils remain cool and wet* during early spring, can be especially vulnerable to attack. Field history is a good indicator of risk because springtails do not migrate from one field to another. Insecticides registered for use in sugarbeet against other soil-dwelling pests may be used for springtail control; however, manufacturers are not legally bound to guarantee acceptable control if springtail control is not listed on the product label.

NDSU research on springtail management suggests the following:

Counter 15G provides good control if applied at 1.5 lb AI (10 lb product) per acre.

Counter should not be applied at less than 0.0 lb AI (6 lb product) per acre for springtail control.

MustangMax has provided unsatisfactory control in some cases. It performs best when applied:

1. directly in-furrow at planting using conventional nozzles (not microtubes)
2. at full rate of 4 oz of product per acre, and
3. tank-mixed with strained 10-34-0 starter fertilizer at a ratio of 60:1 (fertilizer to insecticide)

Lorsban 15G and other chlorpyrifos-based products will not provide adequate protection from springtail injury.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>clothianidin</b> NipsIT INSIDE (seed treatment)	60 g a.i. per unit of seed (a unit is 100,000 seeds)	3.4 fl oz per unit of seed (a unit is 100,000 seeds)	Application to seed by commercial seed treatment equipment utilizing standard liquid or slurry treaters is necessary. Tank mixtures with other seed treatment products should be pretested to evaluate compatibility and assure proper physical compatibility.
<b>clothianidin + beta-cyfluthrin</b> Poncho Beta (seed treatment)	68 g a.i. per unit of seed (a unit is 100,000 seeds) refer to recommended label rate	5.07 fl oz per unit of seed (a unit is 100,000 seeds)	For application to seed by commercial treaters only. Not for application to seed via hopper-box, slurry-box, or similar on-farm seed treatment applicators. Treated areas may be replanted with any crop listed on both clothianidin and beta-cyfluthrin labels. Areas planted with treated seed may be replanted immediately with corn or after 30 days with cereal grains, soybeans, dried beans and dried peas.
<b>imidacloprid</b> Gaucho 600 (seed treatment)	refer to recommended label rate		Apply as a commercial seed treatment only. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>terbufos</b> Counter 15G <sup>a</sup> <i>RUP</i>	1 - 1.8	5.9 - 11.9 lbs or 4 - 8 oz/1,000 row ft	Counter performs best against wireworms if applied using spoon or modified in-furrow (2-3 inches behind seed drop zone) placement at planting time. Banded applications may not provide acceptable control. Do not place in direct contact with seed. Do not harvest sugarbeets or feed tops to livestock within 110 days after application. Treated fields must be posted. <b>Only one application may be made per year.</b>
<b>terbufos</b> Counter 20G <sup>a</sup>	0.9 - 1.8	5.9 - 11.9 or 3 - 6 oz/1,000 row ft	
<b>thiamethoxam</b> Cruiser 5FS (seed treatment)	60 - 70 g a.i. per unit of seed (a unit is 100,000 seeds)	3.39 - 3.95 fl oz per unit of seed (a unit is 100,000 seeds)	Apply at 3.39-3.95 fl oz per seed unit. Cruiser can be combined with seed coating materials and seed treatment fungicides. Such combinations should be tested for seed safety prior to large-scale planting to ensure that there will be no detrimental effects on seed germination or plant stand establishment. Also controls leaf miners, root aphids, white grubs and beet leafhoppers.
<b>thiamethoxam</b> CruiserMaxx Sugarbeets (seed treatment)	60 g a.i. per unit of seed (a unit is 100,000 seeds)	3.3 fl oz per unit of seed (a unit is 100,000 seeds)	CruiserMaxx Sugarbeets is a combination of Cruiser 5FS, Apron XL fungicide, and Maxim 4FS fungicide. See EPA registered product label for fungicide rates.

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<sup>a</sup> Counter 15G and Counter 20G may only be applied once per year.



## SUGARBEET ROOT MAGGOT

This insect overwinters in soil at 6 to 12 inches below the surface as a mature larva in fields that had been planted to sugarbeets during the previous growing season. In late April and early May, overwintered larvae move up to within 3 inches of the soil surface to pupate. In the Red River Valley, fly emergence generally begins in late May and continues for a period of 4 to 6 weeks. Following emergence, flies move to current-year sugarbeet fields and deposit eggs below the soil surface near the base of beet plants. Egg depth is dependent on soil moisture (i.e., eggs are deposited deeper in dry soil conditions). Earlier-seeded (April - early May) plants are usually more vigorous and able to tolerate more injury than smaller, later-planted beets. Fields planted in areas with established maggot populations should be protected with a planting-time insecticide. These treatments will usually be effective with adequate rainfall during June. If dry conditions prevail, a postemergence insecticide application may be needed. This management approach has been shown to be cost-effective during dry growing seasons and under severe maggot infestation levels. Producers should consider the following when deciding if a postemergence treatment is warranted: **soil moisture** - good soil moisture with spring rains should enhance planting-time insecticide performance - extreme rainfall amounts (3 inches within first 24 hours or at least 6 inches if received in 1 or 2 rainfall events within 1 week after planting) may cause movement of the insecticide from the treated target zone; **sugarbeet size** - plants that have 10 to 14 true leaves at peak activity (early- to mid-June) can tolerate moderate levels of feeding injury; **population level** - use sticky-stake traps to monitor for development of damaging population levels.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>aldicarb</b> Temik 15G <sup>b</sup> <i>RUP</i>	1.0 - 2.1	6.7 - 14 lb (4.5 - 9.5 oz/1,000 row ft)	PHI = 90 days for root harvest or within 120 days of top harvest for livestock feeding. Apply at planting in a 2- to 6-inch band or by modified in-furrow. Lightly incorporate banded applications. Do not use in consecutive years or in suspected aggressive soils. For postemergence treatment, apply granules to both sides of row and incorporate immediately. Do not use tops as food for humans. Do not apply more than 33 pounds per acre per year. Treated areas must be posted with warning signs.
<b>chlorpyrifos</b> Lorsban 15G <sup>a</sup> <i>RUP</i>	1.0 - 2.0	6.75 - 13.3 lb (4.5 - 9 oz/1,000 row ft)	Granules must be applied behind furrow openers and ahead of press wheels as a 5-inch band at planting. <b>Do not apply in-furrow or modified in-furrow.</b> Lightly incorporate with chains or tines behind press wheels for best results. <b>Do not apply granules in direct contact with the seed.</b> The low application rate should be considered if low infestation levels are expected. If low rate is applied, monitor for higher than anticipated adult fly numbers. May be applied postemergence in accordance with label directions. <b>Do not make more than 1 application per year.</b>
<b>chlorpyrifos</b> Nufos 15G <sup>a</sup> <i>RUP</i>	1.0 - 2.0	6.75 - 13.4 lb (4.5 - 9 oz/1,000 row ft)	
<b>chlorpyrifos</b> Lorsban 4E Lorsban Advanced <i>RUP</i>	Foliar broadcast for adults: 0.25 - 1  Foliar broadcast for larvae: 1  Band for larvae: 0.67 - 1	Foliar broadcast for adults: 0.5 - 2 pts  Foliar broadcast for larvae: 2 pts  Band for larvae: 1 1/3 - 2 pts	PHI = 30 days for beet roots and tops. Apply in 5- to 7-inch bands or as a broadcast treatment. When banding, apply using a minimum of 6.5 gals of finished spray per acre and <b>do not reduce the dosage for banded applications (i.e., apply the specified broadcast dosage within the band).</b> Time treatments from 7 days before to 3 days after peak adult fly activity. For best results, band-applied treatment should be lightly incorporated, either mechanically or with irrigation. If an organophosphate insecticide was used at planting, make no more than 1 application any chlorpyrifos product per season when adults are active. <b>Do not apply more than 6 pt/acre (broadcast basis) or make more than 3 applications per season.</b> Do not allow meat or dairy animals to graze in treated area or harvest treated beet tops as feed for meat or dairy animals within 30 days of last treatment.
<b>chlorpyrifos</b> Govern 4E <i>RUP</i>	0.25 - 1.0	0.5 - 2 pts	
<b>chlorpyrifos</b> Nufos 4E <i>RUP</i>	0.5	1 pt	

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
chlorpyrifos Warhawk 4E	0.67 - 1	1 1/3 - 2 pts	
<i>RUP</i>			
chlorpyrifos Whirlwind 4E	0.25 - 1.0	0.5 - 2 pts	
<i>RUP</i>			
chlorpyrifos Yuma 4E	0.67 - 1	1 1/3 - 2 pts	
<i>RUP</i>			
<b>clothianidin + beta- Cyfluthrin</b> Poncho Beta (seed treatment)	refer to recommended label rate	5.07 fl oz per unit of seed (a unit is 1000,000 seeds)	Follow all applicable directions, restrictions and precautions on the EPA registered label.
esfenvalerate Asana XL	0.03 - 0.05	5.8 - 9.6 fl oz	<b>Use as foliar spray for control of adult flies only.</b> Do not exceed 0.15 lb ai/acre per season. Apply with a minimum of 2 gal per acre. PHI = 21 days.
<i>RUP</i>			
phorate Thimet 20G <sup>a</sup>	1.0 - 1.5	4.9 - 7.5 lb (3.2 – 5 oz/1,000 row ft)	Apply in a 5- to 7-inch band over the row as a postemergence treatment and incorporate lightly into soil. Do not apply in a broadcast. <b>Do not make more than 1 application per year.</b> PHI = 30 days. Treated areas must be posted with warning signs.
<i>RUP</i>			
terbufos Counter 15G <sup>a</sup>	0.9 - 1.8	5.9 - 11.9 lb (4 - 8 oz/1,000 row ft)	Apply in a 5-inch band or by modified in-furrow at planting time. <b>Do not place in direct contact with seed.</b> Counter may also be banded over the row as a postemergence treatment. Planting-time and postemergence treatments should be incorporated lightly into soil. <b>Only 1 application may be made per year.</b> Do not harvest sugarbeets or feed tops to livestock within 110 days after application. Treated areas must be posted with warning signs.
<i>RUP</i>			
terbufos Counter 20G <sup>a</sup>	0.9 - 1.8	5.9 - 11.9 lb (3 - 6 oz/1,000 row ft)	
<i>RUP</i>			
terbufos Counter CR <sup>a</sup>	0.9 - 1.8	4.5 - 8.9 lb (3 - 6 oz/1,000 row ft)	Apply in a 5-inch band or by modified in-furrow at planting time. <b>Do not place in direct contact with seed.</b> Counter CR may also be banded over row as a postemergence treatment. Planting-time and postemergence treatments should be incorporated lightly into the soil. <b>Only 1 application may be made per year.</b> Do not harvest sugarbeets or feed tops to livestock within 110 days after application. Treated areas must be posted with warning signs.
<i>RUP</i>			
thiamethoxam Cruiser 5FS (seed treatment)	60 - 70 g a.i. per unit of seed (a unit is 100,000 seeds)	3.39 - 3.95 fl oz per unit of seed (a unit is 100,000 seeds)	Apply at 3.39-3.95 fl oz per seed unit. Cruiser can be combined with seed coating materials and seed treatment fungicides. Such combinations should be tested for seed safety prior to large-scale planting to ensure that there will be no detrimental effects on seed germination or plant stand establishment. Also controls leaf miners, root aphids, white grubs and beet leafhoppers.
thiamethoxam CruiserMaxx Sugarbeets (seed treatment)	60 g a.i. per unit of seed (a unit is 100,000 seeds)	3.3 fl oz per unit of seed (a unit is 100,000 seeds)	CruiserMaxx Sugarbeets is a combination of Cruiser 5FS, Apron XL fungicide, and Maxim 4FS fungicide. See EPA registered product label for fungicide rates.

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<sup>a</sup> Counter 15G, Counter 20G, Counter CR, Lorsban 15G, Nufos 15G and Thimet 20G may only be applied once per year.

<sup>b</sup> Temik 15G can be applied once at planting and up to two postemergence treatments can be applied per season; however, total product applied per acre per season cannot exceed 33 pounds.

## WIREWORMS

Wireworm larvae are smooth, somewhat hard-bodied worms varying in length from ½ to 1 ½ inches long. Their color can range from yellowish-white to a light copper color. Wireworms feed on a wide variety of crops and weeds, and are generally difficult to detect and control. They tend to be more prevalent in light-textured soils or in soil that has not been in crop production for several years. Fields that had grassy weed escapes during the preceding season are also at risk. Frequent cropping and working the soil helps reduce wireworm problems.

### Threshold:

Currently, there is no established threshold for wireworms in sugarbeet. The following insecticides labeled for sugarbeet root maggot control will usually provide adequate protection from wireworm injury. Check with your company field representatives before treating sugarbeet seed with an insecticide. Refer to product labels for more information. 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>chlorpyrifos</b> Lorsban 15G (suppression only)	1.5 - 2	10 - 13.3 lbs or 6.5 - 9 oz/1,000 row ft	Lorsban 15G can provide suppression of low to moderate infestations at these rates. <b>Do not apply in-furrow or modified in-furrow.</b> Lightly incorporate with chains or tines behind press wheels for best results. <b>Do not apply granules in direct contact with the seed. Do not make more than 1 application per year.</b>
<b>clothianidin</b> NipsIT INSIDE (seed treatment)	60 g a.i. per unit of seed (a unit is 100,000 seeds)	3.4 fl oz per unit of seed (a unit is 100,000 seeds)	Application to seed by commercial seed treatment equipment utilizing standard liquid or slurry treaters is necessary. Tank mixtures with other seed treatment products should be pretested to evaluate compatibility and assure proper physical compatibility.
<b>clothianidin + beta-cyfluthrin</b> Poncho Beta (seed treatment)	68 g a.i. per unit of seed (a unit is 100,000 seeds) refer to recommended label rate	5.07 fl oz per unit of seed (a unit is 100,000 seeds)	For application to seed by commercial treaters only. Not for application to seed via hopper-box, slurry-box, or similar on-farm seed treatment applicators. Treated areas may be replanted with any crop listed on both clothianidin and beta-cyfluthrin labels. Areas planted with treated seed may be replanted immediately with corn or after 30 days with cereal grains, soybeans, dried beans and dried peas.
<b>imidacloprid</b> Dyna-Shield Imidacloprid 5 Senator 600 (seed treatment)	refer to recommended label rate		Apply as a commercial seed treatment only. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Gaucho 600 (seed treatment)	refer to recommended label rate		Apply as a commercial seed treatment only. Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>terbufos</b> Counter 15G <sup>a</sup> <i>RUP</i>	1 - 1.8	5.9 - 11.9 lbs or 4 - 8 oz/1,000 row ft	Counter performs best against wireworms if applied using spoon or modified in-furrow (2-3 inches behind seed drop zone) placement at planting time. Banded applications may not provide acceptable control. Do not place in direct contact with seed. Do not harvest sugarbeets or feed tops to livestock within 110 days after application. Treated fields must be posted. <b>Only one application may be made per year.</b>
<b>terbufos</b> Counter 20G <sup>a</sup>	0.9 - 1.8	5.9 - 11.9 or 3 - 6 oz/1,000 row ft	

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>zeta-cypermethrin</b> Mustang Max <i>RUP</i>	0.025	4 oz	Research suggests that Mustang Max performs best against wireworms if applied directly in-furrow at planting. Apply in a minimum of 3–5 gallons of finished spray per acre. Do not apply within 50 days of harvesting tops or roots. Do not apply more than 0.075 pound active ingredient per acre per season. Registered for 24 (c) special local need sale and use in sugarbeet in MN (SLN no. MN-100001), MT (SLN no. MT-100001), and ND (SLN no. ND-100003). ND SLN expires December 31, 2015.
<b>thiamethoxam</b> Cruiser 5FS (seed treatment)	60 - 70 g a.i. per unit of seed (a unit is 100,000 seeds)	3.39 - 3.95 fl oz per unit of seed (a unit is 100,000 seeds)	Apply at 3.39-3.95 fl oz per seed unit. Cruiser can be combined with seed coating materials and seed treatment fungicides. Such combinations should be tested for seed safety prior to large-scale planting to ensure that there will be no detrimental effects on seed germination or plant stand establishment. Also controls leaf miners, root aphids, white grubs and <b>beet leafhoppers</b> .
<b>thiamethoxam</b> CruiserMaxx Sugarbeets (seed treatment)	60 g a.i. per unit of seed (a unit is 100,000 seeds)	3.3 fl oz per unit of seed (a unit is 100,000 seeds)	CruiserMaxx Sugarbeets is a combination of Cruiser 5FS, Apron XL fungicide, and Maxim 4FS fungicide. See EPA registered product label for fungicide rates.

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<sup>a</sup> Counter 15G and Counter 20G may only be applied once per year.

## SUNFLOWER INSECTS

### Other Resources Available Through NDSU Extension Service:

Publications	E-1457 E823 A1331 E821 E824	IPM of Sunflower Insect Pests in the Northern Great Plains (2010) Banded Sunflower Moth (2010) Sunflower Production (2007) Biology and Integrated Pest Management of the Sunflower Stem Weevil in the Great Plains (2002) Biology and Integrated Pest Management of the Sunflower Beetle in North Dakota (2000)
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### 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 + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.31 - 0.74 + 0.016 - 0.038	16 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications per season, or apply more than 114 fl oz per acre per season. Do not apply 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>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<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 Nufarm Lambda-Cyhalothrin 1EC <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 + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.31 - 0.74 + 0.016 - 0.038	16 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications per season, or apply more than 114 fl oz per acre per season. Do not apply 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>chlorpyrifos + zeta- cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<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>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<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>	0.0075 - 0.0125	1.92 - 3.2 fl oz	PHI = 45 days.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <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 <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.

*RUP* - Restricted use pesticide

## 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.

<b>Rating</b>	<b>Nymphs (young hoppers) per square yard</b>		<b>Adults per square yard</b>	
	<b>Margin</b>	<b>Field</b>	<b>Margin</b>	<b>Field</b>
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.
<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 + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.12 - 0.25 + 0.006 - 0.013	6 - 13 fl oz	PHI = 45 days. Do not make more than 3 applications per season, or apply more than 114 fl oz per acre per season. Do not apply 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>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<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 Nufarm Lambda-Cyhalothrin 1EC <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	

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<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.

*RUP* - Restricted use pesticide

### 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 + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.43 - 0.74 + 0.022 - 0.038	22 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications per season, or apply more than 114 fl oz per acre per season. Do not apply 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.

*RUP* - Restricted use pesticide

## 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 + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.31 - 0.74 + 0.016 - 0.038	16 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications per season, or apply more than 114 fl oz per acre per season. Do not apply 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>chlorpyrifos + zeta- cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<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 Nufarm Lambda- Cyhalothrin 1EC <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.
<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 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 2010 are listed below.

2010 Sunflower Midge Hybrid Evaluation Trial – Mapleton, ND							
Janet J. Knodel, Entomology Department, North Dakota State University, Fargo, ND Larry D. Charlet, USDA-ARS, Northern Crop Science Laboratory, Fargo, ND Patrick B. Beauzay, Entomology Department, North Dakota State University, 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
Advanta F30008	7.5	18.7	0	4.65	1.06	1.35	0.8
Advanta F51122	7.6	20.2	0	4.7	1.07	1.5	0.89
Advanta F51289	7.5	17.5	0.1	4.5	1.02	2.4	1.42
Advanta F89057	7.3	16.2	0.1	4.5	1.02	3	1.78
Advanta F91034	7.7	16.2	0.1	4.27	0.97	1.73	1.03
CHS HRT10-1	7.8	17.8	0	4.85	1.1	1.6	0.95
CHS HRT10-2	7	15.8	0	4.8	1.09	2.47	1.46
CHS HRT10-3	7.8	20.8	0.1	4.6	1.05	1.75	1.04
CHS HRT10-4	7.1	21.5	0	4.25	0.97	1.45	0.86
CHS HRT10-5	7.4	20.5	0	4.8	1.09	1.45	0.86
CHS HRT10-6	7.1	15.2	0.1	4.6	1.05	2.85	1.69
CHS HRT10-7	6.9	19.1	0	3.85	0.88	1.2	0.71
Croplan 10454	8.1	19	0	4.75	1.08	1.7	1.01
Croplan 10455	8.3	18.1	0.1	4.25	0.97	1.9	1.12
Croplan 10456	8.2	19.1	0	4.7	1.07	1.5	0.89
Croplan 10457	7.8	20.5	0.1	4.7	1.07	1.95	1.15
Croplan 10W1	7.7	19	0.1	4.55	1.03	1.95	1.15
Croplan 12144	7.7	21.3	0	4.65	1.06	1.8	1.07
Croplan 179	7.3	17.1	0.1	4.35	0.99	1.85	1.09
Croplan 9692	7.3	22.2	0	4.45	1.01	1.5	0.89
Croplan 9992	7.2	20.9	0.1	4.58	1.04	2.11	1.25
Croplan 9CX01	7.9	19.6	0	4.15	0.94	1.4	0.83
Croplan 9H611	7.5	19.1	0	4.55	1.03	1.75	1.04
Genosys 7163	7.1	20.9	0	3.7	0.84	1.4	0.83
Genosys 8037	7.7	18.5	0	4.25	0.97	1.55	0.92
Genosys 8064	7.1	19.6	0	4.7	1.07	1.85	1.09
Genosys 9008	7.9	18.7	0	4.81	1.09	1.5	0.89
Genosys 9069	7.4	21.4	0	4.6	1.05	1.75	1.04
Genosys 9279	7.3	19.5	0	4.55	1.03	1.25	0.74
Genosys 9319	7.7	19.1	0	4	0.91	1.5	0.89
Mycogen DAS10-1	7.3	20.5	0.1	4.05	0.92	1.5	0.89
Mycogen DAS10-2	7.5	20	0	4.07	0.92	1.4	0.83
Mycogen DAS10-3	7.4	22.2	0	4.35	0.99	1.55	0.92
Mycogen DAS10-4	7.3	19.4	0	4.2	0.95	1.5	0.89
Mycogen DAS10-5	7.3	22.4	0	4.75	1.08	1.4	0.83
Mycogen DAS10-6	7	20.2	0	4.1	0.93	1.5	0.89
Mycogen DAS10-7	7.3	22.5	0	4.75	1.08	1.4	0.83

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
Nidera LN9714	7.2	19.4	0.1	4.45	1.01	2.1	1.24
Nidera MN12174	7.3	17.9	0.1	4.3	0.98	2.5	1.48
Pannar PEX 7404NS	7.6	20.4	0	4.2	0.95	1.4	0.83
Pannar PEX 7803HO	7.1	20.1	0	4.7	1.07	1.5	0.89
Pannar PEX 7904HO	7.7	21.6	0	4.75	1.08	1.6	0.95
Pioneer 63ME70	7.4	19.3	0	4.8	1.09	1.4	0.83
Pioneer 63N82	7.3	18	0.1	4.6	1.05	2.3	1.36
Pioneer 64HE01	7.3	18.2	0.1	4.85	1.1	2	1.18
Seeds2000 X2113	7.8	24.5	0	4.78	1.09	1.11	0.66
Seeds2000 x3293	7.2	19.7	0.1	4.65	1.06	2.3	1.36
Seeds2000 X4328	7.4	20.6	0	4.55	1.03	1.8	1.07
Seeds2000 X4437	7.1	19.4	0.1	4.35	0.99	1.85	1.09
Seeds2000 X4467	7.8	19.4	0	4.7	1.07	1.45	0.86
Seeds2000 X4628	8.1	18.4	0	4.75	1.08	1.9	1.12
Seeds2000 X5913	8.2	18.4	0	4.4	1	1.6	0.95
Seeds2000 X9464	6.9	22.8	0	4.33	0.98	1.33	0.79
Seeds2000 X9814	7.3	19.9	0	4.39	1	1.5	0.89
Seeds2000 X9828	7.7	16.3	0	4.15	0.94	1.55	0.92
Seeds2000 X9846	7.3	19.1	0	4.45	1.01	1.5	0.89
Seeds2000 X9856	8	17.8	0	4.25	0.97	1.35	0.8
Seeds2000 X9866	7.3	22.5	0	4.4	1	1.3	0.77
Seeds2000 X9978	7.6	21.1	0	4.45	1.01	1.5	0.89
Syngenta 3875 NS	7.3	18.1	0.1	4.4	1	1.7	1.01
Syngenta 4596 HO/DM	7.5	18.5	0.1	3.8	0.86	1.8	1.07
Syngenta 4651 NS/DM	7.1	19.4	0	3.35	0.76	1.3	0.77
Syngenta X9978CL	7.3	20.5	0	3.3	0.75	1.25	0.74
Triumph EX61706	6.8	22.4	0	3.4	0.77	1.2	0.71
Triumph EX62212	7.3	18.8	0.2	4.3	0.98	2.25	1.33
Triumph EX62819	7.4	20.3	0.1	4.55	1.03	1.8	1.07
Triumph TRX61737	7	21	0	3.45	0.78	1.45	0.86
Triumph TRX8343	7.7	20.2	0	4.6	1.05	1.7	1.01
Triumph TRX8344	7.3	20.1	0	4.2	0.95	1.4	0.83
Triumph TRXs8420	7.3	21.7	0.1	4.3	0.98	1.8	1.07
USDA Hybrid 894 Check	7.5	21.2	0.1	4.56	1.04	1.8	1.06

**Plant growth stage** measurements and ratings taken on 30 August 2010; hybrids in single row plots randomized and replicated 4 times; 5 plants were evaluated per row (20 total per hybrid).

**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 indicate 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 indicate a rating less than the average of the trial.

## 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 AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>Bacillus thuringiensis</b> 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>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 + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.31 - 0.74 + 0.016 - 0.038	16 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications per season, or apply more than 114 fl oz per acre per season. Do not apply 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>chlorpyrifos + zeta- cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<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.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <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:

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

example for calculating threshold: Price for Oilseed Sunflowers = \$0.19		Treatment Cost (\$)				
Plant Population	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
<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 + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.31 - 0.74 + 0.016 - 0.038	16 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications per season, or apply more than 114 fl oz per acre per season. Do not apply 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>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<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.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <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.

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### 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.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>chlorpyrifos + lambda-cyhalothrin</b> Cobalt Advanced <i>RUP</i>	0.31 - 0.74 + 0.016 - 0.038	16 - 38 fl oz	PHI = 45 days. Do not make more than 3 applications per season, or apply more than 114 fl oz per acre per season. Do not apply 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>chlorpyrifos + zeta- cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<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 Nufarm Lambda- Cyhalothrin 1EC <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.

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## 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.

<b>INSECTICIDE</b>	<b>DOSAGE IN LB AI/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<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	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.

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# WHEAT INSECTS

**Other Resources Available Through NDSU Extension Service:**

Publications	E-1479	Integrated Pest Management of Wheat Stem Sawfly in North Dakota (2010)
	E1330	Integrated Pest Management of the Wheat Midge in North Dakota (2008)
	E1230	Cereal Leaf Beetle Management (2002)
	E188	Wireworm Control (2001)
	E830	The Armyworm and the Army Cutworm (2000)
	E272	Grasshopper Management (1997)
	E493	Aphid Management in Small Grains, Corn and Sorghum (1993)
	E1007	Biology and Management of Barley Thrips (1991)
	PP680	Wheat Stem Infesting Insects in North Dakota (1989)

## APHID

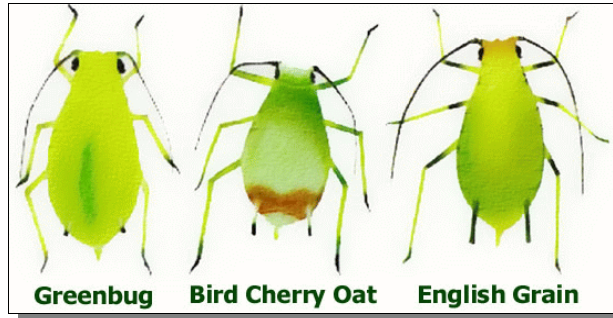
**Wheat aphid descriptions:**

**Greenbug** - pale green with darker stripe down back.

**Bird Cherry Oat Aphid** - olive green, brownish patch at the base of cornicles.

**English Grain Aphid** - bright green with long black cornicles.

The greenbug, English grain aphid and bird cherry oat aphids are the principle species that cause problems in North Dakota small grains. None of these aphids are known to overwinter in North Dakota; they migrate to the region from the South in late spring. The greenbug is the most injurious because it injects a toxin with its saliva during feeding. The English grain aphid is the most common aphid seen in small grains. Its populations grow rapidly when feeding on wheat heads. The bird cherry oat aphid feeds primarily on leaves in the lower part of the small grain plant. These aphids transmit barley yellow dwarf virus. When aphid populations are high, the disease can spread through small grain fields. At greatest risk are later planted fields which attract migrating aphids that are moving from more mature fields.



**Thresholds for Wheat: English Grain, Bird Cherry Oat, Greenbug**

To protect small grains from yield loss due to aphid feeding, the treatment threshold is 85% stems with more than one aphid present or 12-15 aphid per stem, prior to complete heading. Field scouting should begin at stem elongation and continue up to the heading stage of wheat. Aphid populations at or above the thresholds during these growth stages will result in economic injury to plants.

The greatest risk of yield loss from aphids feeding on grains is in the vegetative to boot stages. Significant yield reductions after the onset of flowering could not be demonstrated in research published from South Dakota in 1997 (Voss et al., 1997. J of Economic Entomology 90: 1346-1350). Reasons for these conclusions were that: after heading the only major yield component aphids can affect is seed weight; aphids are unable to sustain the very large populations necessary to achieve significant impact on this factor. Other components of yield are determined earlier (number of spikelets - determined at jointing; number of seeds - determined at flowering).

**Russian Wheat Aphid (RWA):**

15% to 20% of tillers infested up to flowering; 20+% infested tillers from flowering to early milk stage

**Note:** A tiller is infested whether it has one or several RWA present. **RWA have only been found in southwest North Dakota during late summer; no economic damage has been reported. No RWA have been reported in North Dakota since the early '90s. Occasionally, RWA have overwintered during mild winters in Montana.**

**Natural Controls:**

Lady beetles, aphid lions, syrphid fly larvae, and parasitoid wasps play a major role in reducing aphid populations. When natural enemies are present in large numbers, and the crop is well developed, farmers are discouraged from spraying fields.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
beta-cyfluthrin Baythroid XL	0.014 - 0.019	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 3 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
	RUP		

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.14 - 0.25 + 0.003 - 0.004	7 - 13 fl oz	PHI = 14 days for forage and hay, 28 days for grain and straw. Do not make more than 2 applications or apply more than 25 fl oz in a single application. Do not feed straw from treated wheat within 30 days of application.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	PHI = 28 days for grain and straw. PHI = 14 days before harvest for forage and hay. Do not allow livestock to graze within 14 days of application or feed straw from treated wheat within 28 days of application. Do not make more than 2 applications per season. Maximum single application rate is 0.47 lb ai per acre.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.028 - 0.038	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>dimethoate</b> Digon 400, Dimethoate 400	0.25 - 0.5	0.5 - 0.75 pt	PHI = 35 days, or graze within 14 days of last application. Do not make more than two applications per season.
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600		0.8 - 2.4 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> Enhance AW	refer to recommended label rate	4 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. 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> Foothold Extra Sativa IM Max	refer to recommended label rate	3.4 - 5.0 fl oz per cwt of seed	Apply prior to planting as a slurry treatment. Follow all applicable directions, restrictions and precautions on the EPA registered label. Do not graze or feed livestock on treated areas for 45 days after planting.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 day after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai per acre per season.
<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>malathion</b> Malathion 57EC	0.9 - 1.25	1.5 - 2 pts	PHI = 7 days. Do not apply below 60° F.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225 - 0.45	12 - 24 fl oz	PHI = 7 days or feed treated forage within 10 days of application.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>methyl parathion</b> <i>RUP</i>	0.25 - 1.5	0.5 - 1.5 pt	PHI = 15 days of harvest or grazing. To avoid injury to bees, do not apply during pollen shed if bees are visiting the areas to be treated during foraging hours. Do not enter treated fields within 48 hours after application.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 0.75	2 - 3 pts	
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.020 - 0.025	3.2 - 4 fl oz	PHI = 14 days for grain, forage or hay. Do not apply more than 0.125 lb AI per acre per season. Do not make applications less than 14 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground. Aphid control may be variable depending on species present.

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## ARMYWORMS

Armyworm outbreaks in North Dakota can occur when large migrations of moths from Southern states occur in late spring and early summer. Moths prefer to lay eggs in moist, shady areas where small grains or grasses have lodged or been damaged by hail or wind. Armyworms feed at night and hide under vegetation or in loose soil during the day. To scout for armyworms in grains, part the plants and inspect the soil for fecal pellets. If pellets or feeding damage is found, look for larvae under plant trash, soil clods or in soil cracks.

### Threshold for Wheat:

Treat when 4 to 5 or more worms per square foot are present.

### Migrating Armyworms:

Treat a couple of swaths ahead of the infestation in the direction of movement to form a barrier strip.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.014 - 0.019	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 3 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>carbaryl</b> Sevin	1 - 1.5	rate varies by formulation	PHI = 21 days. Do not make more than 2 applications after the boot stage.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.25 - 0.49 + 0.004 - 0.009	13 - 25 fl oz	PHI = 14 days for forage and hay, 28 days for grain and straw. Do not make more than 2 applications or apply more than 25 fl oz in a single application. Do not feed straw from treated wheat within 30 days of application.
<b>chlorpyrifos</b> Lorsban 4E Lorsban Advanced <i>RUP</i>	0.5	1 pt	PHI = 28 days for grain and straw. PHI = 14 days before harvest for forage and hay. Do not allow livestock to graze within 14 days of application or feed straw from treated wheat within 28 days of application. Do not make more than 2 applications per season. Maximum single application rate is 0.47 lb ai per acre.
<b>chlorpyrifos + zeta- cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>cyfluthrin</b> Tombstone Tombstone Helios  <i>RUP</i>	0.028 - 0.038	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>gamma-cyhalothrin</b> Proaxis  <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 30 days. When applying by air, apply in a minimum of 2 gals of water per acre.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC  <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 day after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai per acre per season.
<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>malathion</b> Malathion 57EC	1.25	2 pts	PHI = 7 days.
<b>methomyl</b> Lannate LV  <i>RUP</i>	0.225 - 0.45	12 - 24 fl oz	PHI = 7 days or feed treated forage within 10 days of application.
<b>methyl parathion</b> Methyl parathion 8EC  <i>RUP</i>	0.5	8 fl oz	PHI = 15 days. Do not enter treated fields within 48 hours of application.
<b>methyl parathion</b> PennCap-M  <i>RUP</i>	0.5 - 0.75	2 - 3 pts	
<b>spinosad (microbial)</b> Entrust (suppression only)	0.05 - 0.1	1 - 2 oz	Do not apply more than 5.6 oz (0.28 lb a.i.) per acre per season. PHI = 21 days for grain and straw harvest or within 3 days of forage or hay harvest.
<b>spinosad (microbial)</b> Success	0.047 - 0.094	3 - 6 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest. Do not apply more than a total of 19 fl oz per acre per season.. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>spinosad (microbial)</b> Tracer	0.031 - 0.094	1 - 3 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest.
<b>spinetoram</b> Radiant SC	0.023 - 0.047	3 - 6 fl oz	PHI = 21 days for grain or straw harvest or within 3 days of forage, fodder or hay harvest. Do not apply more than 18 fl oz (0.141 lb ai spinetoram) per acre per year. Do not make more than 3 applications in one calendar year. Do not make applications less than 4 days apart.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect  <i>RUP</i>	0.011 - 0.025	1.76 - 4 fl oz	PHI = 14 days for grain, forage or hay. Do not apply more than 0.125 lb AI per acre per season. Do not make applications less than 14 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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## CEREAL LEAF BEETLE

The cereal leaf beetle is an imported insect pest from Europe. This insect has just been found in **Williams and McKenzie counties of North Dakota**. It was first detected in Michigan in 1962, Utah in 1984, and Montana in 1989. The cereal leaf beetle is a serious pest of barley and wheat in Montana. Both adults and larvae of the cereal leaf beetle damage grain crops through their foliar feeding. The larvae are the most damaging stage and the target of control measures. Generally, the newer plant tissue is preferred with feeding occurring on the upper leaf surface causing characteristic elongated slits.

### Monitoring and Treatment Threshold:

The first sign of CLB activity in the spring is adult feeding damage on the plant foliage. While this is the first sign of adult activity, adults are not the target of control. Eggs and larvae are monitored by plant inspection since thresholds are expressed as egg and larvae numbers per plant or per stem. Examine 10 plants per location and select 1 location for every 10 acres of field. Count number of eggs and larvae per plant (small plants) or per stem (larger plants) and get an average number of eggs and larvae, based on the samples you have taken.

Boot stage is a critical point in plant development and impact of cereal leaf beetle feeding damage can be felt on both yield and grain quality. **Before boot stage**, the threshold is: three 3 eggs and larvae or more per plant (including all the tillers present before the emergence of the flag leaf). Larvae feeding in early growth stages can have a general impact on plant vigor. When the flag leaf emerges, feeding is generally restricted to the flag leaf which can significantly impact grain yield and quality. The threshold is decreased **at the boot stage** to: 1 larvae or more per flag leaf.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.008 - 0.014	1.0 - 1.8 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 3 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>carbaryl</b> Sevin (XLR Plus, 4F, 4-Oil) Sevin 80S	1.0 1.0	2 pt 1.25 pt	PHI = 21 days for grain or within 7 days of grazing.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.25 - 0.49 + 0.004 - 0.009	13 - 25 fl oz	PHI = 14 days for forage and hay, 28 days for grain and straw. Do not make more than 2 applications or apply more than 25 fl oz in a single application. Do not feed straw from treated wheat within 30 days of application.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced <i>RUP</i>	0.5	1 pt	PHI = 28 days for grain and straw. PHI = 14 days before harvest for forage and hay. Do not allow livestock to graze within 14 days of application or feed straw from treated wheat within 28 days of application. Do not make more than 2 applications per season. Maximum single application rate is 0.47 lb ai per acre.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.016 - 0.028	1.0 - 1.8 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>diflubenzuron</b> Dimilin 2L <i>RUP</i>	0.031	2 fl oz	PHI = 50 days for grain or straw, 15 days for hay, or 3 days for forage. Apply at egg laying. For use only west of US highway 281. Do not apply within 25 feet by ground or 150 feet by air of bodies of water. Applications must include a 25 foot vegetative buffer strip to limit runoff. Use 5 to 15 GPA total volume by ground, 3 to 5 GPA total volume by air. Do not exceed 4 fl oz per acre per season. Do not make more than 1 application per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 30 days. Do not apply more than 0.03 lb ai (7.7 oz) per season.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda- Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 day after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai per acre per season.
<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>malathion</b> Malathion ULV	0.3-0.6	4 - 8 oz	PHI = 7 days. Treatment is most effective at temperatures over 70° F.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225-0.45	0.75 - 1.5 pt 0.25 - 0.5 lbs	PHI = 7 days, or 10 day to graze. There is a 24-hour re-entry interval.
<b>spinosad (microbial)</b> Tracer	0.031 - 0.094	1 - 3 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest.
<b>spinosad (microbial)</b> Success	0.031 - 0.094	2 - 6 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest. Do not apply more than a total of 19 fl oz per acre per season.. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>spinetoram</b> Radiant SC	0.016 - 0.047	2 - 6 fl oz	PHI = 21 days for grain or straw harvest or within 3 days of forage, fodder or hay harvest. Do not apply more than 18 fl oz (0.141 lb ai spinetoram) per acre per year. Do not make more than 3 applications in one calendar year. Do not make applications less than 4 days apart.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.011 - 0.025	1.76 - 4 fl oz	PHI = 14 days for grain, forage or hay. Do not apply more than 0.125 lb AI per acre per season. Do not make applications less than 14 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

*RUP - Restricted use pesticide*

## CUTWORMS

Several cutworm species affect regional crops. In western North Dakota, the pale western cutworm and the army cutworm are important pests of small grains. Eggs of pale western hatch in the spring and larvae feed underground. Eggs of the army cutworm hatch in the fall and spring feeding is above ground. In eastern North Dakota, the Dingy cutworm, *Feltia jaculifera*, overwinters as a partially grown larva and is one of the first cutworm species to cause problems during crop emergence from early to mid-May. The moth of the dingy cutworm is known to lay her eggs on sunflower heads from mid-July through September. Crops following sunflowers in rotation are at greatest risk of injury by this cutworm. Other cutworms, the red-backed, *Exoa ochregaster*, and the darksided, *Exoa messoria*, overwinter as eggs which hatch in mid to late May. Eggs are laid in the fall and survive in weedy, wet, and reduced-tillage areas. Feeding injury by these cutworms normally occurs in late May to early June.

### Management and Thresholds in Wheat:

Treatment is recommended when cutworms number 4 to 5 per square foot.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.008 - 0.014	1.0 - 1.8 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 3 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Maximum number of applications per season = 2. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.25 - 0.49 + 0.004 - 0.009	13 - 25 fl oz	PHI = 14 days for forage and hay, 28 days for grain and straw. Do not make more than 2 applications or apply more than 25 fl oz in a single application. Do not feed straw from treated wheat within 30 days of application.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.5	1 pt	PHI = 28 days for grain and straw. PHI = 14 days before harvest for forage and hay. Do not allow livestock to graze within 14 days of application or feed straw from treated wheat within 28 days of application. Do not make more than 2 applications per season. Maximum single application rate is 0.47 lb ai per acre. Control may be reduced under high temperatures and dry soil conditions, or if larvae are more than ½ inch long. Suppression only.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.016 - 0.028	1.0 - 1.8 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Maximum number of applications per season = 2. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.0075 - 0.0125	1.92 - 3.2 fl oz	PHI = 30 days. When applying by air, apply in a minimum of 2 gal water/A.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 day after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai per acre per season.
<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>	0.015 - 0.025	0.96 - 1.60 fl oz	
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.008 - 0.025	1.28 - 4 fl oz	PHI = 14 days for grain, forage or hay. Do not apply more than 0.125 lb AI per acre per season. Do not make applications less than 14 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

*RUP* - Restricted use pesticide

## GRASSHOPPERS

In the Northern Plains, grasshopper egg hatch normally begins in late April to early May. Peak hatch occurs about mid-June. Heavy infestations typically occur in areas of low rainfall or during drought years. Outbreaks are usually preceded by several years of hot, dry summers and warm falls. Cool, wet weather increases disease occurrence and delays development of grasshoppers, reducing the overall population.

**Cultural Control Methods:**

- Early seeding** - Allows for early establishment and vigorous growth of plants.
- Crop rotation** - Avoid planting in areas of high egg deposits. Fields with late-maturing crops or green plant cover attract adults which then lay eggs.
- Tillage** - Summer fallow will act as a trap crop, attracting females for egg laying. Spring tillage of these sites will reduce successful emergence of nymphs.

**Grasshopper 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 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>	0.014 - 0.019	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 3 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-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 = 21 days. Do not make more than 2 applications after the boot stage. No limitations on forage. The lower rate (0.5 lb) is suggested for nymphs on small plants or sparse vegetation. The higher rate is suggested for mature grasshoppers.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.14 - 0.25 + 0.003 - 0.004	7 - 13 fl oz	PHI = 14 days for forage and hay, 28 days for grain and straw. Do not make more than 2 applications or apply more than 25 fl oz in a single application. Do not feed straw from treated wheat within 30 days of application.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	PHI = 28 days for grain and straw. PHI = 14 days before harvest for forage and hay. Do not allow livestock to graze within 14 days of application or feed straw from treated wheat within 28 days of application. Do not make more than 2 applications per season. Maximum single application rate is 0.47 lb ai per acre.
<b>chlorpyrifos + zeta-cypermethrin</b> Stallion (label pending for March 2011) <i>RUP</i>		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.028 - 0.038	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-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>diflubenzuron</b> Dimilin 2L <i>RUP</i>	0.031	2 fl oz	PHI = 50 days for grain or straw, 15 days for hay, or 3 days for forage. For best results, apply when grasshoppers reach the 2 <sup>nd</sup> to 3 <sup>rd</sup> nymphal stage of development (not effective on adult grasshoppers). For use only west of US highway 281. Do not apply within 25 feet by ground or 150 feet by air of bodies of water. Applications must include a 25 foot vegetative buffer strip to limit runoff. Use 5 to 15 GPA total volume by ground, 3 to 5 GPA total volume by air. Do not exceed 4 fl oz per acre per season. Do not make more than 1 application per season.
<b>dimethoate</b> Digon 400M, Dimethoate 400	0.38	0.75 pt	PHI = 35 days. Do not allow graze within 14 days of last application. Do not make more than 2 applications per season.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 30 days. Proaxis may be used in bordering, non-crop areas not hayed or grazed
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate	1.2 - 2.4 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>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z Nufarm Lambda-Cyhalothrin 1EC <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 day after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai per acre per season.
<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>malathion</b> Malathion (ULV)	0.48	8 fl oz/acre (95% concentrate)	Commercial aerial applicators only. PHI = 7 days.
<b>malathion</b> Malathion 57EC	0.9 - 25	1.5 - 2 pts	PHI = 7 days. No time limitation on grazing or straw for dairy or slaughter animals.
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 0.75	2 - 3 pts	PHI = 15 days. Do not enter treated fields within 48 hours after application.
<b>methyl parathion</b> <i>RUP</i>	0.375 - 0.5	0.75 - 1 pt	
<b>spinetoram</b> Radiant SC (suppression only)	0.023 - 0.047	3 - 6 fl oz	PHI = 21 days for grain or straw harvest or within 3 days of forage, fodder or hay harvest. Do not apply more than 18 fl oz (0.141 lb ai spinetoram) per acre per year. Do not make more than 3 applications in one calendar year. Do not make applications less than 4 days apart.
<b>zeta-cypermethrin</b> Mustang Max Mustang Max EC Respect <i>RUP</i>	0.020 - 0.025	3.2 - 4 fl oz	PHI = 14 days for grain, forage or hay. Do not apply more than 0.125 lb AI per acre per season. Do not make applications less than 14 days apart. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

*RUP* - Restricted use pesticide

## HESSIAN FLY

The Hessian fly overwinters as a maggot or pupa in winter wheat, volunteer grain, and wheat stubble. Overwintering maggots pupate and emerge as adults from April to May, infesting fall and spring planted wheat. By June, maggots pupate (flaxseed stage), emerging as adults in August to lay eggs for the overwintering generation.

Managing Hessian Fly:

**Winter wheat planting date** . . . Winter wheat will act as a bridge to get Hessian fly from one season to the next. Delaying planting in the fall should reduce the risk of infestations. Suggested planting dates for ND are: north - September 1 - 15; south - September 15 to 30.

**Tillage** . . . Burying stubble and destroying volunteer grain after the first killing frost or early in the spring before fly emergence helps suppress adult populations.

**Rotation** . . . Rotate wheat with nonsusceptible crops (oats, corn, soybean, sunflower, flax).

**Resistant varieties** . . . Two South Dakota releases, Guard and Shield, are hard red spring wheats. They are semi-dwarf varieties. Guard is reported to be prone to shattering.

**Chemical control** . . . Imidacloprid and thiamethoxam are registered as active ingredients for use at planting time treatment or as a seed treatment on wheat. Warrior II is also labeled as a foliar application when adults emerge. However, population levels of this pest would rarely warrant the need for such treatments in North Dakota.

INSECTICIDE	DOSAGE IN LB		PRODUCT	RESTRICTIONS ON USE
	A/ACRE		PER ACRE	
<b>imidacloprid</b> Gaucho 600	refer to recommended label rate		0.8 - 2.4 fl oz per cwt of seed	Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate		0.8 - 2.4 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> Enhance AW	refer to recommended label rate		4 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. 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> Foothold Extra Sativa IM Max	refer to recommended label rate		3.4 - 5.0 fl oz per cwt of seed	Apply prior to planting as a slurry treatment. Follow all applicable directions, restrictions and precautions on the EPA registered label. Do not graze or feed livestock on treated areas for 45 days after planting.
<b>lambda-cyhalothrin</b> Kaiso 24 WG <i>RUP</i>	0.02 - 0.03		1.33 - 2.0 oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 day after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai per acre per season.
<b>lambda-cyhalothrin</b> Warrior II <i>RUP</i>	0.02 - 0.03		1.28 - 1.92 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 day after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai per acre per season. Make foliar application when adults emerge.
<b>thiamethoxam</b> Cruiser Maxx Cereals	refer to recommended label rate		0.48 - 1.0 fl oz per cwt of seed	Follow all applicable directions, restrictions and precautions on the EPA registered label.

## WHEAT MIDGE

Though infestation pressure from this insect has declined, it remains an economic concern in North Dakota. Since 1996, wheat midge has been detected in all areas east and north of the Missouri River. A contributing factor to the recent outbreaks was delayed planting of wheat due to excessively wet soils in the spring. Any factor which results in having heading wheat present in the fields during midge emergence will put a wheat crop at risk to infestation.

The adult midge is active from late June to early August. Peak activity is from late June to mid-July. A model using daily temperatures to calculate degree day accumulations allows for a more accurate prediction of local adult emergence. Wheat is attractive for egg laying by midge from the time the head emerges from the boot through flowering. Insecticides for the control of midge are effective on the adult; however, control of the orange larvae, which feed on the developing kernels, has not been demonstrated due to protection within the glume.

### Degree Days as a Tool for Wheat Midge Management

Based on data from Canada, the threshold temperature for wheat midge development is 40° F. Observations indicate the following DD accumulations for events in the midge population.

DD	Biological Event
450	the midge breaks the larval cocoon and moves close to soil surface to form the pupal cocoon
1300	10% of the females will have emerged
1475	about 50% of the females will have emerged
1600	about 90% of the females will have emerged

### Identifying Wheat Fields at Risk for Midge Infestation

Based on North Dakota field observations, midge larval infestations were the greatest when heading occurred during peak female emergence (1475 DD). When using 40° F as a threshold for wheat development (*normally wheat development is monitored with 32 degrees*), heading occurs around 1000 - 1100 DD. Using this information, the following midge activity is expected based on degree day accumulations at time of wheat planting. There is a wheat growth and midge emergence model available through the North Dakota Agricultural Weather Network (NDAWN) Internet site and can be found at:

<http://ndawn.ndsu.nodak.edu>

Wheat Midge Degree Days Used as a Guideline for HRSW Risk Assessment
HRSW planted <b>PRIOR</b> to accumulating <b>200 DD</b> will head before wheat midge emerge.
HRSW planted <b>FROM 200 to 600 DD</b> will be heading at the time wheat midge are emerging.
HRSW planted <b>AFTER 600 DD</b> will head after peak emergence and should be at low risk to midge infestation (higher risk of frost, however).

#### Thresholds for Wheat:

Examine wheat heads at dusk (9 p.m. and later when temperatures are above 60° F and wind speed less than 6 mph). The orange-colored adult midge can be seen laying eggs on the wheat heads. Plants are susceptible as the head emerges from the boot. In general, **Hard Red Spring Wheat** treatment is warranted when 1 or more midge are observed for every 4 or 5 heads. **Durum Wheat** treatment is warranted when 1 or more midge are observed for every 7 or 8 wheat heads. Treatments after 50% of the first heads have flowered are not recommended due to reduced levels of efficacy and for the protection of a parasitic wasp that attacks the midge eggs.

#### Detecting adult midge:

Pheromone traps and sticky traps may be used to capture adult midges active in wheat fields. A simple trap design would be a white styrofoam plate, attached to the top and bottom of a surveyors flag. The trapping surface can be coated with Tanglefoot® or vegetable oil. The trap can alert an individual to the presence of midge and their identity, but it does not provide information about the need to treat.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>chlorpyrifos + gamma- cyhalothrin</b> Cobalt <i>RUP</i>	0.25 - 0.49 + 0.004 - 0.009	13 - 25 fl oz	PHI = 14 days for forage and hay, 28 days for grain and straw. Do not make more than 2 applications or apply more than 25 fl oz in a single application. Do not feed straw from treated wheat within 30 days of application.
<b>chlorpyrifos</b> Chlorpyrifos 4E AG Lorsban 4E Lorsban Advanced Warhawk Yuma 4E <i>RUP</i>	0.5	1 pt	PHI = 28 days for grain and straw. PHI = 14 days before harvest for forage and hay. Do not allow livestock to graze within 14 days of application or feed straw from treated wheat within 28 days of application. Do not make more than 2 applications per season. Maximum single application rate is 0.47 lb ai per acre.
<b>lambda-cyhalothrin</b> Lambda-Cy Silencer Grizzly Z <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 day after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai per acre per season.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
lambda-cyhalothrin Kaiso 24 WG	0.02 - 0.03	1.33 - 2.0 oz	
<i>RUP</i>			
lambda-cyhalothrin Warrior II	0.02 - 0.03	1.28 - 1.92 fl oz (suppression)	
<i>RUP</i>			
methyl parathion PennCap-M	0.5 - 0.75	2 - 3 pts	PHI = 15 days. Do not enter treated fields within 48 hours after application.
<i>RUP</i>			

*RUP* - Restricted use pesticide

## WHEAT STEM MAGGOT

The maggot tunnels in stems of wheat, resulting in a white head that can be easily pulled out of the boot. This damage becomes evident after flowering. Infestations rarely exceed 2% and fail to become an economic concern. Crop rotation and destruction of volunteer grain are the most effective methods of reducing maggot populations. Preliminary research data from NDSU suggests that tank mixing insecticides with the early season herbicides during 5-leaf to jointing wheat helped reduce the incidence of white heads and increased yields when large numbers of wheat stem maggot adults are present. Time insecticide application during peak adult activity and before larvae bore into stem. No economic threshold has been developed.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
beta-cyfluthrin Baythroid XL	0.014 - 0.019	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 3 days. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per three-day interval.
<i>RUP</i>			
lambda-cyhalothrin Warrior II	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 day after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai per acre per season.
<i>RUP</i>			
chlorpyrifos + zeta-cypermethrin Stallion (label pending for March 2011)		9.25 - 11.75 fl oz	See EPA registered label for restrictions on use.
<i>RUP</i>			

*RUP* - Restricted use pesticide

## WHEAT STEM SAWFLY

Sawfly damage occurs annually in North Dakota. This insect primarily affects wheat in the central and western areas of the state. The larvae tunnel in the stem, reducing grain yield by 10% to 25% or higher yield losses when infestations are severe. Additional loss occurs when infested stems lodge, rendering the grain unharvestable. Larvae overwinter in the wheat stubble making infested sites the source of next year's problems.

### Managing Wheat Stem Sawfly:

**Chemical control.** Insecticides have been found to be ineffective in controlling wheat stem sawfly.

**Harvesting.** Swath the most heavily infested fields at 30% to 35% moisture before significant lodging occurs. This requires field surveys to determine infestation levels. Infested stems have a reddish-brown spot below the second or third node. Examine 50 consecutive stems in a drill row from at least two sites (one near the field margin, another near the center). Determine the percent of stems infested at each site. **If more than 15% of stems are infested by sawflies, producers should swath the wheat crop.** Producers should swath sawfly-infested wheat as soon as kernel moisture drops below 40% to save infested stems before they lodge. If producers decide to swath grain, use a high swathing height to conserve the parasitoids that attack wheat stem sawfly. Research from Montana State University has shown that taller residue (at least the lower 1/3 of the plant) is better for conserving the parasitoids. If 10 to 15% of the crop was cut by sawfly during the current field season, a solid-stemmed variety of wheat is recommended for the upcoming field season.

**Fall tillage.** A shallow fall tillage to dislodge stubble and leave it on the soil surface can result in 90% mortality of overwintering larvae. Tillage can be limited to areas where surveys indicated infestations within the field or strip.

**Crop rotation.** Non-host crops are oats, flax, sunflower, legumes, and to a lesser extent barley, rye, durum or winter wheat.

**Resistant wheat varieties.** Resistant wheats have a solid-stem trait which is unsuitable for sawfly development. Please note the 2009 release of the NDAES solid-stem hard red spring wheat release named 'Mott' which has good resistance to wheat stem sawfly and high yield.



### Wheat Stem Sawfly Resistant Wheat Variety Descriptions

Variety	Type <sup>1</sup>	Height	Origin <sup>2</sup>	Year Released	Straw Strength	Maturity	Test Weight	Protein	Yield <sup>3</sup>
<b>Older varieties that were released prior to 1990 (may be difficult to find):</b>									
Cutless	HRS	semidwarf	NDAES	1986	med	med early	high	avg	med
Glenman	HRS	semidwarf	MAES	1985	strong	med	avg	low	high
Fortuna	HRS	standard	NDAES & MAES	1966	med	med	high	avg	high
Lew*	HRS	standard	MAES & ARS	1976	med	med	high	low	high
Leader	HRS	standard	AC	1981	med	med	high	high	med
Rambo	HRS	semidwarf	WPB	1986	very strong	med early	high	avg	high
Tioga	HRS	standard	NDAES & ARS	1974	med	med	high	avg	low
<b>Newer varieties that were released after 1990:</b>									
AC Abbey	HRS	standard	AC	1998	med	med	high	high	high
AC Eatonia	HRS	standard	AC	1996	med	med	high	high	high
AC Lilian	HRS	standard	AC	2006	med	med	high	high	high
Agawam	HWS	semidwarf	WPB	2005	strong	med	high	avg	high
Choteau	HRS	semidwarf	MAES	2003	strong	med	avg	avg	high
Ernest	HRS	standard	NDAES	1995	med	med	high	high	high
Explorer*	HWS	semidwarf	MAES	2002	strong	med	high	high	high
Genou	HRW	standard	MAES	2004	strong	med	high	high	high
Mott	HRS	standard	NDAES	2009	strong	med-late	high	high	high
Rampart	HRW	standard	MAES	1996	med	med	high	high	high
Vanguard	HRW	standard	MAES	1995	med	med	avg	high	high

\*indicates semi-solid lines that provide partially resistance. <sup>1</sup>HRS = Hard Red Spring Wheat, HRW = Hard Red Winter Wheat, HWS = Hard White Spring Wheat.

<sup>2</sup>AC = Agriculture Canada, ARS = Agriculture Research Service (USDA), MAES = Montana Agricultural Experiment Station, NDAES = North Dakota Agricultural Experiment Station, WPB = Western Plant Breeders, Inc.

<sup>3</sup>Yields are relative to sawfly resistant varieties.

## WIREWORMS

imidacloprid and Cruiser(thiamethoxam are labeled for application to wheat planting seed for wireworm management. Please refer to the seed treatment section in the introduction for more information.

**Caution:** Do not use treated seed for feed or food purposes. Prevent the contamination of commercial grain by thoroughly cleaning bins, grain augers and trucks that have been used to store, handle and/or home treat seed.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Gaucho 600	refer to recommended label rate	0.13 - 0.26 fl oz per cwt of seed	Follow all applicable directions, restrictions and precautions on the EPA registered label.
<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	refer to recommended label rate	0.13 - 0.26 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>INSECTICIDE</b>	<b>DOSAGE IN LB A/ACRE</b>	<b>PRODUCT PER ACRE</b>	<b>RESTRICTIONS ON USE</b>
<b>imidacloprid</b> Enhance AW	refer to recommended label rate	4 oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. 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> Foothold Extra Sativa IM Max	refer to recommended label rate	3.4 - 5.0 fl oz per cwt of seed	Apply prior to planting as a slurry treatment. Follow all applicable directions, restrictions and precautions on the EPA registered label. Do not graze or feed livestock on treated areas for 45 days after planting.
<b>imidacloprid</b> Sativa IM RTU	refer to recommended label rate	5 fl oz per 100 lbs of seed	Apply as an on-farm seed treatment at planting time. 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>thiamethoxam</b> Cruiser 5FS, Cruiser MAXX Cereals	refer to recommended label rate		Follow all applicable directions, restrictions and precautions on the EPA registered label.

## STORED GRAIN

Preparing Bins For Storage: The key to good grain storage is anticipating and preventing potential problems through good bin management.

Before treating with protectant, make sure that the bins are free of insect-infested grain. Leftover grain should be removed from the bin, and the walls should be swept and vacuumed. All grain handling equipment including augers, combines, trucks and wagons should be thoroughly cleaned and grain residues removed before harvest.

A residual bin spray such as malathion, Tempo, Diacon or a combination of the two should be applied to all interior bin surface areas 2 to 3 weeks before new grain is placed in the bin. The treatment will kill insects emerging from their hiding places (cracks, crevices, under floors and in aeration systems). Also, insects crawling or flying in from the outside will be killed.

Apply the spray to as many surfaces as possible, especially joints, seams, cracks, ledges and corners. Spray the

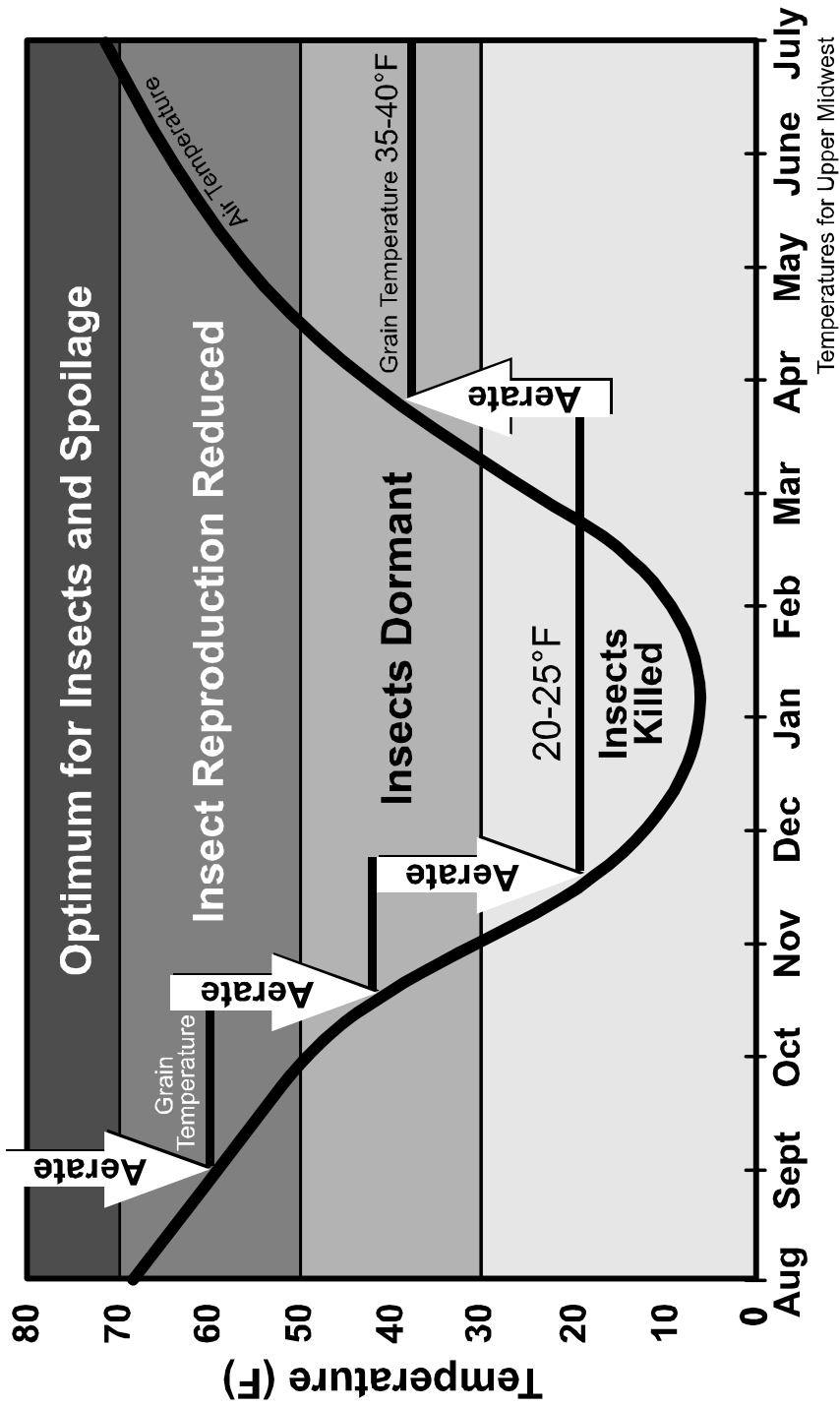
ceiling, walls and floors to the point of runoff. Use a coarse spray at a pressure of more than 30 lb per square inch and aim for the cracks and crevices.

Spray beneath the bin, its supports, and a 6 ft border around the outside foundation. Treat the outside surface, especially cracks and ledges near doors and fans.

The increased use of metal bins with perforated floors for grain drying and aeration has helped produce a serious insect problem in farm-stored grain. Grain dockage (broken kernels, grain dust, and chaff) sifts through the floor perforations and collects in the subfloor plenum creating a favorable environment for insect development. Unfortunately, the floors are usually difficult to remove, making inspection, cleaning and insecticide spraying in the plenum difficult if not impractical. The infested plenum may be disinfected with an approved fumigant such as chloropicrin.

TYPE OF TREATMENT	CROP	INSECTICIDE	Comments
<b>Residual Bin Sprays:</b> (empty bins)  Clean, sweep and spray all bins before harvest.  <b>Note:</b> Do not add grain to a treated bin for at least 24 hours or until walls have dried thoroughly.	All bins	<b>(S)-methoprene</b> Diacon II Diacon-D	Active ingredient is an insect growth regulator. It prevents the development of larvae into adults. Adult insects are not controlled. Recommend that it is mixed with Tempo for adulticide.
		<b>malathion</b>	May not provide control of Indian meal moth. Check label for listing of this use.
		<b>cyfluthrin</b> Tempo	Check product label for rates of application. Do not apply to grain.
		<b>chlorpyrifos-methyl + cyfluthrin</b> Storcide II	Storcide combines the active ingredients of Reldan (chlorpyrifos methyl) and Decis (deltamethrin).
<b>Surface Treatment:</b> Apply insecticide to surface after grain is binned.  <b>Note:</b> To ensure control, remove all surface crusting and webbing before treatment.	Wheat Barley Corn Oats Rye Soybeans Sunflowers	<b>Bacillus thuringiensis, subspecies kurstaki</b> Dipel	(Indian meal moth larvae only.) As a surface treatment, apply ½ lb of Dipel in 5-10 gal. of water per 500 sq ft of grain surface area: mix into top 4 inches.
		<b>(S)-methoprene</b> Diacon II Diacon-D	Active ingredient is an insect growth regulator. It prevents the development of larvae into adults. Adult insects are not controlled. Soybeans are not on Diacon II and Diacon-D labels. Canola and legumes are also on Diacon-D label.
		<b>diatomaceous earth</b> Insecto, Dryacide	4.0 lbs per 1,000 sq ft. Treat only the top 1 to 2 ft of the grain mass.
<b>Grain Protectant:</b> All the grain is treated when bin is being filled. Insecticides may be applied as a spray or dust to the grain as it is being augered into the bin. These products may also be used for treatment of the grain surface for registered commodities.	Corn Sorghum	<b>pirimiphos-methyl</b> Actellic 5E	No food or feeding restrictions. Lesser grain borer is not listed as a target pest.
	Wheat Barley Oats Sorghum Corn	<b>(S)-methoprene</b> Diacon II Diacon-D	Active ingredient is an insect growth regulator. It prevents the development of larvae into adults. Adult insects are not controlled. Sunflowers are on Diacon II and Diacon-D labels. Canola and legumes are also on Diacon-D label.
		<b>malathion</b>	May not provide control of Indian meal moth. Products not labeled specifically for application to stored grain should not be used.
		<b>chlorpyrifos-methyl + cyfluthrin</b> Storcide II	Storcide II combines the active ingredients of Reldan (chlorpyrifos methyl) and Decis (deltamethrin). Storcide II does NOT have export restrictions on the label.

# Cool Grain to Prevent Storage Problems



\* Prevent crusting due to moisture migration by cooling grain to within 15°F of average outdoor temperatures.

\* Cooling grain by 10°F doubles its allowable storage time

Dr. Kenneth J. Hellevang, PE  
NDSU Extension Service

## FUMIGANTS

The two principal types of fumigants used for the treatment of farm-stored grain are liquids (chloropicrin) and solids (aluminum phosphide). Limited amounts of methyl bromide (a compressed gas) are also used in farm storage. These vapors permeate the grain mass and kill insects by suffocation or by chemical action on their breathing system, preventing the assimilation of oxygen or other vital functions. In order for a grain fumigant to kill insects, it is necessary that the vapor or gas remain at a toxic concentration for a sufficient period of time for the insects to contact the gas. No fumigant kills insects instantaneously; usually it requires several hours of exposure, even under ideal conditions, for fumigating.

### Some Important Steps for Successful Fumigation

1. Do not attempt fumigating grain unless the grain temperature is 60° F or higher.
2. Before applying fumigants, level the grain surface and break up any surface "caking."

3. Apply fumigants on a calm day. Seal bin as tightly as possible. The fumigant should be retained in the grain and not allowed to "leak" out. Use polyethylene and/or caulk to cover or seal all holes and cracks. Cover the grain with a tarpaulin or polyethylene if there is a large air space above the grain.
4. All fumigants should be handled with extreme care because the fumes are highly toxic. Apply the fumigant from the outside of the bin whenever possible. Always have a second person nearby while fumigating. Use a self-contained breathing apparatus if you must enter the bin.
5. Always use the recommended dosage.
6. Keep all people and animals out of the building for at least 48 hours.
7. Never use fumigants when the grain temperature is below 60° F. During the cold winter months, it would be better to aerate, turn or move the grain.

FUMIGANT*	COMMODITIES	COMMENTS
Chloropicrin <i>RUP</i>	Empty-bin treatment only. (See comments on right.)	Chloropicrin is no longer registered for direct application to stored grain. However, the fumigant can still be used for treating the perforated floors in empty bins in order to control insects in the subfloor area prior to bin filling.
Aluminum phosphide ** <i>RUP</i>	Wheat, barley, rye, oats, corn sorghum, safflower seed, sunflower seed, soybeans, triticale and millet	Aluminum phosphide is available under trade names such as Fumitoxin, Weevil-Cide and Phostoxin in pellet or tablet form. Since phosphine gas is only slightly heavier than air, it is very important that the bins are tightly sealed and the grain surface covered with plastic sheeting after the fumigant has been probed into the grain mass. Since there is a delay time of 1 to 2 hours with tablets before dangerous amounts of phosphine gas are released, applicators can normally complete application before toxic fumes begin to develop in the bin.
Methyl bromide <i>RUP</i>	Wheat (similar small grain), shelled corn and milo (grain sorghum)	Methyl bromide can affect the germination of seeds at high moisture levels and high dosages. It is more than 3 times the weight of air, and recirculation techniques may be needed to ensure even distribution. This, plus the fact that methyl bromide is very hazardous to work with, are reasons that this product should only be used by trained professional fumigators.

*RUP* - Restricted use pesticides are to be applied by or under the direct supervision of certified pesticide applicators only.

\* Dosage rates for the fumigants listed will vary depending upon the commodity and type of storage structure to be treated. Read and follow label directions carefully!

### \*\* Fumigation Management Plan:

The certified applicator is responsible for working with the owners and/or responsible employees of the structure and/or area to be fumigated to develop and follow a Fumigation Management Plan (FMP). The FMP is intended to ensure a safe and effective fumigation. The FMP must address characterization of the structure and/or area, and include appropriate monitoring and notification requirements, consistent with, but not limited to, the following:

- Inspect the structure and/or area to determine its suitability for fumigation.
- When sealing is required, consult previous records for any changes to the structure, seal leaks and monitor any occupied adjacent buildings to ensure safety.
- Prior to each fumigation, review any existing FMP, MSDS, Applicator's Manual and other relevant safety procedures with company officials and appropriate employees.
- Consult company officials in the development of procedures and appropriate safety measures for nearby workers who will be in and around the area during application and aeration.
- Consult with company officials to develop an appropriate monitoring plan that will confirm that nearby workers and bystanders are not exposed to levels above the allowed limits during application, fumigation and aeration.
- This plan must also demonstrate that nearby residents will not be exposed to concentrations above the allowable limits.
- Consult with company officials to develop procedures for local authorities to notify nearby residents in the event of an emergency.
- Confirm the placement of placards to secure entrance into any structure under fumigation.

- Confirm the required safety equipment is in place and the necessary manpower is available to complete a safe and effective fumigation.
- Written notification must be provided to the receiver of a vehicle that is fumigated in transit.

These factors must be considered in putting an FMP together. It is important to note that some plans will be more comprehensive than others. All plans should reflect the experience and expertise of the applicator and circumstances at and around the structure and/or area. In addition to the plan, the applicator must read the entire label and Applicator's Manual and follow its directions carefully. The FMP and related documentation, including monitoring records, must be maintained for a minimum of two years.

## REASONS FOR FUMIGATION FAILURES

**Insufficient Fumigant:** Because the efficiency of a fumigant depends on the maintenance of a killing concentration in the grain, any factor that affects gas concentration is important. You cannot get satisfactory results by applying less than the recommended dosage (a common problem). Be sure to use the amount of fumigant required for the capacity of the bin, not the amount of grain contained in the bin.

**Storage Structure:** A loosely constructed, leaky bin may not retain fumigants long enough to kill the insects while a tight concrete or metal bin may hold the fumigant in killing concentrations for several days. The depth of the grain in relation to its surface area also affects the efficiency of a fumigant. In general, the greater the surface area of the grain in proportion to the bulk, the greater the difficulties encountered in fumigation. This is the practical reason (except for leaks) that flat storages require higher dosages than round silo-type bins. Storage structures with a large amount of space over the grain are also difficult to fumigate effectively, as large amounts of gas escape into the head space.

**Type of Grain and Dockage:** The kind of grain affects the efficiency of a fumigant in accordance with its sorption quality. For example, shelled corn and grain sorghum appear

to be much more sorptive than wheat. Wheat with dockage exceeding 3% requires nearly twice the dosage than wheat with less than 1% dockage requires.

**Moisture:** The moisture content of the grain has a profound effect on the efficiency of a fumigant - the higher the moisture content, the higher the dosage required. As the moisture content increases above 12%, a proportionally higher dosage is required. Generally you cannot satisfactorily fumigate grain having a surface moisture content of 15% to 20% because the fumigant vapors will not penetrate the moist layer.

**Temperature:** During fumigation the gas quickly assumes the temperature of the grain. An increase in temperature results in greater molecular activity of gases, which facilitates the diffusion and penetration of the fumigant. However, there are limiting factors for both extremes of high or low temperatures. If grain temperature reaches 115° F, the fumigants vaporize very rapidly and may escape from the bin before lethal gas concentrations can be obtained. Most stored grain insects cannot survive in grain at 115° F or above, thus eliminating the need for fumigating. You need not fumigate stored grain with a temperature of 60° F or below as the insects are inactive at this temperature.

## VEGETABLE CROP INSECTICIDE PRODUCTS - QUICK REFERENCE CHARTS

The following charts are for use as a quick reference to locate possible insecticides available for use against insect pests in field crops. For complete information, restrictions, and precautions, ALWAYS READ THE PRODUCT LABEL.

Carrots	aphids	leaf eating caterpillars	cutworms	flea beetles	grasshopper	leafhopper
<i>General use Insecticide</i>						
azadirachtin (Neem)	●	●	●			●
<i>Bacillus thuringiensis</i>		●				
carbaryl		●	●	●	●	●
malathion	●	●		●		●
methoxychlor		●		●		●
potassium salts - M-Pede	●					●
pyrethrins	●	●	●	●		●
pyrethrins + rotenone - Pyrellin	●	●		●		●
thiamethoxam - Platinum 2SC, 75SG	●			●		●
<i>Restricted use Insecticide - see previous chart, page 21</i>						

Cole crops	aphids	leaf-eating caterpillars	cutworms	grasshoppers
<i>General use insecticides</i>				
acephate	●	●		
azadirachtin - (Neem)	●	●	●	
<i>Bacillus thuringiensis</i>		●	●	
Bt + sulfur premix		●		
carbaryl		●	●	●
chlorantraniliprole		●		
cryolite		●	●	
dimethoate	●			
imidacloprid - Nuprid	●			
indoxacarb - Avaunt		●		
malathion	●	●		
methoxychlor		●		
methoxyfenozide - Intrepid IGR		●		
naled - Dibrom	●	●		
petroleum oil	●	●		
potassium salts - M-pede	●			
pyrethrins	●	●		
pyrethrins + rotenone - Pyrellin	●	●		
spinosad - Success		●		
spinetoram - Radiant SC		●		
thiamethoxam + chlorantraniliprole - Voliam Flexi	●	●		
<i>Restricted use insecticides</i>				
azinphos-methyl	●	●		
chlorpyrifos	●	●	●	
cypermethrin	●	●	●	
disulfoton - Di-syston	●			
esfenvalerate - Asana		●	●	●

Cole crops	aphids	leaf-eating caterpillars	cutworms	grasshoppers
imidacloprid	●			
lambda-cyhalothrin	●	●	●	●
lambda-cyhalothrin + chlorantraniliprole - Voliam Xpress	●	●	●	●
methomyl - Lannate		●	●	
methyl parathion	●	●		
permethrin	●	●		
thiodicarb - Larvin brand 3.2		●	●	
zeta-cypermethrin	●	●	●	

Cucurbits	aphids	cucumber beetle	leaf-eating caterpillars	cutworms	flea beetles	grasshoppers
<i>General use insecticides</i>						
azadirachtin	●	●	●	●	●	
carbaryl		●	●	●	●	●
chlorantraniliprole			●			
cryolite		●	●		●	
dimethoate	●					
imidacloprid - Nuprid	●					
malathion	●	●		●		
methoxychlor		●	●		●	
naled - Dibrom	●	●	●			
petroleum oil	●		●			
potassium salts - M-pede	●					
pyrethrins	●	●	●		●	
pyrethrins + rotenone - Pyrellin	●	●	●		●	
thiamethoxam + chlorantraniliprole - Voliam Flexi	●	●	●		●	
<i>Restricted use insecticides</i>						
azinphos-methyl		●				
beta-cyfluthrin - Baythroid XL		●	●	●		●
bifenthrin	●	●	●	●		●
cyfluthrin - Tombstone, Tombstone Helios		●	●	●		●
deltamethrin - Delta Gold		●	●	●	●	●
esfenvalerate - Asana		●		●		●
lambda-cyhalothrin + chlorantraniliprole - Voliam Xpress	●	●	●	●	●	●
methomyl - Lannate	●	●	●	●	●	
oxamyl - Vydate	●					
permethrin		●	●	●		



Lentils	aphids	leaf-eating caterpillars	cutworms	bean leaf beetle	flea beetles	grasshoppers	tarnished plant bug
<i>General use Insecticides</i>							
azadirachtin - (Neem)	●	●	●		●		
carbaryl		●	●	●	●	●	●
dimethoate	●						●
malathion	●						
pyrethrins	●	●			●		
pyrethrins + rotenone - Pyrellin	●	●					●
<i>Restricted use Insecticides</i>							
lambda-cyhalothrin + chlorantraniliprole - Voliam Xpress	●	●	●	●	●	●	
lambda-cyhalothrin - Warrior II	●	●	●	●	●	●	●

Peas	aphids	bean beetle	leaf-eating caterpillars	cutworms	grasshoppers	leafhoppers	lygus bugs
<i>General use Insecticides</i>							
azadirachtin - (Neem)		●	●	●			
carbaryl			●	●	●	●	
dimethoate	●						
malathion	●	●			●	●	
methoxychlor		●	●				
naled - Dibrom	●		●			●	●
potassium salts - M-pede	●					●	
pyrethrins	●		●			●	●
pyrethrins + rotenone - Pyrellin	●		●			●	●
spinosad - Success			●				
<i>Restricted use pesticides</i>							
bifenthrin	●	●	●	●	●	●	●
disulfoton - Di-syston	●					●	
esfenvalerate - Asana	●	●	●	●		●	●
lambda-cyhalothrin - Warrior II	●	●	●	●	●	●	●
methomyl - Lannate	●		●	●			
methyl parathion	●		●	●		●	●

Peppers	aphids	Colorado potato beetle	leaf-eating caterpillars	cutworms	flea beetles	grasshoppers	lygus bugs
<i>General use Insecticides</i>							
acephate	●		●			●	
azadirachtin - (Neem)	●	●	●	●	●		
carbaryl		●	●	●	●	●	●
chlorantraniliprole		●	●				
cryolite		●	●		●		
dimethoate	●						
imidacloprid	●	●			●		
indoxacarb - Avaunt			●				
malathion	●						
methoxychlor			●		●		
naled - Dibrom	●				●		

Peppers	aphids	Colorado potato beetle	leaf-eating caterpillars	cutworms	flea beetles	grasshoppers	lygus bugs
petroleum oil	●		●				
potassium salts - M-pede	●						●
pyrethrins	●	●	●	●	●		●
pyrethrins + rotenone - Pyrellin	●	●	●		●		●
spinetoram - Radiant SC		●	●				
thiamethoxam + chlorantraniliprole - Voliam Flexi	●	●	●		●		
<i>Restricted use Insecticides</i>							
aziphos-methyl			●		●		
beta-cyfluthrin - Baythroid XL	●	●	●		●		●
bifenthrin			●	●	●		
cyfluthrin - Tombstone, Tombstone Helios	●	●	●		●		●
deltamethrin - Delta Gold	●		●	●	●		●
diazinon	●			●			
disulfoton - Di-syston	●						
esfenvalerate - Asana		●	●		●		
lambda-cyhalothrin - Warrior II	●	●	●	●	●	●	●
lambda-cyhalothrin + chlorantraniliprole - Voliam Xpress	●	●	●	●	●	●	
methomyl - Lannate	●		●	●			
oxamyl - Vydate	●						
permethrin			●	●	●		

Sweet corn	aphids	armyworms	corn rootworm	cutworm	European corn borer	grasshoppers	grubs	sap beetles	seedcorn maggots	wireworms
<i>General use pesticides</i>										
<i>Bacillus thuringiensis</i>		●		●	●					
carbaryl		●	●	●	●	●		●		
indoxacarb - Avaunt		●			●					
malathion	●		●			●		●		
methoxychlor		●								
permethrin (foliar) - Arctic		●	●	●	●					
permethrin (seed treatment)									●	●
petroleum oil	●	●	●							
pyrethrins + rotenone - Pyrellin	●				●					
spinosad - Success		●			●					
spinosad - Tracer		●			●					
spinetoram - Radiant SC		●			●					
<i>Restricted use insecticides</i>										
beta-cyfluthrin - Baythroid XL		●	●	●	●	●				
bifenthrin	●	●	●	●	●	●	●	●	●	●
chlorethoxyfos - Fortress			●	●			●		●	●

	aphids	armyworms	corn rootworm	cutworm	European corn borer	grasshoppers	grubs	sap beetles	seedcorn maggots	wireworms
<b>Sweet corn</b>										
chlorpyrifos		●	●	●	●	●	●		●	●
cyfluthrin - Tombstone, Tombstone Helios		●	●	●	●	●				
cyfluthrin + tebufos - Aztec			●	●			●		●	●
deltamethrin - Delta Gold	●	●	●	●	●	●				
esfenvalerate - Asana	●	●	●	●	●	●		●		
ethoprop - Mocap			●	●			●			
imidacloprid <i>(commercial seed treatment)</i>	●								●	●
lambda-cyhalothrin -Grizzly Z, Warrior II	●	●	●	●	●	●		●		
lambda-cyhalothrin + chlorantraniliprole - Voliam Xpress	●	●	●	●	●	●		●		
methomyl - Lannate	●	●	●	●	●					
permethrin		●	●	●	●					
phorate			●				●		●	●
tefluthrin - Force 3G, Force CS			●	●			●		●	●
terbufos - Counter			●	●			●		●	●
thiodicarb - Larvin brand 3.2		●		●	●					
zeta-cypermethrin - Respect	●	●	●	●	●	●		●		

	armyworms	aphids	Colorado potato beetle	cutworms	European corn borer	fllea beetles	grasshoppers	plant bugs	wireworms
<b>Tomatoes</b>									
<b>General use Insecticides</b>									
azadirachtin	●	●	●	●		●			
beta-cyfluthrin - Baythroid XL	●	●	●	●	●	●	●		
carbaryl	●		●	●	●	●	●	●	
chlorantraniliprole	●		●		●				
cryolite			●			●			
dimethoate		●							
imidacloprid		●	●						
indoxacarb - Avaunt	●								
malathion		●							
methoxychlor			●						
petroleum oil		●							
potassium salts - M-pede		●						●	
pyrethrins	●	●	●	●	●	●		●	
pyrethrins + rotenone - Pyrellin		●	●		●	●		●	
spinetoram - Radiant SC	●		●		●				

	armyworms	aphids	Colorado potato beetle	cutworms	European corn borer	flea beetles	grasshoppers	plant bugs	wireworms
<b>Tomatoes</b>									
thiamethoxam + chlorantraniliprole - Voliam Flexi	●	●	●		●	●			
<i>Restricted use Insecticides</i>									
abamectin			●						
azinphos-methyl		●	●		●	●	●		
bifenthrin	●	●		●	●	●	●	●	
cyfluthrin	●	●	●	●	●				
disulfoton - Di-syston		●	●			●			
esfenvalerate - Asana	●	●	●	●		●	●		
lambda-cyhalothrin - Warrior II	●	●	●	●	●	●	●	●	
lambda-cyhalothrin + chlorantraniliprole - Voliam Xpress	●	●	●	●	●	●	●	●	
methomyl - Lannate	●	●		●					
methyl parathion	●	●	●	●	●	●	●	●	
oxamyl - Vydate		●	●						
permethrin	●		●	●					

## HOME AND LANDSCAPE INSECT CONTROL

With recent changes due to the elimination of Dursban and diazinon from the list of available homeowner products, insect control recommendations have gotten a little more complicated. Also, there are numerous brands available to homeowners that can be found on the shelves in nurseries, garden centers, grocery stores, farm and livestock supply stores, local elevators and others. It has become increasingly difficult with this diversity of choices to talk “brand names.” Instead, the emphasis is on active ingredient in the product and reading the label for specific use directions, which is necessary for any pesticide user.

Another complicating factor is the marketing program of various manufacturers and the naming of their products. The same concentration of an active ingredient might be used in a line of products, each with a different name which specifies its use. But upon reading each product’s label, the insect pests and use sites are identical ..... thus there is no reason to buy two products when one will be adequate.

The following list was prepared in one state to illustrate the diversity of products that can be found. These products may or may not be available in North Dakota and are presented only as an illustration of this diversity. The list contains 27 manufacturers which have utilized 36 active ingredients (of combinations thereof) to produce 132 products which are marketed as RTU (ready-to-use), hose-end, granular, dust, bait and EC (emulsifiable concentrate) formulations.

### acephate

Ortho Isotox Insect Killer  
Ortho Systemic Insect Killer Concentrate  
Ortho Orthonex Insect and Disease Control Concentrate

### azadiractin

Natural Guard Multi-Purpose Neem Insecticide

### *Bacillus thuringiensis*

American Brand Thuricide  
Fertilome Dipel Dust

### bifenthrin

Ortho Home Defense Perimeter and Outdoor Insect Killer RTU  
Ortho Rose and Flower RTU  
Ortho Bug-B-Gon MAX Insect Killer for Lawns Granules  
Scotts Lawn Pro Insect Control and Fertilizer Granules

### carbaryl

Cornbelt Sevin 5% Dust  
Eliminator 7 Dust  
Eliminator Lawn Insect Killer Granules  
Fertilome Carbaryl Garden Spray  
GardenTech Sevin RTU Bug Killer  
GardenTech Sevin Hose-end  
GardenTech Sevin 5 Dust  
GardenTech Sevin Bug Killer Concentrate  
Garden Tech 2% Granules  
Ortho Bug-B-Gon Multipurpose Insect Killer Granules

### carbaryl/malathion

Bonide Fruit Tree Spray

### carbaryl/metaldehyde

Bonide No Escape Snail, Slug and Sowbug Bait

### carbaryl/rotenone

Bonide Tomato/Potato Spray or Dust

### cyfluthrin

Bayer Tempo SC Ultra  
Schultz Insect Killer  
Schultz Lawn and Garden Insect Killer Granules

### cyfluthrin/imidacloprid

Bayer Advance Garden Power Force Multi Insect Killer Hose-end  
Bayer Advance Garden Power Force Multi Insect Killer RTU  
Bayer Advance Garden Power Force Multi Insect Killer Concentrate  
Bayer Advance Rose and Flower Insect Killer RTU

### deltamethrin

Bonide Delta Eight Insect Control

### diatomaceous earth

Concern Diatomaceous Earth Crawling Insect Killer

### dicofol

Hi-Yield Kelthane Concentrate

### dimethoate

Fertilome Ornamental & Evergreen Spray Concentrate  
Hi-Yield Cygon 2E Systemic Ornamental and Vegetable Insecticide Concentrate  
ProTech X-ectue Systemic Insecticide Concentrate

### disulfoton

Bayer Advance Garden 2-in-1 Rose and Flower Care  
Bonide Systemic House Plant Insect Control  
Fertilome Systemic Insecticide Granules  
Fertilome Rose Food Granule  
Hi-Yield Di-Syston Insecticidal Granules

### endosulfan

Fertilome Cutworm & Hornworm Killer Dust  
Hi-Yield Thiodan

### esfenvalerate

KGRO Multi-Purpose Insect Killer Concentrate  
Ortho Bug-B-Gon Garden and Landscape Dust  
Ortho Bug-B-Gon Garden and Landscape RTU  
Ortho Bug-B-Gon MAX Lawn & Garden Insect Killer Hose-end  
Ortho Bug-B-Gon MAX Lawn & Garden Insect Killer Concentrate  
Ortho Bug-B-Gon Multi-Purpose Insect Killer Concentrate  
Ortho Bug-B-Gon Multi-Purpose Insect Killer RTU

### imidacloprid

Bayer Advance Lawn - Season Long Grub Control Hose-end  
Bayer Advance Garden, Tree & Shrub Insect Control Concentrate  
Scotts GrubEX Granules

### iron phosphate

Garden Safe Snail & Slug Bait  
Monterey Sluggo

### lambda cyhalothrin

Spectracide Triazicide hose-end  
Spectracide Triazicide Soil & Turf Insect Killer Concentrate  
Spectracide Triazicide Soil & Turf Insect Killer Granules  
Spectracide Triazicide .04 Granules

### malathion

Fertilome Fruit Tree Spray Concentrate

Fertilome Mal-A-Cide  
 Gordons Malathion Concentrate  
 Green Thumb Malathion Insect Killer Concentrate  
 Hi-Yield Malathion  
 Ortho Malathion Plus Insect Spray EC  
 Schultz Malathion Concentrate  
 malathion/carbaryl  
   Bonide Fruit Tree Spray EC  
 malathion/methoxychlor  
   Fertilome Bagworm and Tent Caterpillar Killer  
   Fertilome Triple Action  
 metaldehyde  
   Hi-Yield Snail and Slug Killer Pellets  
   Eliminator Snail & Slug Bait  
   KGRO Snail and Slug Killer  
 metaldehyde/carbaryl  
   Bonide No Escape Snail, Slug and Sowbug Bait  
   Fertilome Eliminate Snail, Slug and Bug Bait  
   Ortho Bug-Geta Snail and Bug Killer  
 methoxychlor/malathion  
   Fertilome Bagworm and Tent Caterpillar Killer  
 neem  
   Fertilome Triple Action Plus  
 nicotine  
   Bonide Tobacco Dust  
*Nosema locustae*  
   Planet Natural Semaspore Grasshopper Bait  
 oil (Horticultural)  
   Bonide All-Season Spray Oil  
   Ortho Volck Oil Spray  
   Sunspray Ultra-fine Year-Round Pesticidal Oil  
 permethrin  
   Bonide Eight Garden Dust  
   Bonide Eight Insecticide Concentrate Garden and Lawn  
   Bonide Eight Insecticide Concentrate Vegetable, Fruit  
     and Flower  
   Bonide Borer-Miner Killer  
   Bonide Total Pest Control Concentrate (Outdoor  
     Formula)  
   Cutter Bug-Free Backyard Hose-end  
   Do It Best Multi-Purpose Garden Insect Killer  
     Concentrate  
   Do It Best Multi-Purpose Garden Pest Dust  
   Eliminator Ant, Flea, Tick & Mosquito Killer Concentrate  
   Eliminator Ant, Flea and Tick Killer Granules  
   Green Thumb Multi Purpose Insect Killer Concentrate  
   Hi-Yield 38Plus Turf, Tree & Ornamental Insect Control  
     Concentrate  
   Hi-Yield Garden, Pet and Livestock Insect Control  
     Concentrate  
   Hi-Yield Garden, Pet and Liverstock Dust  
   Hi-Yield Kill-A-Bug II Lawn Granules  
   KGRO Insect Killer Granules  
   KGRO Multi-Purpose Insect Killer (hose-end, RTU)  
   Ortho Basic Solutions Lawn & Garden Insect Killer  
     Concentrate (also hose-end)  
   Ortho Basic Solutions Lawn & Garden Insect Killer  
     Granules  
   Ortho Bug-B-Gon Garden and Landscape  
   Ortho Bug-B-Gon Multi-Purpose Garden Dust  
   Ortho Bug-B-Gon Multi-Purpose Insect Killer hose-end  
   Ortho Mosquito-B-Gon Tree, Shrub & Lawn Spray  
     hose-end  
   Schultz Mosquito Control Hose-end  
   Schultz Fungicide Plus Concentrate  
   Schultz Triple Action Formula Fungicide  
   Terro Outdoor Ant Killer Granules

pyrethrin  
   Concern Multi-Purpose Insect Killer  
   Fertilome Triple Action Plus RTU  
   Green Thumb Rose and Flower Insect Killer RTU  
   Green Thumb Tomato and Vegetable Spray RTU  
   KGRO Tomato and Vegetable Insect Killer RTU  
   Schultz Expert Gardener House Plants and Gardens  
     Insect Spray  
   Schultz Expert Gardener Insect Spray  
   Schultz Fruit & Vegetable Insect Spray RTU  
   Schultz Rose and Flower Insect Spray RTU  
 rotenone  
   Hi-Yield Rotenone Insecticide  
 rotenone/carbaryl  
   Bonide Tomato/Potato Spray or Dust  
 rotenone/pyrethrin  
   Bonide Rotenone/Pyrethrum Concentrate  
 rotenone/sulfur  
   Fertilome Rose, Flower & Vegetable Dust  
 soap  
   Concern Insect Killing Soap  
   Safer House Plant Insect Killing Soap concentrate  
   Safer House Plant Insect Killing Soap With Seaweed  
     Concentrate  
   Safer Insecticide Killing Soap With Seaweed RTU  
   Safer Insecticide Killing Soap Concentrate  
   Safer Insecticide Multi-Purpose Soap Insect Killer  
     Concentrate  
 spinosad  
   Fertilome Borer, Bagworm, Leafminer and Tent  
     Caterpillar Spray Concentrate  
 sulfur  
   Fertilome Dusting Sulfur

## TREES AND SHRUB INSECTICIDE PRODUCTS - QUICK REFERENCE CHARTS

Insecticides for the Management of Insect and Mite Pests of Trees and Shrubs.

The "Alternative" products represent those that would be generally classified as "organic," representing botanicals, microbials and soaps.

Always Read and Follow the Label! (● indicates listed pest is found on the pesticide label)	aphids	plant bugs	leafhoppers	scale insects	spider mites	gall insects	leaf beetles	caterpillars	sawflies	wood borers
<b>Synthetic Insecticides</b>										
acephate (Orthene® and Isotox®)	●	●	●	●	●		●	●	●	
carbaryl (Sevin®)	●	●	●	●		●	●	●	●	
cyfluthrin (Bayer Advanced®)	●	●	●	●			●	●	●	
dimethoate (Cygon®)	●									
esfenvalerate (Bug-B-Gone®)	●	●	●				●	●	●	
horticultural oils				●	●	●				
imidacloprid (Bayer Advanced Garden®)	●	●	●	●			●		●	●
malathion	●	●	●	●		●	●			
permethrin (Astro™ and others)	●	●	●					●	●	●
spinosad (Conserve®)					●		●	●		
<b>Alternative Products</b>										
<i>Bacillus thuringiensis</i>								●		
insecticidal soaps (M-Pede)	●	●	●		●					
Intrepid (IGR)								●		
pyrethrins	●	●	●				●	●		
neem (Bioneem®)	●							●	●	
rotenone							●			
<b>Other Synthetic Insecticides</b>										
bifenthrin (Talstar®)		●	●	●		●		●	●	●
cyfluthrin (Tempo®)	●	●	●				●	●	●	
deltamethrin (Deltagard® and Suspend®)	●	●	●	●	●		●	●	●	
dicrotophos (Inject-A-Cide B®)	●					●	●			●
disulfoton (Di-Syston®)	●		●				●	●		
fenpropathrin (Tame®)	●		●		●					
fluvalinate (Mavrik®)	●		●			●		●	●	
imidacloprid (Merit®)	●	●	●				●		●	●
lambda-cyhalothrin (Scimitar®)	●	●	●	●	●		●	●	●	
oxythioquinox (Morestan®)					●	●				
pymetrozine (Endeavor®)	●									

## FLOWER GARDEN INSECTICIDE PRODUCTS - QUICK REFERENCE CHARTS

The "Alternative" products represent those that would be generally classified as "organic," representing botanicals, microbials and soaps. Always read and follow the label. Before treating flowering plants, check the label for comments pertaining to plant sensitivity to the chemical.

( '●' indicates listed pest is found on the pesticide label)

	Aphids	Leaf Beetles	Grasshoppers	Rose Curculio	Rose Slug	Spider Mites	Leafhoppers	Plant Bugs	Thrips	Scale Insects	Caterpillars	Cutworms	Millipedes	Sowbugs	Slugs & Snails
<b>General Use Insecticides</b>															
acephate (Orthene® and Isotox®)	●	●	●		●	●	●	●	●	●					
carbaryl	●	●	●	●	●		●	●	●	●	●	●	●	●	
chlorpyrifos*										●		●	●	●	
cyfluthrin (Advanced Garden®)	●	●	●		●		●	●		●	●	●	●	●	
dimethoate	●								●						
imidacloprid (Advanced Garden®)	●						●	●	●	●					
malathion	●	●					●	●	●	●					
mesurol															●
metaldehyde															●
methoxychlor	●	●			●				●						
<b>Alternative Products</b>															
<i>Bacillus thuringiensis</i> (Bt)											●				
insecticidal soaps	●					●	●	●							
neem (Bioneem®)	●								●		●				
pyrethrins	●	●					●	●			●				
rotenone		●							●						
<b>Professional Use Only</b>															
cyfluthrin (Tempo®)	●	●	●				●	●			●	●	●	●	
disulfoton (Di-Syston®)	●	●					●		●						
fenpropathrin (Tame®)	●					●	●								
fluvalinate (Mavrik®)	●						●		●		●				
imidacloprid (Merit®)	●	●					●	●	●						
lambda-cyhalothrin (Scimitar®)	●	●				●	●		●		●	●		●	
oxythioquinox (Morestan®)						●									



## INSECTICIDES FOR LAWN PEST CONTROL - QUICK REFERENCE TABLE

Insecticide	Rate	Remarks
<b>WHITE GRUBS</b>		
carbaryl (Sevin, several formulations)	Follow label rates for white grubs.	Water into sod after application.
imidacloprid (Advanced Lawn ®)	3 lbs/1,000 sq. ft.	Apply in mid-May. Water after application.
isazophos 4E (Triumph)	1.5 fl. oz./1,000 sq. ft.	Apply in sufficient water to ensure uniform coverage. As soon as application is complete, apply ½ inch of water but stop watering before puddling or runoff occurs. Do not treat golf course fairways.
isofenfos 22% EC (Oftanol 2)	3.0 fl. oz./1,000 sq. ft. or 1 gal./acre	Water lawn thoroughly within 12 hours of the application, using sufficient water to wet the soil to a depth of 1 to 1½ inches.
<b>SOD WEBWORM</b>		
bendiocarb 76% EC (Turcam)	½ to 1 fl. oz./1,000 sq. ft.	Apply when pest is evident. Use adequate quantity of water to thoroughly moisten grass and thatch.
carbaryl (several formulations) (Sevin)	Follow label rate for sod webworm.	Insure good penetration of turf. For best results mow lawn and apply after a rain or watering. Repeat at 2 to 3 week intervals if needed.
isazophos 4E (Triumph)	0.75 fl. oz./1,000 sq. ft.	Apply in sufficient water to ensure uniform coverage. As soon as application is complete, apply ½ inch of water but stop watering before puddling or runoff occurs. Do not treat golf course fairways.
isofenphos 22% EC (Oftanol 2)	1.5 to 3 fl. oz./1,000 sq. ft. treatment.	Apply ¼ to ½ inch of water within 12 hours of application.
<b>ANTS</b>		
bendiocarb 76% EC (Turcam)	0.5 to 1.0 oz./1,000 sq. ft.	Apply to hills and surrounding areas. Use adequate quantities of water to thoroughly moisten grass and thatch.
carbaryl (several formulations) (Sevin)	Follow label rates for ants.	Same as above.
isazophos 4E (Triumph)	0.75 fl. oz./1,000 sq ft.	Apply in sufficient water to ensure uniform coverage. As soon as application is complete, apply ½ inch of water but stop watering before puddling or runoff occurs. Do not treat golf course fairways.
<b>EARTHWORMS</b>		
<p>There are no lawn insecticides that list earthworms on the label of pests controlled. Publications from Ohio State University have listed the toxicity of the common lawn insecticides to earthworms. The only lawn insecticide that is listed as highly toxic to earthworms is carbaryl (Sevin). From this information the following control procedure is suggested:</p> <ol style="list-style-type: none"> <li>1. In early spring, lightly roll or power rake the lawn to remove old worm castings.</li> <li>2. Thoroughly water the lawn several hours before the application is to be applied.</li> <li>3. Apply liquid carbaryl (Sevin) insecticide at the label rate recommended for sod webworms. Evening applications are most effective. Do not water the lawn for several days after application.</li> <li>4. Repeat if castings continue to appear.</li> </ol>		

## North Dakota Insecticide Price List

The listings are approximate retail prices for small quantities. Insecticide prices do not include cost of additives or application costs. Prices may vary depending on area of the state, wholesaler, bulk discounts, seasonal changes, quantities purchase, and particular program the manufacturing company offers. Prices are averages based on statewide dealer survey for small quantities. Producers should consult local agricultural product suppliers for exact price of each product in their area. Note: These prices are based on 2009 price list.

Product	Cost \$/Unit	Product/A		Cost \$/A	
		Low	High	Low	High
Acephate (see Orthene 97)					
Actara	5.68/oz	1.5 oz		8.52	
Admire Flex 4					
Agrimek	5.50/fl oz	8 fl oz	16 fl oz	44.00	88.00
Alias	3.56/fl oz	15.66 fl oz	22.6 fl oz	55.75	80.45
Arctic (permethrin)	0.70/fl oz	4 fl oz	8 fl oz	2.80	5.60
Asana	0.75/fl oz	2.9 fl oz	9.6 fl oz	2.18	7.20
Assail 30 SG	6.10/fl oz	1.5 fl oz	4 fl oz	9.15	24.40
Avaunt	5.10/oz	2.5 oz	6 oz	12.75	30.60
Aztec	2.37/lb	7.28 lb		17.25	
Baythroid XL	2.55/fl oz	0.8 fl oz	2.8 fl oz	2.04	7.14
Capture 2 EC	2.62/fl oz	1.3 fl oz	6.4 fl oz	3.40	16.75
Capture LFR	1.90/ fl oz	6.8 fl oz	8.5 fl oz	12.92	16.15
Carbaryl 4	6.50/qt	1 qt	2 qt	6.50	13.00
Confirm 2F	1.50/fl oz	4 fl oz	16 fl oz	6.00	24.00
Coragen	6.20/fl oz	3.5 fl oz	5 fl oz	21.70	31.00
Counter 15G	1.82/lb	4.4 lb	8.8 lb	8.00	16.00
Delta Gold (formerly Decis)	2.66/fl oz	0.8 fl oz	2.4 fl oz	2.15	6.40
Dimate 4E	4.25/pt	0.33 pt	1 pt	1.40	4.25
Dimethoate 4E	4.28/pt	0.5 pt	1 pt	2.15	4.25
Dimilin 25W	2.63/oz	0.5 oz	2 oz	1.30	5.25
Dimilin 2L	1.81/fl oz	0.5 fl oz	1 fl oz	0.90	1.80
Dipel	10.40/lb	0.5 lb	2 lb	5.20	20.80
DiSyston*	2.81/lb	6.5 lb	21.8 lb	18.25	61.25
Dyna-Shield Imidacloprid 5	8.58/fl oz	0.8 fl oz/cwt	2.4 fl oz/cwt	6.86/cwt	20.59/cwt
Endosulfan 3ED (Phaser, Thiodan)	6.62/qt	0.7 qt	1.3 qt	4.37	8.80
Enhance AW	0.87/oz	4 oz/cwt		3.48/cwt	
Entrust (spinosad - Organic formulation)	24.07/oz	0.5 oz	2 oz	12.05	48.15
Force 3G	4.54/lb	3.26 lb	5.4 lb	14.80	24.50
Fortress 5G	4.73/oz	3.26 oz	5.4 oz	15.40	25.55
Fulfill	5.65/oz	2.75 oz		15.55	
Grizzly Z	2.14/fl oz	1.92 fl oz	3.84 fl oz	4.10	8.25
Guthion	11.06/lb	0.75 lb	1.5 lb	8.30	16.60
Hero	1.44/fl oz	4 fl oz	10.3 fl oz	5.76	14.83
Imidan 70WSB	6.90/lb	1 lb	1.3 lb	6.90	9.18
Intrepid 2F	1.95/fl oz	4 fl oz	8 fl oz	7.80	15.60
Kelthane MF	5.04/pt	1 pt	3 pt	5.50	15.15
Lannate LV	0.44/fl oz	12 fl oz	24 fl oz	5.30	10.55
Leverage 360	2.00/fl oz	2.4 fl oz	2.8 fl oz	4.80	5.60
Lock-On	4.23/pt	1.5 pt	2 pt	6.35	8.45
Lorsban 15G*	1.69/lb	4.9 lb	9.8 lb	8.30	16.55

Product	Cost \$/Unit	Product/A		Cost \$/A	
		Low	High	Low	High
Lorsban 4E	4.35/pt	0.25 pt	4 pt	1.10	17.40
Malathion 5	2.83/pt	1 pt	2 pt	2.85	5.65
Malathion 57EC	3.13/pt	1 pt	2.5 pt	3.13	7.83
Mocap 15G	2.65/lb	8.8 lb		23.32	
Mocap EC	11.15/pt	1.5 pt	3.15 pt	16.73	35.12
Monitor 4	17.00/pt	1.5 pt	2 pt	25.50	34.00
Movento	5.70/oz	4 fl oz	5 fl oz	22.80	28.50
M-Pede	2.20/pt	4 pt		8.80	
Mustang Max EC	1.78/fl oz	1.4 fl oz	4.3 fl oz	2.50	7.65
Oberon 2SC	3.80/fl oz	5.7 fl oz	8.5 fl oz	21.66	32.30
Orthene 75 WSP	11.67/lb	0.33 lb	1.33 lb	3.85	15.50
Orthene 97	12.90/lb	0.25 lb	1 lb	3.25	12.90
Oxamyl (Vydate L)	7.84/pt	2 pt	4 pt	15.69	31.68
PennCap-M	3.61/pt	1 pt	6 pt	3.60	21.65
Permethrin	0.72/fl oz	2 fl oz	8 fl oz	1.45	5.75
Platinum	9.60/fl oz	5 fl oz	8 fl oz	48.00	76.80
Platinum Ridomil Gold	2.82/fl oz	38 fl oz	fl oz	107.15	
Pounce 1.5G	1.16/lb	8.7 lb	17.4 lb	10.10	20.20
Proaxis	2.11/fl oz	1.92 fl oz	3.84 fl oz	4.05	8.10
Provado 1.6F	2.65/fl oz	3.5 fl oz	3.8 fl oz	9.28	10.07
Regent*	4.55/fl oz	4.14 fl oz		18.85	
Renounce 20 WP	2.50/fl oz	1 fl oz	3.5 fl oz	2.50	8.75
Rimon 0.83EC	1.02/fl oz	9 fl oz	12 fl oz	9.18	12.24
Sevin 4F	9.50/qt	1 qt	2 qt	9.50	19.00
Sevin 80S	7.70/lb	0.63 lb	2.5 lb	4.85	19.25
Sevin XLR Plus	10.25/qt	0.5 qt	2 qt	5.13	20.50
Sniper	2.46/fl oz	2.1 fl oz	6.4 fl oz	5.17	15.74
Success	4.68/fl oz	2 fl oz	6 fl oz	9.36	28.08
Temik 15G	3.24/lb	4.9 lb	10.22 fl oz	15.90	33.10
Thimet 20G	3.80/lb	18.8 lb		71.44	
Thionex 3EC	6.43/qt	0.33 qt	2 qt	2.10	12.85
Thionex WSB	8.03/lb	0.5 lb	3 lb	4.00	24.10
Tracer (spinosad)	7.04/fl oz	1 fl oz	3 fl oz	7.00	21.15
Tundra	2.05/fl oz	2.1 fl oz	5.2 fl oz	4.30	10.65
Warhawk	3.94/pt	0.5 pt	6 pt	2.00	23.65
Warrior II	3.69/fl oz	0.96 fl oz	1.92 fl oz	3.54	7.08
Yuma	3.68/pt	0.5 pt	6 pt	1.85	22.10

Grain Storage Products	Product Use Rate	Cost \$/Unit	Product rate		Cost/Rate	
			Low	High	Low	High
Actellic	9.2 - 12.3 fl oz/30 ton or 3 fl oz/1000 sq ft	6.30/fl oz	9.2 fl oz	12.3 fl oz	58.00	77.50
Diacon II Grain Protectant	30 - 420 ml/1000 bu	0.16/L	30 L	420 L	4.80	67.20
Dryacide (diatomaceous earth)	2 lb/ton	1.93/lb	2 lb		3.85	
Insecto (diatomaceous earth)	2 lb/empty bin of 4300 bu capacity, rate increases with bin size	2.58/lb				
Grain Guard	2 oz/bu, barley, oat; 3 oz/bu corn	0.39/oz	2 oz	3 oz	0.80	1.20
Storcide II	6.6 - 12.4 fl oz / 1000 bu	1.75/gal	6.6 gal	12.4 gal	11.55	21.70
Weevilcide Pellets	150-300/1000 cu ft	31.40/flask	150	300		

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