II.16 Improving the Economics of Grasshopper Bait Application: Efficacy and Swath Comparison of an Experimental and Standard Aircraft Spreader

R. N. Foster, D. D. Walgenbach, J. A. Henderson, G. Rodriguez, L. E. Jech, D. Colletto, W. Meeks, C. Jackson, J. Patterson, K. C. Reuter, and Mike W. Sampson

Using solid baits, particularly carbaryl–wheat bran bait, for controlling or suppressing grasshoppers on rangeland has gained renewed attention in recent years. During the 1950's, use of bait declined as use of effective small amounts of chemical sprays increased.

Renewed interest in the use of baits was a direct result of improvement in aerial application equipment and the development of calibration procedures that produced consistent results. Increasing concern for the environment and the environmental advantages inherent with baits over many chemical sprays spurred these improvements.

Grasshopper density management studies conducted in North Dakota in the mid-1980's relied on and successfully demonstrated these advances (Foster and Roland 1986). However, narrow swaths produced by the equipment used for aerial application of bait treatments in these studies demonstrated the competitive edge that was still associated with the wider swaths of aerially applied chemical sprays.

The narrow swath, while hindering the wide-scale use of baits from the air, led to the development and production of an experimental aircraft spreader with an improved swath width. Jack Henderson and the New Mexico State University designed and produced an improved spreader and incorporated further modifications during the late 1980's.

Field Studies

As part of the Grasshopper Integrated Pest Management (GHIPM) Project, we carried out field studies that looked at swath width, uniformity of bran flakes within the swath, and resulting efficacy of dispersed bait for grasshopper suppression on rangeland with the experimental spreader. During the tests, we used a Cessna Ag Husky for all flights with the modified experimental spreader. For studies with the standard spreader, a Transland 20244, a Cessna Ag Truck was equipped to prevent bridging (flow blockage) of the bran in the hopper and to promote uniform application (Foster and Roland 1986). We calibrated both spreaders according to U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) guidelines for aerial contractors.

Bait was the D-Bug® Ag (Sidwell Enterprises, Inc., Parker, CO) formulation of carbaryl and wheat bran grasshopper bait containing 2 percent carbaryl by weight. Bait was applied at 1.42 lb/acre for the experimental spreader and at 1.54 lb/acre for the standard (Transland 20244) spreader.

Efficacy in the Field.—There were four treatment blocks of mixed-grass rangeland for each spreader trial. Pilots flew the blocks on July 19, 1989, northeast of Edgemont, SD. Application with the standard spreader was at 127 miles per hour (mi/hour) at an altitude of 50–75 ft with a

Figure II.16–1—Adhesive card and aluminum pan collection devices used to evaluate swath width and uniformity of application for the aircraft spreaders used in applying bran bait.

Figure II.16–2—Cessna Ag Husky with experimental bran bait spreader.

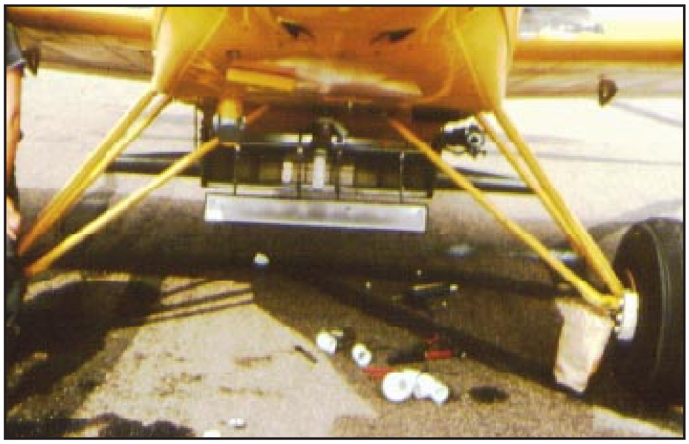

Figure II.16–3—Commercial Turbine Thrush with Transland 20244 standard spreader.

working swath of 45 ft. Application with the experimental spreader was at 120 mi/h at an altitude of 70–100 ft with a working swath of 100 ft. These swath assignments were based on widths determined in earlier studies with the standard and experimental equipment. When sprays are used, these aircraft are assigned working swaths of 75–100 ft depending on the type of formulations (USDA, APHIS 1994).

We measured grasshopper densities before and after treatment using 40 0.1-m^2 rings developed by Onsager and Henry (1977). Grasshopper densities from four untreated plots were used for comparison to determine natural change in the grasshopper population during the study and for comparison to treated populations. Post-treatment population levels were compared with pretreatment levels to determine the effectiveness of the bait to reduce grasshopper populations as dispersed by both spreaders.

Comparison of Swaths.—Another set of trials compared the uniformity and widths of swaths of the standard and experimental spreaders. Adhesive cards (unfolded sticky pink bollworm traps) (Foster et al. 1977) and aluminum cake pans collected particles of bran bait dispensed during the test flights. The total number of particles collected for each card or pan was converted to particles of bait per square foot to determine the uniformity of the swath, overall swath width, and effective or working swath width. Flights for these trials occurred on July 20, 1989, at an altitude of 30 ft. This altitude was chosen because the investigators were looking for information that might also be of use if bait were used on crops in the future. Applications on cropland typically occur at lower altitudes than on rangeland. Other flights at higher altitudes were studied to determine the effect of altitude on the uniformity of bait within the swath.

Among organizations or individuals who deal with aircraft applications, there is no widely accepted specific method or criteria for assigning operational swath widths. In this study we defined “effective swath width” as the width where collection devices captured at least 73 percent of the number of bran flakes expected per square foot. Extraordinary reductions in the rate of bran deposited took place when less than 73 percent of the expected rate actually did fall to the ground.

Results.—Pretreatment grasshopper densities ranged from 11.8 to 25 per square meter and averaged 20.2 grasshoppers/m^2 in the experimental spreader plots. In the standard spreader plots, grasshoppers ranged from 18.8 to 42.5 per square meter and averaged 27. Grasshoppers in the untreated check plots ranged from 20.3 to 29 and averaged 24.5 per square meter. The grasshopper density in the untreated check plots decreased .01 percent per day during the course of the study because of natural mortality.

At 24 and 48 hours after treatment, trials with both spreaders resulted in reducing grasshoppers below the general 1989 APHIS action level in 1989 of 8 per square yard (9.6 per square meter). There was no significant difference in grasshopper mortality between the spreaders (table II.16–1).

When compared to the standard spreader at an application altitude of 30 ft, the experimental spreader provided a significantly wider swath. Both the pan and adhesive-card particle collectors showed increases in overall and effective swath width (table II.16–2).

The experimental spreader showed an increase of between 125 and 132 percent for overall swath width and between 113 and 140 percent for effective swath width. Such significant increases strongly suggest that using the experimental spreader would make the choice of bait control more cost effective.

Table II.16–1—Efficacy of 2% carbaryl bran bait on grasshoppers when aerially applied with a standard Transland spreader and an experimental spreader near Edgemont, SD, 1989 (replicated 40-acre blocks)

Spreader	Application rate	Mean percent control at indicated interval after treatment[1] 2 days	4 days
	(Lb/acre)	*(Percent)*	
Experimental	1.42	39.4a	54.7a
Standard	1.54	41.7a	57.4a

[1]Adjusted for untreated check. Means followed by the same letter in a column do not differ significantly at the 5% level of confidence (Duncan's new multiple-range test).

Table II.16–2—Mean[1] swaths (overall and visual effective) of experimental and standard dry-material aircraft spreaders with aluminum pan and adhesive card collection devices (flown at 30-ft altitude)

	Swaths			
	Overall		Effective	
Spreader	Pan	Card	Pan	Card
		(Ft)		
Standard	60b	50b	35b	39b
Experimental	135a	116a	84a	85a

[1]Means in a column followed by the same letter do not differ significantly at the 5% confidence level (Mann–Whitney test).

The standard spreader demonstrated greater uniformity of bran bait particles at 30 ft within the effective swath than did the experimental spreader. At higher altitudes, the experimental spreader showed an increase in uniformity. This increase points to the need for more study that could show additional improvements in bait economics.

Key Findings and Conclusions

• Spreaders can be built that work with swaths equal to those used for liquid applications.

• The experimental spreader produced a working swath 2.2 to 2.4 times that of the standard spreader from an application altitude of 30 ft.

• Adhesive-card particle collectors accounted for a greater number of particles per square foot than did pan collectors. Cards also are more convenient to use.

• At an application altitude of 30 ft, the standard spreader gave greater uniformity of bran bait deposited than did the experimental spreader. With minimal improvement, the experimental spreader could offer increased uniformity.

• Using the experimental spreader at higher altitudes improved uniformity of depositing bait and may increase swath widths.

• Both spreaders performed equally well in terms of rangeland grasshopper control with baits.

• The experimental spreader was efficient and was an economical improvement compared to the standard spreader.

For More Information

A detailed report on the comparison of a standard and experimental aircraft spreader for bran bait is available from the USDA, APHIS, Methods Development Center, 4125 E. Broadway Road, Phoenix, AZ 85040. The report includes data on grasshopper species composition before and after treatment, grasshopper collection procedures, and techniques for determining density, swath overlap, particle-count data, and effects of aircraft altitude on bait coverage.

Selected References

Foster, R. N.; Roland, T. J. 1986. Grasshopper suppression: techniques for ultra low volume applications of carbaryl wheat bran baits. Bismarck, ND: North Dakota Cooperative Extension Service, North Dakota Agricultural Experiment Station, North Dakota Department of Agriculture: 68–73.

Foster, R. N.; Staten. R. T.; Miller, E. 1977. Evaluation of traps for pink bollworm. Journal of Economic Entomology 70: 289–291.

Onsager, J. A.; Henry, J. H. 1977. A method for estimating the density of rangeland grasshoppers (Orthoptera: Acrididae) in experimental plots. Acrida 6: 231–277.

USDA, APHIS. 1994. Prospectus No. 73-M-APHIS-94 for aerial application.

Selected Reference—Unpublished

Foster, R. N;, Walgenbach, D. D.; Henderson, J. A.; Rodriguez, G.; Jech, L. E.; Colletto, D.; Meeks, W.; Jackson, C.; Patterson, J.; Reuter, K. C. 1990. Improving the economics of grasshopper bait application: efficacy and swath comparison of an experimental and standard aircraft spreader. In: Cooperative Grasshopper Integrated Pest Management Project, 1989 annual report. Boise, ID: U.S. Department of Agriculture, Animal and Plant Health Inspection Service: 173–183.