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Fact Sheet No. 73
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CHEMICAL and BIOLOGICAL CONTROL of GRASSHOPPERS in UTAH

This fact sheet provides general information and perspective on currently available alternatives for reducing grasshopper populations. Additional information about the basic biology of grasshoppers is presented in the companion Fact Sheet No. 72: Grasshoppers in Utah: General Biology.

Controlling infestations of grasshoppers

Killing and controlling grasshoppers, unfortunately, are often not synonymous. Grasshoppers can be killed readily by spraying with insecticides. But often infestations become so widespread that unless large acreages are treated, resident grasshoppers killed by insecticides will soon be replaced by other individuals migrating into the area. Given the great mobility of grasshoppers, even treatments over large areas may result in reduced grasshopper numbers only during the year of treatment.

Ranchers are encouraged to be on the lookout for grasshopper "hot spots", that is, local areas in which grasshoppers concentrate egg-laying and outbreaks first occur, and from which the infestation may spread over much larger areas. If such areas can be identified from a rancher's intimate knowledge of the land, it may be possible to nip grasshopper problems in the bud: relatively small acreages may be treated during incipient outbreaks before grasshopper infestations spread over much larger areas. All too often, huge populations of grasshoppers grow and spread before control measures are taken, thus greatly increasing both the costs and difficulties of control attempts.

The USDA Animal and Plant Health Inspection Service (APHIS) is responsible for control programs against grasshoppers on public lands. When grasshoppers occur at high numbers (more than eight per square yard) over large areas (at least 10,000 contiguous acres) of privately owned rangelands, the owners may band together to receive help from USDA APHIS in planning and conducting a large-scale Cooperative Rangeland Grasshopper Management Program (see below under Additional Reading). The condition and forage value of the rangelands affected must be weighed against the potential for damage from grasshoppers to determine whether the cost of control is justified by potential benefits.

Grasshoppers often threaten croplands as well as rangelands. It is unclear how often such infestations arise from grasshoppers migrating into crops from rangelands. Probably most often, fence rows and roadsides adjacent to crops serve as the major sources of grasshoppers; as the vegetation dries up in such areas, grasshoppers that hatched and matured there move into adjacent crops. A grower may be able to prevent severe infestation of crops late in the season by regularly checking these grasshopper breeding

grounds earlier in the season, and treating with insecticide in years when young grasshoppers are extremely numerous.

Spraying with insecticides to control grasshoppers

Grasshoppers may be eliminated from crops by spraying with a number of insecticides. The Pacific Northwest Insect Control Handbook is an excellent source of recommendations; the USU County Extension Office can provide specific recommendations for particular crops from this and other sources. Malathion and carbaryl in liquid form are relatively non-toxic to humans, and may be sprayed to kill grasshoppers along roadsides and fence rows by following label directions (malathion should be used only when the air temperature is above 65 oF). These sprays will be most effective when used against young grasshoppers (nymphs) rather than against adults.

Carbaryl bait

While both malathion and carbaryl in liquid form are relatively non-toxic to humans, both are broad spectrum insecticides that kill many beneficial insects (e.g., predators, parasites, and pollinators) in addition to grasshoppers. Predators and parasites in particular may be important in long-term control of grasshoppers. Use of carbaryl bait (wheat bran laced with carbaryl) is therefore a particularly desirable alternative to spraying as an insecticide treatment for grasshoppers in pastures, fence rows, wasteland, and along roadsides. Spread evenly through the habitat, the bait selectively kills only grasshoppers and those other insects that consume it in foraging on the ground. Young grasshopper nymphs of the species most likely to injure crops forage actively for dry plant material on the ground, and therefore their populations are very effectively reduced in number by this poison bait. The bait is provided at a reduced price by the State Department of Agriculture, and can be obtained by contacting the USU County Extension office.

Biological control with *Nosema locustae*

Nosema locustae (Canning) is a protozoan (microsporidian) that infects grasshoppers and Mormon crickets. This single-celled parasite attacks a great diversity of grasshoppers and occurs naturally in grasshopper populations throughout western North America. *Nosema* infests the fat bodies and other internal organs of its host, where it produces large numbers of spores. Infected grasshoppers consume less forage, mature more slowly, develop more deformities, and produce fewer eggs than healthy grasshoppers before dying prematurely as puffy, whitened individuals several weeks after infection. Death may ensue either directly from the massive build-up of spores and concommittant depletion of food reserves, or indirectly from the disease as the weakened and lethargic grasshopper becomes more susceptible to predators. During a given summer, the disease spreads primarily as uninfected grasshoppers feed upon their dead, infected comrades. The spores have some capacity to survive in the soil, and this is probably the major means by which the disease persists from one year to the next. The disease may also be passed to some degree to the next year's generation of grasshoppers as spores transmitted to eggs by infected females.

Years of federal and university research by J. E. Henry and others have focused especially on developing treatment with *Nosema* as an environmentally safe, biological control program for grasshoppers over large expanses of western rangeland. One benefit of this research is that commercial formulations of the disease are now available to assist private individuals in combatting grasshopper outbreaks (the USU County Extension Office can

supply telephone numbers and addresses of current suppliers). Spores applied to wheat bran (at a rate of one billion spores per lb of bran) can be spread (either from the air or on the ground) as bait to be consumed by grasshoppers. The potential for *Nosema* is exciting, especially because the pathogen attacks only grasshoppers and crickets; it does not kill or harm other insects, wildlife, or humans. It may also provide long-term control, if the disease persists sufficiently in the host population from one year to the next.

Despite its potential, *Nosema* is not a miracle treatment for all grasshopper problems. Grasshopper species differ in their susceptibility to the disease; not all will be reduced by treatment (ideally, the abundance of individual species in grasshopper outbreaks should be determined before treatment). There are other disadvantages and drawbacks to *Nosema* (at least at present), and it cannot be recommended for all situations. One might pause to consider that despite its widespread occurrence, only very small percentages of grasshoppers typically are infected in natural (untreated) populations. Particularly when host densities are low (less than 2 m-2), the disease drops markedly in its incidence in grasshopper populations.

A major drawback of *Nosema* for many people desiring to reduce grasshopper infestations, is that grasshopper populations do not decline immediately upon treatment. The disease is not highly virulent, and infected hosts continue to live (and feed, although at a somewhat reduced rate) for several weeks. Therefore, to be most effective, *Nosema* should be applied when grasshoppers are still young nymphs, preferably in the third instar, such that the disease will take its toll on population numbers before grasshopper adults are able to inflict heavy damage. Most people do not perceive grasshoppers as a problem until they reach the mobile adult stage (when, for example, they may migrate into crops and gardens in large numbers), at which point application of *Nosema* will be too late to prevent damage this year. It is unclear at present how much long-term benefit beyond the year of application *Nosema* will provide, as the ability of the disease to persist and/or increase in incidence between years is not well understood.

Experimental treatments with *Nosema* have yielded variable success in reducing grasshopper numbers, probably reflecting in part that outbreaks of disease generally occur only under a fairly narrow range of conditions. Practical difficulties in assessing densities of highly mobile grasshoppers also complicate efforts to evaluate the effectiveness of *Nosema*. Documented successful applications of *Nosema* to large acreages have resulted in reductions of up to 50-60% in grasshopper numbers three or more weeks later, with indications that suppression may persist for two years post-treatment.

The following recommendations can be made to increase the chances of successful suppression of grasshoppers by treatment with *Nosema*:

- **1)**. Collect and identify the grasshopper species involved to make sure that they are species that will feed on the bran bait (grasshopper specimens can be submitted to the USU Pest Diagnostic Lab through the County Extension Office for identification).
- **2)**. Treat only moderate to high grasshopper populations (more than 5 per square yard). The disease is unlikely to spread well in less dense populations, which are not likely to cause severe damage in any case.
- **3)**. Treat when most grasshoppers are in the third instar (and/or when immediate control is not mandatory; e.g., when range is in good condition and can tolerate damage). As explained above, treating older grasshoppers will not prevent the grasshoppers from consuming large quantities of vegetation before they succumb to the disease.

- **4)**. Treat on sunny mornings when the temperature is between 60 and 90 F. This is when grasshoppers feed most actively. The bran typically will disappear quickly (even if not washed away by rain) as other organisms (birds, rodents, other insects) consume it as well.
- **5)**. Treat when large acreages of rangeland are infested. Treated areas of only a few dozen acres or less are quite likely to be reinfested quickly by grasshoppers migrating in from untreated areas. This may not be true if one treats a "hot spot" of high density surrounded by grasshopper populations much lower in density, but one should be aware of the problem of continual immigration when one attempts to eliminate grasshoppers from a small area. Success in treating small acreages of cropland, nurseries and gardens will depend on the degree to which such areas are subject to repopulation by grasshoppers migrating in from surrounding source areas.
- **6)**. Use fresh material. *Nosema* loses much of its viability when stored for more than thirty days, or at high temperatures (above 70 F).

Additional Reading

APHIS Questions and Answers: The cooperative rangeland grasshopper management program. USDA AHIS. February 1990.

This document provides basic information for all those interested in assistance from APHIS in controlling grasshoppers on private lands. Copies are available directly from the APHIS office in Salt Lake City, or in the USU County Extension Office.

Lockwood, J.A. 1988. Biology and recommendations for use of Nosema locustae Canning, a biological control agent of grasshoppers. Agricultural Experiment Station, University of Wyoming, B-917

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