II.6 Using Hopper To Adapt Treatments and Costs to Needs and Resources

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NOTE: Acephate is no longer approved by EPA for rangeland grasshopper control.

Total treatment cost may be the most critical factor in determining whether grasshopper control on rangeland is feasible, especially because profits from grazing lands are usually much lower than profits from croplands on a per-acre basis. The simplest ways to reduce treatment costs are to use less insecticide or to treat less land. Both solutions require the land manager to accept reduced grasshopper control compared to the level of mortality achieved through traditional control methods. However, reduced grasshopper mortality as a result of less vigorous treatment may be practical when the treatment produces a favorable benefit–cost ratio, adequate forage production, and an acceptable reduction in the number of grasshopper eggs produced by the survivors of the treatment.

Hopper is a recently developed computer-based decision support tool that allows users to conduct sophisticated, precise, and repeatable economic analyses of proposed treatment actions. In the treatment decisionmaking process, Hopper can help users choose from among a greater number of options by analyzing a range of reduced treatments.

There are two techniques for reducing total treatment expenses—interval swath spacing and direct dosage reduction. These techniques can be used separately or jointly in adapting grasshopper control treatments to individual financial resources and circumstances. When these techniques are used, the traditional goal of controlling the maximum number of grasshoppers no longer applies.

Interval Swath Spacing

This technique leaves, by design, an untreated strip of infested land (interval) of predetermined width between treated swaths. The technique has a high potential for reducing costs. Both the cost of the insecticide and the cost of application are reduced because less acreage is treated.

The potential savings of this technique become apparent when its costs are compared to costs of traditional control techniques on a fixed size of rangeland. For example, if the pesticide used costs $2/acre and application of the pesticide costs $2/acre, on a 10,000-acre block of rangeland with traditional control techniques, the total treatment costs would be $40,000 (table II.6–1).

Using interval swath spacing on the same 10,000-acre block and leaving 20 percent of the block (2,000 acres) untreated in narrow intervals between the treated swaths reduces treatment costs to $32,000 (table II.6–1).

Table II.6–1—Costs to treat a 10,000-acre block of rangeland when minimum grasshopper control is the goal and when interval swath spacing and direct dosage-reduction techniques are employed. Costs in this table are for example purposes only.

	Pesticide costs		Application costs[1]		Total treatment cost
	$/acre		*$/acre*		
Traditional technique					
All 10,000 acres treated with conventional pesticide dosage	$2 ($20,000	+	$2 $20,000)	=	$40,000
Interval swath technique					
20% of the 10,000 acres left untreated; conventional pesticide dosage used	$2 ($16,000	+	$2 $16,000)	=	$32,000
Reduced dosage technique					
All 10,000 acres treated with a 25% reduction in pesticide applied	$1.50 ($15,000	+	$2 $20,000)	=	$35,000
Combined technique					
20% of the 10,000 acres left untreated; 25% less pesticide applied to the 8,000 treated acres	$1.50 ($12,000	+	$2 $16,000)	=	$28,000

[1] Figures in this column include $0.30/acre for costs associated with typical aerial spray applications (travel, pay, vehicles, flagging, etc.).

Direct Dosage Reduction

This technique simply uses less pesticide per treated acre. For example, on the same 10,000-acre block of rangeland, the pesticide cost of $2/acre for the traditional program results in a total pesticide cost of $20,000. With a direct dosage reduction of 25 percent, the total pesticide cost is $15,000 (75 percent × $2/acre × 10,000 acres). With both traditional and direct-dosage-reduction techniques, the application costs are identical—$20,000. Total treatment costs are $40,000 for a traditional program and $35,000 for a direct-dosage-reduction program.

Combining Techniques

Both of the techniques discussed above demonstrate substantial savings compared to a traditional program. But, by using both techniques jointly, further treatment cost savings can be realized. For example, on the same 10,000 acres, let's assume that both a 25-percent reduction in direct dosage is used and that 20 percent of the block is left untreated in narrow intervals between treated swaths. For example, a pesticide that is traditionally used at 8 fluid oz/acre is used at 6 fluid oz/acre (a 25-percent reduction). Table II.6–1 illustrates these additional savings of treatment costs when compared to traditional treatment.

This example of using interval swath spacing and reduced pesticide together results in a total cost of $28,000 for the treatment. Additionally, there is a 40-percent reduction in pesticide applied on the 10,000-acre block. (For example, in a traditional program, 10,000 acres × 8 fluid oz/acre = 80,000 total fluid oz and combined techniques 8,000 acres × 6 fluid oz/acre = 48,000 total fluid oz.)

Cost reductions on this scale could be highly significant in deciding whether or not pesticide treatment is economically feasible in a given situation. By keeping costs low, land owners and managers can make grasshopper control more affordable on rangelands.

Comparison of Typical Traditional and Combined-Techniques Programs

The following list illustrates a typical cooperative grasshopper management program for the early 1990's when maximum control of grasshoppers is the goal and malathion is the insecticide chosen.

10,000 acres	
Pesticide cost	$1/acre
Application costs	$1/acre
Associated costs (travel, pay, vehicles, flagging, etc.)	$0.30/acre
Total treatment cost	**$2.30/acre**
($23,000 for a 10,000-acre block)	

In an example of a combined program of interval swath spacing and direct dosage reduction, a 20-percent interval swath is used (20 percent of the block is left untreated in narrow intervals between treated swaths). In addition, the per-acre amount of pesticide applied is reduced by 25 percent. This example reduces the overall cost per acre within the 10,000-acre block by 30 percent and the pesticide applied by 40 percent (table II.6–1).

Managers could implement this example by directing the pilot of a spray aircraft who normally flies a 100-ft swath to space the swaths at 120 ft with the 100-ft calibration. This gives a 20-ft untreated interval between treated swaths. A 25-percent reduction in pesticide applied per acre could be achieved by lowering the dosage rate from 8 to 6 fluid oz/acre.

The following two examples compare data from two different Hopper test runs. Example A is for current grasshopper treatments used on the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine-administered cooperative grasshopper management program. Example B is for the same scenario but with a 20-percent interval-swath-spaced treatment and a 25-percent reduction in pesticide applied per acre treated (combined interval swath spacing and direct dosage reduction).

The Hopper test run data show yield in pounds per acre, total cost of treatment, return (dollar value saved by treatment), benefit–cost ratio (B/C) (returns divided by cost), and grasshopper eggs per square yard. You can calculate the net return by subtracting cost from return. In most cases, net returns will also be important to your decision. Keep in mind that these are only example test runs. Each real-world situation is different. You will need to do several test runs on Hopper to get an idea of the appropriateness of reduced treatments for any given situation. Notice that the mortality values entered are different among these examples. This difference is important as the expected mortality value you enter when using Hopper has a large impact on the analysis. As a rule of thumb, if you use interval swathing, the expected level of mortality in the intervals left untreated is conservatively set at zero.

Example A

The following is a list of parameter definitions and values as currently seen on the Hopper 4.0 screen on a computer:

Weather at time of treatment	hot and dry
Survey Date	06/22/93
Treatment Date	06/30/93
Environmentally sensitive (no chemicals)	Isolated Areas
Managed Bees in the area	No
Protect beneficial insects	No
Average stage at survey	3.06
Average stage at treatment	3.67
Percent early season target species	40.00
Closed canopy	No
Egg hatch completed	greater than 90%
Grasshoppers density is greater than 22/yd^2	Yes
Weed biocontrol insectaries present	No

The following is a list of economic definitions and values you would find on one of the Hopper screens:

Forage and Grasshopper Models
Sheridan Historical Levels of Trt

GRASS FEEDING HOPPERS (#/yd^2)	15
MIXED FORAGE FEEDING HOPPERS (#/yd^2)	20
PEAK EDIBLE FORAGE PRODUCTION	550
FORAGE PROD. MULTIPLIER	1.00
% Warm Season Grass	40
% Cool Season Grass	40
% Forbs	20
Normal Soil Moisture (% by Wt.)	23
Inches of Rain to fill dry soil to field capacity	5
Soil Water Holding Capacity (% by Wt)	25
Days for saturated soil to dry to 10% Water	65

TREATMENT COSTS

Treatment	Cost	Mortality %
Acephate	$2.30	91
Carbaryl Bait	$4.50	73
Carbaryl Spray	$3.50	92
Malathion	$2.30	90
Nosema Bait	$4.75	—

Survey date: 06/22/93 Stage: 3.1, Treatment date: 06/30/93 Stage: 3.7. Yield Without Treatment: 449 #/acre. Acres to be treated: 16044. Eggs per sq yd without treatment: 29.8

Treatment	Yield (lbs/a)	Cost ($)	Return ($)	B/C Ratio Current	B/C Ratio + 2 Years	Eggs per yd^2
Acephate	533	36900	44848	1.22	3.27	1.8
Carbaryl Bait	514	72196	35310	0.49	1.32	8.2
Carbaryl Spray	524	56153	40196	0.72	1.93	2.8
Malathion	534	36900	45072	1.22	3.29	1.8
Nosema Bait	480	76207	16895	0.22	0.60	13.3

Example B

The following is a list of parameter definitions and values as currently seen on the Hopper 4.0 screen on a computer:

Weather at time of treatment	hot and dry
Survey Date	06/22/93
Treatment Date	06/30/93
Environmentally sensitive (no chemicals)	Isolated Areas
Managed Bees in the area	No
Protect beneficial insects	No
Average stage at survey	3.06
Average stage at treatment	3.67
Percent early season target species	40.00
Closed canopy	No
Egg hatch completed	greater than 90%
Grasshopper density is greater than 22/yd^2	Yes
Weed biocontrol insectaries present	No

The following is a list of economic definitions and values you would find on one of the Hopper screens.

Forage and Grasshopper Models
Sheridan Historical Levels of Trt

GRASS FEEDING HOPPERS (#/yd^2)	15
MIXED FORAGE FEEDING HOPPERS (#/yd^2)	20
PEAK EDIBLE FORAGE PRODUCTION	550
FORAGE PROD. MULTIPLIER	1.00
% Warm Season Grass	40
% Cool Season Grass	40
% Forbs	20
Normal Soil Moisture (% by Wt.)	23
inches of Rain to fill dry soil to field capacity	5
Soil Water Holding Capacity (% by Wt)	25
Days for saturated soil to dry to 10% Water	65

TREATMENT COSTS

Treatment	Cost	Mortality %
Acephate	$1.61	73
Carbaryl Bait	$4.50	73
Carbaryl Spray	$2.45	75
Malathion	$1.61	72
Nosema Bait	$4.75	—

Survey date: 06/22/93 Stage: 3.1, Treatment date: 06/30/93 Stage: 3.7. Yield Without Treatment: 449 #/acre. Acres to be treated: 16044. Eggs per sq yd without treatment: 29.8

Treatment	Yield (lbs/a)	Cost ($)	Return ($)	B/C Ratio Current	B/C Ratio + 2 Years	Eggs per yd^2
Acephate	517	25830	36696	1.42	3.82	6.3
Carbaryl Bait	514	72196	35310	0.49	1.32	8.2
Carbaryl Spray	496	39307	25122	0.64	1.72	10.5
Malathion	516	25830	35938	1.39	3.74	7.0
Nosema Bait	480	76207	16895	0.22	0.60	13.3

Decisions and Conservation Practices

Another practical aspect of these reduced treatment strategies may be the conservation of nontarget organisms. In pest management, conservation techniques are practices that conserve nontarget organisms. Conservation techniques, such as treatments with reduced active ingredient and interval swath spacing, may significantly reduce the pesticide exposure of nontarget insects.

Natural enemies of grasshoppers, such as parasites and predators, may be affected to a lesser degree when conservation practices are employed. Interval swath spacing could be employed within treated areas to create refuges that may provide significant protection for naturally occurring and released biological control agents. These conservation practices may provide useful grasshopper integrated pest management options in areas where the presence of biological control agents is important to pesticide use decisions. These practices may become more important in the future as biological control of rangeland weeds is implemented on a wider scale in rangeland areas where grasshopper management is also a problem.

You should consider reduced treatment options when some level of reduced grasshopper control can be accepted and for conservation and/or economic purposes. To enter useful data into Hopper, users need to have a good understanding of how these reduced treatment techniques affect both treatment cost and expected mortality. Reduced treatment options provide an opportunity to adapt treatment programs to resources and site-specific circumstances. The models in Hopper produce much of the information needed in such decisionmaking.

Considerations

While reducing the amount of pesticide used to control grasshopper pests is extremely attractive, use caution when deciding to leave a significant portion of the pest population. In geographic locations where grasshoppers seldom or never cause problems 2 or more years in a row, or during times when the overall trends for the general area indicate grasshopper populations to be in decline, such a strategy could be used with minimal risk. In these cases, grasshoppers remaining after reduced treatments pose little chance of propagating a problem for the next season, and single-year economic analysis can be used to support significantly reducing pesticide use.

In locations where grasshopper populations historically cause damage over several years, or in years when general grasshopper populations show no indication of quickly declining on their own, the potential risk associated with a reduced-pesticide strategy should be carefully considered. The risk is one of leaving enough grasshoppers to propagate populations of damaging levels that could require treatment the next year. The argument for leaving some grasshoppers may be supported by a favorable benefit–cost analysis for the season of treatment.

If the remaining grasshoppers result in populations that require treatment the next year, the strategy may be seriously questioned. But even if populations the next season reach damaging levels, the benefit–cost ratio could still be favorable in the succeeding year if treatment was again required. However, even though benefit–cost analysis for 2 years in a row may have proven economical, treating the same acreage 2 years in a row, even at reduced pesticide level, would probably be much more expensive than treating one time with a standard rate of pesticide for maximum control in the initial year.

The strategies of interval swath spacing and reduced doses of pesticide offer exciting possibilities and afford numerous advantages if employed under the right conditions. The trick is deciding where and when risking the need for a second-year (next-year) treatment is too high. Attention to the history of the area and knowledge of current grasshopper population trends will help in making this decision.