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A Guide to Grasshopper Control in Cropland

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This NebGuide discusses grasshopper damage to cropland, how to determine when control is required, and methods of control.

Grasshoppers have been a major concern to farmers and ranchers since Nebraska was first settled. The potential for devastation, while still serious, is not as great as it was 100 years ago because many prime grasshopper breeding areas along the eastern slopes of the Rocky Mountains are now under tillage. Statewide, grasshopper populations fluctuate in cycles with large numbers occurring for two to four years, followed by low to moderate numbers for several years.

While grasshoppers can be found across the state, most damage occurs in areas with less than 25 inches of annual rainfall. In most years, the western half of Nebraska falls into this higher-risk category and is most susceptible to severe grasshopper outbreaks.

Damage

While more than 100 grasshopper species may be found in Nebraska, only a few are of major importance to cropland. Four grasshopper species — the migratory, differential, twostriped, and redlegged — cause nearly all the damage to cultivated crops. These grasshopper species prefer habitats with a variety of host plants, including both grasses and broadleaf weeds. As a result, they prefer cropland settings with nearby undisturbed areas such as roadside ditches, crop borders, abandoned cropland, and over-grazed pastures or rangeland. Field crop problems usually do not arise from neighboring well-managed rangeland or pasture.

Grasshoppers primarily damage wheat, alfalfa, soybeans, and corn, but during years of high populations, they will feed and seriously damage almost any crop, tree, shrub, and home garden. Grasshoppers do not like dense canopies and are most likely to feed on field edges and along grass waterways.


Twostriped nymph

The primary injury caused by grasshoppers is defoliation, as they consume and clip foliage as they feed. Grasshoppers also cause direct crop losses by feeding on ripening grain. With favorable, warm dry climatic conditions, grasshoppers can hatch and mature two to four weeks earlier than normal. Early hatching (early May) can threaten establishment of sugarbeet, corn, or other crops planted in early spring. If grasshoppers mature early, they can move to nearby crops, such as pretassel corn, entering the whorl and destroying the developing tassel.

Primary damage to alfalfa is through defoliation; however, during years of high infestation, grasshoppers also will feed on stems and crowns. This feeding can damage the crowns so severely that plants do not recover, especially when damage occurs just after harvest. Extensive mid- and late-season feeding in sugarbeet crowns also can kill plants. Grasshoppers prefer the blossoms and fruit of some plants (e.g. sunflowers), resulting in considerable loss of seed production.

Early-seeded winter wheat is more vulnerable to injury than later plantings because the plants emerge while adult grasshoppers are still actively feeding. Newly emerged wheat can be so severely damaged by grasshopper feeding that it will not establish. Increased grasshopper pressure also may occur after a light fall frost that kills broadleaf weeds, such as sunflowers, in areas adjacent to winter wheat. Grasshoppers losing this forage source may move quickly into winter wheat and cause damage; however, a heavy frost will reduce or eliminate grasshopper numbers. Spring wheat and other small grains are most likely to be attacked late in the growing season. Grasshoppers can seriously damage maturing small grains as they clip the stems, causing entire heads to fall to the ground.

Table I. Hatching, development, and size characteristics of the four major cropland grasshopper species.

Species	*Relative Hatching Time*	*Hatching Period*	*Developmental Period*	*Pre-egg Laying Period*	*Size of 3rd-4th Instar*	*Size of Adults*
Twostriped	First to hatch	4-6 wks	6 wks	1-2 wks	0.4-0.8”	1.1-1.6”
Migratory	+1 1/2 wks	3-6 wks	5 wks	2-3 wks	0.3-0.6”	0.8-1.1”
Differential	+3 wks	2 wks	5 wks	several wks	0.4-0.6”	1.2-1.6”
Redlegged	+3 wks	7 wks	6 wks	1-2 wks	0.3-0.6”	0.7-1.1”

Life Cycle

There are three stages in the grasshopper life cycle — the egg, nymph, and adult. The female lays eggs in the soil and surrounds the eggs with a frothy liquid that hardens to form a protective “pod.” The number of egg pods deposited by a single female ranges from 7 to 30, and the number of eggs per pod ranges from 8 to 30, depending on the species. Typically, a female grasshopper will lay about 100 eggs during the summer and fall. Outbreak potential is increased when females produce more eggs as a result of better food quality and/or an extended fall, which allow more laying time.

Egg pods are deposited in the upper few inches of undisturbed soil in grasslands, pastures, ditches, field borders, etc. Some grasshoppers prefer to lay their eggs in soil surrounded by grass roots, and other species select open areas with accumulations of surface debris.

Eggs are well-insulated within the pod and can survive extremely cold temperatures as they over-winter. Most grasshoppers over-winter as eggs, but a few species spend the winter as nymphs. Most of the latter are “bandwinged” grasshoppers that make a crackling noise when in flight. They are seen early in the spring, normally are few in number, and are of little concern in cropland.

Hatching time is strongly influenced by temperature, with earlier hatching occurring after a warm spring. The twostriped grasshopper is the earliest hatching grasshopper of concern in cropland, with eggs beginning to hatch from mid- to late May. The eggs of the migratory grasshopper hatch about 10 days later, with those of the redlegged and differential grasshoppers hatching about three weeks after those of the twostriped. Hatching periods range from two weeks for the differential to seven weeks for the redlegged grasshopper *(Table I)*.

Nymphs start feeding immediately after hatching and usually feed on the same plants as adults. Because of limited fat reserves, young nymphs are vulnerable to adverse weather just after hatching. **Extended cool temperatures (less than 65°F) and rainy weather during this period can result in severe nymphal mortality due to starvation.**

Grasshopper nymphs go through five stages or instars. After each instar, they shed their cuticle and grow larger, developing to the adult stage in five to six weeks. In most years, adult grasshoppers are present by late June and early July.

Adult grasshoppers, the only stage with wings, can readily move out of hatching areas. Hoppers begin egg laying one to three weeks after reaching the adult stage and may live two to three months, depending on the late summer and early fall weather. All developmental stages are influenced by weather.

Most grasshoppers lay their eggs in untilled soil and must move from these hatching beds to infest a crop. The exception is the migratory grasshopper. It may deposit eggs through- out a field, particularly alfalfa. No-till fields also have increased risk due to potential egg laying throughout the field.

Management

Scouting/Thresholds

Because grasshoppers move into crop production fields from hatching beds around field borders, grasshopper surveys should be conducted in adjacent untilled areas early in the season (late May and June) to determine the potential for problems. If grasshoppers have already invaded the field, it also can be sampled to determine if control is warranted. If timely rains keep the vegetation in and around hatching beds green, the grasshoppers may not move to adjacent crops until later in the season.

Sweep net sampling is useful in determining the stage (instar) and species makeup of grasshopper populations. A standard 15-inch diameter sweep net, equipped with a heavy cloth net, should be used. Information from sweep net samples is particularly valuable early in the season for determining the stage of grasshopper development. With this information you optimize treatment timing and assess the potential for damaging infestations.

The best method for determining grasshopper density in field borders or hatching areas is to count grasshoppers using the square-foot method. With practice, this approach can provide good estimates of hopper density.

To use this method, randomly select a point several feet away and visualize a one-square-foot area around that point. When first learning this method, practice with a measured square-foot area to improve your ability to visualize the counting area. Walk toward this point while watching this square-foot area and count the number of grasshoppers in or jumping out of the area. Repeat this procedure 18 times and divide the total number of grasshoppers by two. This

Table II. Treatment guidelines based on number of grasshoppers (nymphs and adults) per square yard.

Grasshopper Population	*Within Field*	*Field Border*	*Treatment necessary?*
Non-economic	0-2	5-10	No
Light	3-7	11-20	Questionable, depends on size, species, type of crop
Moderate	8-14	20-40	Probably
Abundant	15 or more	41 or more	Yes

will give you the number of grasshoppers per square yard (9 square feet).

Counting sites should be 50-75 feet apart and randomly chosen. Just after egg hatch, when grasshoppers are small, they will be difficult to see and underestimating the true hopper density is common. When sampling, try to vary the vegetation in the count area and sample both north- and south-facing slopes.

Within fields, both grasshopper densities and treatment thresholds are lower; therefore, the area visualized while sampling can be increased to one square yard. Because of the difficulty of seeing hoppers in this larger area, counts will be somewhat less accurate. Eighteen samples should still be taken. Averaging these estimates will give the number of grasshoppers per square yard.

When the number of grasshoppers per square yard has been estimated, use *Table II* to determine if treatment is necessary. While sampling, it is important to determine the species present and the approximate nymphal stage of the grasshoppers. If the grasshoppers are rangeland species (bandwinged or slant-faced species), they are unlikely to move into the adjacent crops. The best time to control grasshoppers is during the third and fourth nymphal stages, when most of the eggs will have hatched. This generally occurs from early June into early July. While in this stage, young hoppers will be concentrated in and near hatching beds and will be more susceptible to insecticides.

Cultural Control

While tillage operations can reduce (but not eliminate) grasshopper numbers, they're often not practical in potential grasshopper hatching areas. Tillage destroys grasshopper egg pods by direct mechanical damage and by exposing them to predators, parasites, and adverse weather conditions. Fall tillage is undesirable in most situations because winter cover is essential to protect soil from wind erosion and to conserve moisture. Spring tillage may accomplish the objective with fewer undesirable side effects, but grasshopper survival may be greater.

A longer term solution to reduce grasshopper potential is to reduce the attractiveness of abandoned or weedy areas to cropland grasshoppers by establishing a dense grass cover that includes few broadleaf plants. Another cultural control method would be to plant a grasshopper-resistant crop, such as sorghum, in highly susceptible areas.

Delaying winter wheat seeding in high-risk fields also can reduce the potential for grasshopper damage, but may not be practical, especially during a warm fall when grasshopper survival is extended. If severe infestations are anticipated, field margins can be planted at a higher (double) wheat density to allow for some plant loss. Planting at increased density would only be needed on field edges in the first one or two passes with the drill.

Chemical Control

The treatments discussed here should provide adequate control of low to moderate grasshopper infestations. If grasshopper numbers are extreme, control will be difficult and perhaps impossible to maintain.

Grasshoppers are easiest to control before they become adults. If a range of rates is listed for a given insecticide, the higher rates generally should be used once adults are present. Grasshoppers can be controlled by using sprays or baits. Read the label thoroughly before any insecticide application, and follow safety instructions and precautions. When spraying borders adjoining cropland, be sure to read and follow label restrictions on grazing. See the Web site: *http://entomology.unl.edu/grasshoppers/insecticides.shtml*.

Baits. One option for grasshopper control is a bait formulation. Carbaryl-impregnated bran bait is available as a 2 percent or 5 percent formulation. This method can provide good control when applied just before winter wheat emergence, when crops are only a few inches tall, or in areas with short, dry vegetation. Success depends on uniform distribution of the bait and reapplication if the bait is no longer attractive to grasshoppers. Moisture (rain or heavy dew) will substantially reduce the bait's attractiveness.

Border Treatments. In most years, treating either the crop margin or the border area surrounding the crop is adequate for control. A border treatment of 150 feet beyond the crop edge should be adequate in most situations, depending on the size of the grasshopper source area, but season-long control may require up to a 1/4-mile border treatment when the population source is large. Under extreme pressure, control will be difficult and multiple border treatments may be required. Using insecticides with the longest residual activity would be most effective. The residual activity of the treatments will vary with the chemical and environmental conditions. It is important to monitor the border areas and crop margins after treatment to make sure grasshoppers do not re-enter the field.

Growers with large grass areas surrounding field crops should consider using the Reduced Agent/Area Treatment (RAATs) program for control around field margins early in the season when grasshoppers are small. Recent research at the University of Wyoming has demonstrated the effectiveness of the RAATs grasshopper control strategy in range and pasture. This strategy reduces the amount of

insecticide applied by using lower rates and alternating treated and untreated strips in the target area. These treatment tactics have been very effective in grasshopper management. Control costs are greatly reduced (50-75 percent lower) with only a limited reduction in overall grasshopper control (5-15 percent reduced control). Techniques have been worked out for both aerial and all-terrain vehicle (ATV) application when using this program. The effectiveness of the program relies heavily on proper application techniques and optimum timing (apply during 3rd-4th instars). Details of the RAATs program for both the aerial and ATV application can be found on the University of Wyoming Web site listed under *Further Information*. South Dakota studies also have demonstrated this program to be effective at controlling grasshoppers in alfalfa fields.

Alfalfa. Border treatments should provide grasshopper control in newly infested alfalfa fields. When an entire alfalfa field is infested, it is better to remove the cutting and apply an insecticide to protect new growth. Also, the ATV-RAATs strategy can be used as described above to reduce costs. Another method is to leave a few small, uncut strips, and then spray the hoppers when they congregate in those strips. This will help assure regrowth of the next alfalfa crop and reduce pesticide residues and costs.

Winter Wheat. The thresholds in *Table II* need to be lowered for fall grasshopper control in winter wheat. Adult grasshoppers can consume a great deal of plant material in a short time. Due to the small amount of vegetation available in emerging wheat and the life stage of the grasshoppers, light to moderate infestations in the field and borders can cause stand loss along borders. Timing of border treatments is critical for optimum grasshopper control. The best time to spray the borders is just before the wheat emerges. If the application is made too early, there will be no residual insecticide activity in the borders when the wheat emerges and grasshopper populations may quickly build back. If it is applied too late, some of the earliest emerging wheat may already be damaged.

Planting insecticide-treated seed can help control grasshoppers in emerging wheat. Imidacloprid (Gaucho and generics) and Thiamethoxam (Cruiser) seed treatments can be effective when hoppers are present at moderate levels. These seed treatments can only be purchased on pretreated seed. Once in the soil, the chemical is taken up by the germinating seed and seedling and is ingested by feeding grasshoppers. Grasshoppers can still feed on the wheat, but damage will be slowed considerably as they are affected by the insecticide. As with all control methods at this time of year, this method will not be totally effective if grasshopper infestations are high.

Border treatments applied at planting also can be made using a liquid insecticide. Furadan 4F has a 24C (special local need) registration in Nebraska and can be applied as a direct microtube injection into the seed furrow or mixed with liquid fertilizer, which can improve product effectiveness. Furadan is highly toxic, and for safety reasons, the best application method is a closed injection system. This application is effective against all but the heaviest grasshopper pressure situations.

Further Information

Pesticide registrations are constantly changing. Updated lists of pesticide registrations for various crops can be found at the following Web sites:

High Plains Integrated Pest Management Guide at *http://www.HighPlainsIPM.org/*

University of Nebraska–Lincoln Department of Entomology at *http://entomology.unl.edu/fldcrops/ipm/index.htm*.

The following Web sites contain extensive information on grasshoppers and grasshopper management:

University of Wyoming at *http://www.sdvc.uwyo.edu/grasshopper/*

USDA-ARS grasshopper index at *http://www.sidney.ars.usda.gov/grasshopper/index.htm*

University of Nebraska–Lincoln Department of Entomology at *http://entomology.unl.edu/grasshoppers/index.shtml*.

Index: Insects and Pests
Other Pests
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