



Grasshoppers

Wanner Crop Entomology Lab

Grasshopper populations increase during hot dry periods, in rangeland and other grassy areas, from where they can invade and damage many different crops

Species name: More than 100 different species occur in Montana; about 24 can damage rangeland and crops. The migratory (*Melanoplus sanguinipes*), two-striped (*Melanoplus bivittatus*) and clear-winged (*Camnula pellucida*) grasshoppers are three common species that become abundant. The USDA lab in Sidney, Montana maintains a webpage with extensive grasshopper information: <https://www.sidney.ars.usda.gov/grasshopper/>.

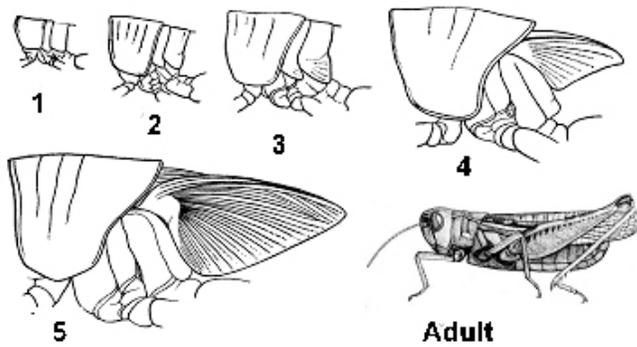
Appearance: Depending on the species, grasshoppers come in a variety of sizes and colors. Mature adults can range from $\frac{3}{4}$ to 2 inches in length. The juveniles develop through 5 instar stages that resemble the adults in shape. However, the juveniles can vary widely in color compared to the adults, and only the adults have fully formed wings for flying. On juveniles, the developing wing buds increase in size with each instar stage, and this feature is used to time insecticidal sprays.



Two-striped grasshopper: 5th instar on the left, adult on the right



Clear-winged grasshopper. Left; 1st instar. Right; adult.



Increasing wing bud sizes as juveniles develop; instars 1-5. Only adults have fully formed wings and can fly.



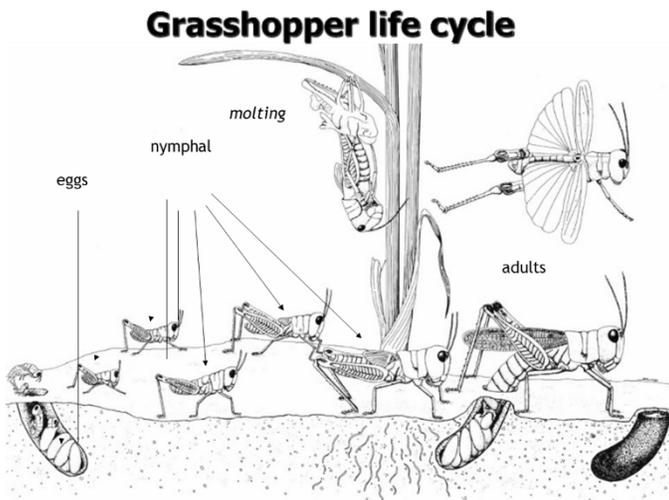
Migratory grasshopper: egg, juvenile instars 1-5 and the adult. Adults are about 1 ¼ inches long.

Geographic range: Grasshoppers are found across the US and globally, particularly in hot arid regions. In Montana, the highest populations are typically found in the central and eastern regions.

Host range: Most grasshoppers prefer to eat grasses, and some species are more common on rangeland. However, most will feed opportunistically on a wide range of plants including forbs. Later in the summer when grasses are dry or have been consumed, these grasshoppers will move to, and feed on, almost any available green vegetation. Juvenile grasshoppers can migrate on land and adults can fly long distances.

Damage: Grasshoppers have chewing mouthparts and damage rangeland and crops by consuming the foliage. At high populations they can strip a field bare. As the season progresses and grasshoppers get larger the amount of damage can become more severe. Crop damage is often first observed along the field margin as grasshoppers migrate from surrounding grassy areas. In some cases, they may cause yield damage more directly, by clipping off wheat heads or by preferentially feeding on developing pulse crop flowers.

Life cycle: Adult grasshoppers mate and the females deposit egg pods (8-30 eggs in a pod) in the soil. The eggs overwinter and begin hatching during May – July depending on the species. The juveniles develop through 5 instar stages (30 – 40 days) and only the adults have fully formed wings and can fly. Adults live for 40-60 days. Only a few species overwinter as nymphs, and in the spring, these are commonly mistaken as “unusually large grasshoppers,” but these species do not cause economic damage. The adults of smaller species are often mistaken as a “late hatch” but can be identified as adults because they have fully formed wings. Hot dry spring seasons favor survival while cool wet springs cause juvenile mortality. Large region-wide outbreaks typically last 2-4 years and collapse as natural diseases build up in the population. Mortality of overwintering eggs due to cold temperature is usually not significant.



Management: Most methods for managing grasshoppers rely on insecticide applications based on scouting, and thresholds depend on the crop being protected. Biological and cultural control options are generally not highly effective.

Scouting: Monitoring grasshoppers can begin at the end of May and may continue throughout the summer. Early in the season grasshoppers are small, less mobile, and more difficult to see. Populations may first aggregate on south facing slopes that are warmer. Later in the season they are very mobile and may appear suddenly in high numbers. Grasshopper numbers can be estimated using the square foot method: the number of grasshoppers in a one square foot area is estimated visually and randomly repeated 18 times while walking a transect. Grasshoppers are less active earlier in the morning and easier to count. The total number of grasshoppers is tallied and divided by two to give the number per square. Alternatively, four 180-degree sweeps with a 15-inch diameter sweep net is considered equivalent to the number of grasshoppers per square yard.

Rangeland: A total of 15-20 grasshopper nymphs per square yard is considered an economic threshold for treatment. At these densities grasshoppers can result in 200 – 500 pounds of lost forage per acre of rangeland, depending on their duration and conditions such as precipitation. Reduced Agent and Area Treatment strategies (RAATs) can be used to control grasshoppers in rangeland. USDA research has demonstrated that RAATs, a “skip pass” approach that also uses lower rates of insecticide, can achieve 80 to 95% control (compared to 85-99% control with complete blanket coverage at the full insecticide rate) at a lower cost. RAATs can be applied by ground or air (<https://www.sidney.ars.usda.gov/grasshopper/Research/index.htm>). The insecticide Dimilin is most commonly used in large-scale grasshopper spray operations. Dimilin is an insect growth regulator that is only effective against juvenile insects that are molting. It is NOT effective against adult insects that no longer molt, so timing is critical. Ideally the majority of grasshoppers should be in the 2nd to 4th instar stage during treatment. At this time most eggs have hatched but adults are not yet present. Commercial honeybee colonies are often placed on ranchland. A benefit of Dimilin’s mode of action is that it is relatively safe to honeybees.

Spring Wheat: Grasshoppers are notorious for their ability to move into cropland from surrounding grassy areas; cropland surrounded by grass is particularly at risk. The treatment threshold for immature nymphs is different from thresholds for adults, and also depends on whether the grasshoppers are within the field or around the edges. Crop protection is typically achieved by applying a border treatment of insecticide to keep the grasshoppers from entering the crop. A border width of 150 feet surrounding the crop may be adequate for control, but if grasshopper densities are high, control may require up to a 1/4-mile border treatment where ground applied RAATs can be considered. Under extreme pressure, control may be difficult and multiple border treatments may be required. Border areas and crop margins should be monitored after treatment to ensure that grasshoppers do not re-enter the field. Insecticide baits can also be effectively used but USDA research has found that the effectiveness of insecticidal baits can depend on grasshopper densities. Baits are not recommended when grasshopper densities are higher than 30-40 per square yard.

Winter Wheat: Emerging winter wheat can be particularly vulnerable to damage by grasshoppers. The larger adult stage grasshoppers are more difficult to control and can move into emerging winter wheat fields from surrounding grassy areas. Treatment thresholds for emerging winter wheat are lower. Border treatments applied as insecticidal sprays or seed treatments are the main recommendation for protecting emerging winter wheat. Typically, spraying 150 feet beyond the edge of the crop or 1-2 passes with treated seed around the perimeter of the field is a sufficient border. Adult grasshoppers are more difficult to control, and the higher end of the label rate is recommended. When applying border sprays, timing is important. Border sprays beyond the edge of the crop need to be applied just before the wheat emerges; if it is applied too early there may not be enough residual; if it is applied too late, the damage may have already occurred. Systemic seed treatments eliminate the timing concern, but systemic insecticides require feeding to be active. Damage should still be slowed considerably.

Table 1. Spring treatment guidelines for immature and adult grasshoppers in spring wheat

Rating	Immatures/yd ²		Treat?	Adults/yd ²		Treat?
	Margin	Field		Margin	Field	
Nonthreatening	<25	<15	No	<10	<3	No
Light	25-35	15-25	No	10-20	3-7	Yes, if there is potential for head clipping
Threatening	50-75	30-45	Depends on prices, crop condition	21-40	8-14	Yes, if there is potential for head clipping
Severe	>100	>60	Yes, monitor for retreatment	>41	>15	Yes, consider wider border treatments and monitor for retreatment

Table 2. Fall treatment guidelines for adult grasshoppers in winter wheat

Rating	Adults/yd ²		Treat?
	Margin	Field	
Nonthreatening	<10	<3	No
Light	10-20	3-7	Yes
Threatening	21-40	8-14	Yes, consider wider border treatments
Severe	>41	>15	Yes, use wider border treatments and monitor for retreatment

Alfalfa, Dry Beans: Thresholds for spring wheat (Table 1) are used for alfalfa and dry beans. During the first year of establishment alfalfa stands are more vulnerable to damage. When found in lentil fields during flowering, grasshoppers may feed preferentially on the flowers and developing pods, and a treatment threshold of only 2 per square yard has been recommended.