

example, with ATV tires having a 30-inch circumference, place a mark on the tire and count 17 rotations between swaths (30 inches x 17 = 510 inches = 42.5 feet). Unlike cultivating a crop, spraying grasshoppers doesn't require absolute precision. Skips in the pattern to avoid obstacles won't affect results if the majority of the area is treated at the coverage and rate desired. An advantage with ATV-RAATs is that rocky hill tops and other areas that don't hold much forage or many grasshoppers can be skipped and additional swaths placed in more heavily infested, productive areas.

### Operator Safety Equipment and Training

ATVs can be hazardous to operate. ATV-sprayers should only be operated by persons at least 18 years old. Always wear recommended safety equipment such as gloves, safety goggles, and a helmet. Be sure to take a training course on the safe operation of an ATV. Drive cautiously as fully-loaded spray tanks will add more than 200 pounds of weight that will affect the braking and handling characteristics of an ATV.

### Carbaryl-Bran Application

Carbaryl-treated wheat bran is sometimes a good choice for grasshopper control because it is fairly target specific and it reduces the amount of insecticide introduced in the environment. The susceptibility to carbaryl bran of the predominant grasshopper species in the infestation must be determined, because not all grasshopper species will pick up treated bran flakes. Bait susceptibility information is available at <http://www.sidney.ars.usda.gov/grasshopper/>. Peacock Industries makes both

systemic insecticide wheat bran and the Model 20 ATV-compatible applicator. More information can be found at [www.grasshoppercontrol.com](http://www.grasshoppercontrol.com) or by calling (306) 225-4691.

### Exceptions to the "Rules"

Higher rates and/or coverages may be needed if:

1. treatments are applied to late-instar nymphs (especially if using Dimilin® 2L),
2. ground temperatures exceed air temperatures,
3. grasshopper densities are extreme (e.g., >40 per square yard),
4. forage cover is tall and/or dense, or
5. terrain is rough.

In all cases, grasshopper management software (CARMA<sup>1</sup> or HOPPER<sup>2</sup>) should be used to assess program options. Always apply insecticides in accordance with label directions and established guidelines for buffers around water, bees, and human habitations.

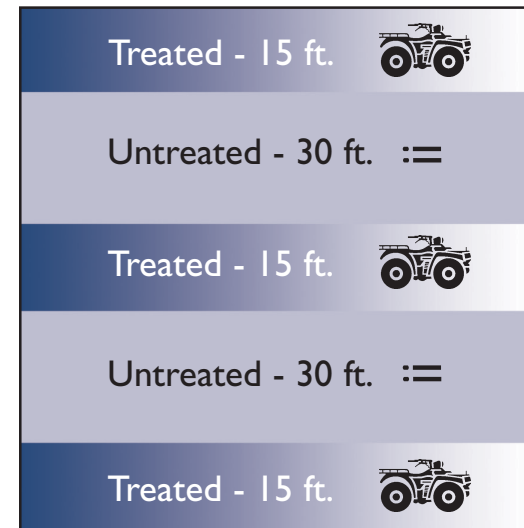
<sup>1</sup>For more information on RAATs or to download CARMA, visit [www.wygisc.uwyo.edu/grasshopper/](http://www.wygisc.uwyo.edu/grasshopper/)

<sup>2</sup>Available from the USDA-ARS Northern Plains Agricultural Research Laboratory at [www.sidney.ars.usda.gov/grasshopper/Support/Hopper.htm](http://www.sidney.ars.usda.gov/grasshopper/Support/Hopper.htm)

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**A schematic of an ATV-RAAT application with a 15 feet spray swath and 33% coverage.**



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## Ground-Applied Reduced Agent Area Treatment (RAATs) Strategies

Ground-based spraying to control grasshopper infestations is not new, but it has been largely disregarded by pest managers for two reasons. First, blanketing thousands of infested acres using a spray rig is impractical. However, economically and rapidly treating moderately-sized “hot spots” (up to 640 acres) can prevent them from growing into serious outbreaks. Second, equipment and operators can’t stand the abuse when using traditional tractor or truck-mounted sprayers on rangeland. But now there is a viable alternative to these vehicles.

By combining RAATs and heavy-duty, 4-wheel drive All-Terrain Vehicles (ATVs), a way has been found to suppress incipient infestations. ATVs are widely used for applying herbicides in rough country, and these systems can be easily adapted to grasshopper control. By adapting strategies gleaned from eight years of aerial-RAAT research, grasshopper control for less than \$1.00/acre protected is now possible.

### What are RAATs?

RAATs are a method of integrated pest management (IPM) for rangeland grasshoppers in which the rate of insecticide is reduced from conventional levels and untreated swaths (refuges) are alternated with treated swaths. RAATs work through *chemical control*, meaning grasshoppers are killed in treated swaths and as they move out of untreated swaths, and *conservation biological control*, which allows predators and parasites preserved in untreated swaths to suppress grasshoppers. This IPM approach can reduce the cost of control and the amount of insecticide used by more than 50 percent.

### Why use RAATs?

#### Economics

Inflation and the restructuring of the USDA cost-share program have tripled the cost of rangeland grasshopper management for ranchers compared with the control cost during the late 1980s. Most states no longer subsidize grasshopper programs; therefore, the cost of traditional tactics will usually exceed the benefits. Even though certain federal or state subsidies for grasshopper control are becoming available in some states, the expenses of a management program remain largely a producer’s burden because of high insecticide and treatment costs.

#### Environment

Less insecticide in the environment lowers the risk to native species (including fish and wildlife), water quality, and humans. The untreated swaths provide a refuge for organisms with lower mobility than grasshoppers, and even those organisms that move into the treated swaths will be largely unaffected unless they feed on the foliage. RAATs are the preferred option in the USDA-APHIS EIS if grasshopper control is required.

### What to expect from ATV-RAATs

#### Efficacy

This method will normally result in 75 to 85% control, which is approximately 5 to 15% lower mortality than with a conventional (higher rate, blanket coverage) treatment. Leaving low, residual densities of grasshoppers after RAATs does not necessarily result in a subsequent outbreak (see *Environment* below).

#### Economics

Using ATV-RAATs will reduce costs by approximately 60 to 80% versus aerial blanket application, depending on the agent and swath

width. These savings are possible due to the greatly decreased cost of ATV application for small acreages infestations as compared to an aerial application. It should be noted that the greatest economic benefits derive from increased swath spacing since this effectively decreases the cost for both insecticide and application.

#### Environment

RAATs mean 50 to 75% less insecticide is applied to rangelands for grasshopper control. The untreated swaths harbor species essential to rangeland ecosystems including biocontrol agents of grasshoppers and weeds. Low densities of surviving grasshoppers allow predators and parasites in the untreated refuges to recolonize and thereby reestablish natural regulation of grasshopper populations. For these reasons, RAAT programs may also allow for higher densities of birds than blanket applications.

### Formulation, Rate, and Application Recommendations

Only emulsifiable concentrate formulations of carbaryl<sup>1</sup> (Sevin® XLR Plus), and diflubenzuron<sup>2</sup> (Dimilin® 2L) which are labeled for grasshopper control on rangeland and all non-cropland areas are suitable for ATV-RAATs. The recommended minimum rates of these two products for ATV-RAATs are: 1 fluid ounce of Dimilin® 2L per treated acre and a minimum of 16 fluid ounces of Sevin® XLR Plus per treated acre. To ensure good coverage on the range vegetation and to increase efficacy, we recommend the addition of at least 8 ounces of oil adjuvant per treated acre. Crop oil concentrate by itself or a mixture of 1 part crop oil concentrate and 7 parts corn or canola oil work well as spray adjuvants. In the experimental plots, their inclusion has increased

control by at least 10%. Always refer to current labels of both of these insecticides to ensure safe, effective control.

TeeJet® 1/4-KLC-5 FieldJet and other boomless type nozzles have been tested on 54 small plots and on one 400-acre full-scale area since 2001. Any nozzle that can produce a 12 to 20-foot spray swath with relatively low volume and fine spray so that several acres can be treated per tank is suitable. Many herbicide spraying systems can be adapted for rangeland grasshopper treatments. More detailed information on nozzles and calibration can be found at: [www.wygisc.uwyo.edu/grasshopper/](http://www.wygisc.uwyo.edu/grasshopper/) under the ATV-RAATs information link.

<sup>1</sup> *Alkaline water used for carrier fluid should be buffered to neutral pH to prevent chemical degradation of carbaryl.*

<sup>2</sup> *Dimilin® 2L is a restricted-use pesticide available only to certified applicators.*

### Coverage Recommendations

Test results indicate that the percent coverage should be approximately equal to the average number (density) of grasshoppers/square yard in the infestation, with a minimum of 33% coverage. For example, if there are 40 grasshoppers/square-yard and the swath is 17 feet a swath will need to be treated every 42.5 feet (17 feet/0.4 = 42.5 feet) to get 40% coverage. For all but the most extreme grasshopper infestations, 50% coverage should be the maximum needed.

To achieve uniformly spaced and treated swaths, use swath markers, a handheld or mounted geographic positioning system (GPS), compass headings, previous swath tracks, and/or counted tire rotations on the turns at the ends of swaths. For this latter method, to apply a swath every 42.5 feet, for