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# Grasshoppers and their Control

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There are hundreds of different species of grasshoppers in the United States, but only a relative few are considered economic pests. Nationwide, four grasshoppers species, differential, twostriped, redlegged, and migratory, are responsible for about 90% of all grasshopper injury to cultivated crops. An additional 25 species are known to cause economic injury to rangeland. Like most insect populations, grasshopper numbers fluctuate widely from year to year due to environmental conditions and other variables. Widespread severe infestations are often associated with a series of dry years. The heaviest grasshopper injury usually occurs in areas with 10-30 inches of precipitation per year.

## Life Cycle

The economically significant species of grasshoppers overwinter in the soil in egg pods. The period of egg hatch varies with the species and temperature. Elevation and exposure also affect egg hatch due to their relationship to temperature. Most eggs hatch from late May through early July. The young grasshoppers (nymphs) resemble small adults without wings. Nymphs pass through 4-5 growth stages (instars) before they reach the adult stage and obtain functional wings. Eggs are deposited in pods in the soil in August, September, and October. Depending on the species, each female may produce up to 25 pods with up to 100 eggs in each. There is usually only one generation produced each year.

## Damage

Grasshopper injury is most often associated with rangeland, corn, small grains, and vegetable crops. However, during heavy infestations almost any type of plant may be attacked including trees, shrubs, flowers, and lawn grasses. Grasshoppers have chewing mouthparts, and their feeding results in removal of the host tissues. They are commonly thought of as foliage feeders but will also feed on flowers, fruits, seed heads, stems, and essentially all above ground plant parts.

## Control Considerations

Preferences for egg-laying sites vary somewhat, but most grasshopper species prefer to lay eggs in undisturbed, sparsely vegetated sites. Therefore, immediately after egg hatch the

heaviest infestations will occur in rangeland, roadsides, ditch banks, terraces, waterways, fence rows, field margins, thin stands of perennial forage crops, etc. The young grasshoppers will continue to feed in these areas as long as there is suitable food material. If the food material is consumed, mowed, dries up, or is rendered unsuitable in some other fashion, the grasshoppers will move to adjacent .pa areas. Once the grasshoppers reach the adult stage and acquire functional wings, they can disperse further and move rapidly.

The ideal time to treat grasshoppers is after egg hatch is complete and before the majority of the population is more than 1/2 grown. Treatments applied before the majority of the eggs hatch may result in the need for an additional application(s) to kill late-hatching nymphs. Grasshoppers tend to be more difficult to control as they get larger, due partially to increased body weight and mobility. Percent control often drops significantly when applications are made to grasshoppers larger then 1/2 grown.

**Grasshopper Control Formulations**

Grasshopper control products are available in spray, dust, or bait formulations. Dusts and baits have the advantage that they may be applied to small areas without sophisticated application equipment. However, dusts do not readily adhere to foliage and must be reapplied frequently. Since they are ready-to-use formulations, which contain a high percentage of inert ingredients, dusts and baits are relatively expensive ways to purchase insecticides. Baits must be consumed in order to be effective; consequently, they are often ineffective when applied in heavy vegetation because grasshoppers either have difficulty locating the bait or prefer to feed on the foliage. Baits are most likely to be effective when food plants are scarce, small, or have dried up. For these reasons, insecticidal sprays are generally preferred for grasshopper control.

**Grasshopper Control in the Yard and Garden**

It is usually not too difficult to control grasshopper infestations originating in a yard or garden. Problems arise when homes are located adjacent to large areas, range, or other prime grasshopper egg-laying sites. In addition to farm houses, such situations occur on the outskirts of many Utah communities, particularly where new subdivisions are being developed. When large populations of grasshoppers begin migrating from the surrounding large hatching sites into yards and gardens, there is no practical solution left to the individual homeowner. The grasshoppers rapidly reinvade and overrun the relatively small areas that can be treated. In such a situation, organized groups of homeowners may be able to coordinate their treatment activities to simultaneously reduce grasshopper numbers in the immediate vicinity. It would be preferable to organize before grasshoppers begin to migrate and reach a cooperative agreement to treat the hatching areas to prevent or reduce the subsequent invasion of the residential area.

Grasshopper control insecticides available for homeowner use include formulations of acephate, Beauvaria bassiana, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, deltamethrin, diazinon, dimethoate, lambda-cyhalothrin, malathion, permethrin, and synergized pyrethrins. Agricultural insecticides for grasshopper control include formulations containing the above active ingredients plus some formulations of azinphosmethyl, carbofuran, disulfoton, esfenvalerate, methyl parathion, Nosema locustae, parathion, phorate,

and phosmet.

With the exceptions of methyl parathion, parathion, and phorate, some insecticide formulations containing the active ingredients listed above are available for grasshopper control on ornamental flowers, shrubs, or trees. With the exceptions of deltamethrin and Nosema locustae, some insecticide formulations containing the above active ingredients are available for use on vegetable crops. Insecticides for grasshopper control on turf include formulations containing acephate, azadirachtin, Beauvaria bassiana, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, deltamethrin, diazinon, lambda-cyhalothrin, and synergized pyrethrins. Grasshopper control insecticides available for use on fruit and nut crops include formulations of acephate, Beauvaria bassiana, azadirachtin, azinphosmethyl, bifenthrin, carbaryl, chlorpyrifos, diazinon, dimethoate, disulfoton, esfenvalerate, malathion, permethrin, phosmet, and synergized pyrethrins.

Even products containing the same active ingredients may have different labeling. Check the individual product labels for registered uses, rates, restrictions, and safety precautions.

**Biological Control**

Grasshopper control products are available which contain Nosema locustae (Canning) spores. Utah-registered products are Nolo Bait by M and R Durango and Semaspore by Bozeman Bio-Tech. These formulations contain spores of a microsporidian protozoa which infects grasshoppers. The available formulations are both baits. Upon ingestion of the bait, the spores germinate in the grasshopper's midgut and the protozoa infect the fat tissue. Under ideal conditions and with the proper application timing (when the predominate summer species are about 1/2 grown), these materials will result in a 50-70% population reduction with 35-50% of the surviving grasshoppers infected. Infected grasshoppers are weakened, feed less, and produce fewer eggs. Application to older grasshoppers results in substantially lower control percentages.

The main advantage of this material is that it is environmentally safe, infecting only various species of grasshoppers and crickets. The disadvantages are: 1) it is a slow killer - peak mortality occurs within 4-6 weeks after application; 2) it is most effective when applied to large areas with relatively sparse vegetation - experimental plots in which the best results were obtained were 10 acres or larger in size (we are not aware of any research where this material has provided satisfactory control of heavy infestations in small plot situations, such as yards and gardens); 3) control of grasshopper outbreaks still requires the use of conventional pesticides in addition to the Nosema materials; and (4) the Nosema materials are considerable less effective when the application area is subjected to large numbers of grasshoppers migrating from surrounding areas.

Another biological control agent labeled for grasshopper control in various situations is Beauvaria bassiana, an insect-attacking fungus. Specific information about its effectiveness on grasshoppers is not available, but it has been used in conjunction with predators and parasites to control cereal leaf beetle in Michigan without the use of traditional insecticides.

**Grasshopper Control in Agricultural Situations**

The need for grasshopper control is determined by a visual estimate of the number of grasshoppers per square yard. Due to the fact that some nymphs will die before they reach the adult stage in Utah, mortality of immatures averages about 25-30% during the 1st through 3rd instars (1/2 grown or less)- the treatment thresholds for young nymphs are somewhat higher than for adults. When surveying for grasshoppers, nymphs in the 4th and 5th instars (more than 1/2 grown) should be counted as adults. Counts of nymphs in the 1st through 3rd instars should be reduced by 25-30% to convert to the expected number of adults that will eventually result. In rangeland, treatment is normally justified when populations reach or exceed 8 adults and/or large nymphs per square yard or the equivalent number of small nymphs (about 11-12 per square yard). In crop field margin treatment is recommended to prevent migration into the crop when there are an average of 15 or more adults and/or large nymphs or 20-22 or more small nymphs per square yard.

Once grasshoppers have moved into a crop, the need for treatment will depend on the crop, the stage of growth, the type of damage, and the potential for additional migration as well as the number of grasshoppers per square yard. For instance, grasshopper damage to the lower leaves of small grains may not justify treatment (depending on the stage of growth and the severity of the damage), while the same number of grasshopper would require treatment if they were feeding on the flag leaf or clipping seed heads. Depending on the situation, treatment may be justified in field crops when populations reach or exceed 5-8 adults and/or large nymphs or 7-12 small nymphs per square yard.

In all these situations, several sites should be surveyed to insure a representative estimate of the grasshopper infestation. Since grasshoppers hatch outside of cultivated fields, the initial infestations in cropland will usually occur along the borders. It is preferable to detect and treat grasshoppers in the border areas before they invade the crop. If migration has recently commenced, it may be possible to obtain satisfactory control by treating the border rows and field margins without treating the entire field. This will not be possible if a thorough survey indicates grasshoppers have already dispersed throughout the field.

When grasshopper control is required in a forage crop, such as alfalfa, clover, or grasses, the treatment will be more effective if the crop is removed and insecticides are applied to protect the regrowth. This procedure could cause movement of the grasshoppers into adjacent row crops where control may be even more difficult to obtain. To prevent or reduce this possibility, leave several unharvested strips in the forage field and treat the strips after the grasshoppers have moved into them.

Late season grasshopper infestations occasionally move into newly emerged fall seeded wheat. When a survey of the surrounding area reveals potentially damaging numbers of grasshoppers, Thimet (phorate) 20G or Di-Syston (disulfoton) 15G can be incorporated at planting time to provide protection from migrating grasshoppers. A treated barrier of 2-4 drill widths is often sufficient to prevent infestation of the entire field.

Registered uses, rates, harvest restrictions, and safety precautions may vary among formulations of the same active ingredient. Always read and understand individual product labels before purchase and application. Do not apply insecticides to crops in bloom or to fields with blooming weeds that are being worked by bees.

**Rangeland Grasshopper Survey**

Rangeland grasshopper surveys are conducted under the direction of USDA/APHIS/PPQ (United Stated Department of Agriculture/Animal and Plant Health Inspection Service/Plant Protection and Quarantine). In the past, during years of grasshopper outbreaks, the U.S. Congress has allocated funds for a cooperative rangeland grasshopper control program conducted under the direction of USDA/APHIS/PPQ in which 1/3 the control costs are paid by the federal government and the other 2/3 by the landowner. There is no way to predict the status of future funding for this program. For information regarding the survey or cooperative control program, contact USDA/APHIS/PPQ, 1043 Administration Building, 1745 West 1700 South, Salt Lake City, UT 84104, Tel. (801) 524-5076.

**Precautionary Statement**

All pesticides have both benefits and risks. Benefits can be maximized and risks minimized by reading and following the labeling. Pay close attention to the directions for use and the precautionary statements. The information on pesticide labels contains both instructions and limitations. Pesticide labels are legal documents, and it is a violation of both federal and state laws to use a pesticide inconsistent with its labeling. The pesticide applicator is legally responsible for proper use. Always read and follow the label.