II.15 Comparison of Single and Multiple Applications of Bran Bait

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Introduction

Insecticidal baits generally kill 30 to 70 percent of all rangeland grasshoppers (Quinn et al. 1989, Ewen 1990, Jech et al. 1993). Several factors influence the overall effectiveness of insecticidal baits. These include (1) the species composition of grasshoppers in the treated area, (2) total density of grasshoppers, and (3) the amount of bait applied to an area.

For control purposes, communities of grasshoppers can be classified as "bran acceptors" or "bran rejectors" depending on whether or not they consume treated baits (see chapter II.12 on bait acceptance). The larger the proportion of bran acceptors in the community, the greater the level of control by insecticidal baits. In turn, the species composition of grasshoppers is determined partly by vegetation. For example, some mixed-grass communities dominated by grasses will harbor a greater proportion of bran-rejector species than communities with abundant forbs (Quinn et al. 1991).

The effectiveness of insecticidal baits also depends on the density of grasshoppers in an area. Because insecticidal baits generally cause less mortality than sprays, baits can be ineffective when grasshopper densities are relatively high. For example, an insecticidal bait that causes only 60-percent mortality can reduce grasshopper populations below 10 per square yard only if initial densities are less than 25 per square yard.

There is some evidence that the amount of bait applied to rangeland also can limit the effectiveness of the treatments because much of the bait disappears quickly after application. For example, Mukerji et al. (1981) found that an increase in the amount of dimethoate-treated bran bait from 3.6 to 8 lb/acre caused an increase in mortality. Henry (1975) reported that most bran is consumed within a few hours of application.

In 1989, a 20-acre section of rangeland in the North Dakota Grasshopper Integrated Pest Management Project demonstration area was treated with 2 percent carbaryl bran bait at the rate of 2 lb/acre. After treatment, populations decreased 28 percent, but densities were still quite high at 25.8 grasshoppers/yd^2. After a second treatment of the insecticidal bait, populations declined an additional 47.3 percent. These results suggest that single applications of insecticidal baits at standard dosages may not produce the maximum possible control of grasshoppers because the bait is quickly consumed or lost. Besides grasshoppers, other insects may also compete for the bait. For example, Quinn et al. (1990) found that darkling beetles (Tenebrionidae), a dominant insect group on mixed-grass rangeland, probably consume treated bran bait.

Single and Multiple Applications of Bran Bait—A Case Study

In 1990, Foster et al. (unpubl.) conducted a detailed followup study to their 1989 work to determine if greater control of grasshoppers could be achieved with the application of higher dosages or multiple applications of insecticidal baits. In this study, the investigators applied flaky wheat bran containing carbaryl at 2 percent by weight to 40-acre, mixed-grass rangeland plots in North Dakota. The baits were applied with a Cessna Ag Truck operating at an altitude of 40–60 ft at 115 miles per hour (mi/hour) and equipped with a standard Transland 20244 spreader. Swath widths were 45 ft.

Three sets of plots received a single application of the carbaryl–bran bait at either 1.5, 3, or 4.5 lb/acre. One set of plots was treated with two successive applications of 1.5 lb/acre, and another set was treated with three successive applications of 1.5 lb/acre. The repeated treatments were applied 3 days apart. A final set of plots was left untreated. The six treatments were arranged in a randomized block design with four replicates per treatment. Pretreatment densities were used as the blocking variable. When the initial applications were made June 20–22, about 80 percent of the grasshoppers were in the nymphal stage.

The test showed that high dosages of the carbaryl–bran bait (3 and 4.5 lb/acre) caused greater reductions in grasshoppers after 2 days compared with the 1.5-lb/acre dosage (fig. II.15–1). The highest dosage, 4.5 lb/acre, caused a 48-percent reduction in populations of total grasshoppers after 2 days. Mortality in the single-application plots increased by an additional 7–14 percent after 7 days, perhaps because healthy grasshoppers cannibalized infected individuals.

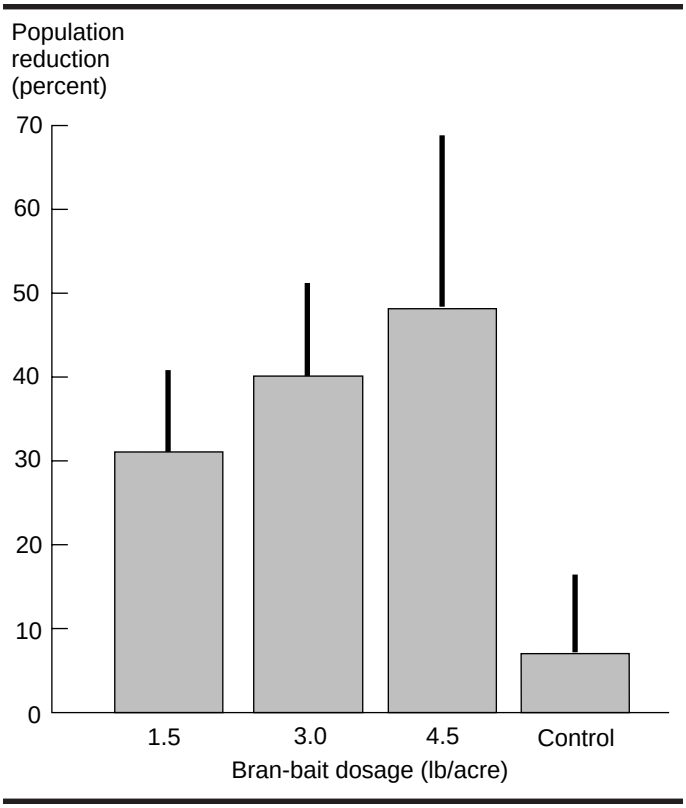

Figure II.15–1—Mean percent reduction in total grasshoppers after 2 days in plots treated with 1.5, 3, and 4.5 lb/acre of bran bait. Sample sizes for the 1.5, 3, 4.5, and control treatments were 12, 4, 4, and 4 plots, respectively. Bars indicate 1 standard error of the mean (SEM).

Successive applications of the insecticidal bait at 1.5 lb/acre caused progressive reductions in total grasshoppers (fig. II.15–2). For example, densities of grasshoppers declined by 52 percent in plots receiving the initial application of the 1.5 lb/acre treatment and declined by another 32 percent after the second application. The third application had no effect on grasshoppers.

Although repeated applications of insecticidal baits or higher dosages increased grasshopper mortality after 2 days, there was no difference in the effects of these treatments compared with a single application of 1.5 lb/acre after 7 days (fig. II.15–3). All treatments caused similar reductions after 7 days, whereas densities did not change in the control plots. Final densities of grasshoppers ranged from 6.3 to 15 per square yard in the treatment plots and were 23.8 per square yard in the control plots.

Uses of Multiple Applications of Insecticidal Baits

Foster et al. (unpubl.) found that multiple applications of 1.5 lb/acre had no real advantage over a single application at 1.5, 3, or 4.5 lb/acre. However, bran baits applied at lower dosages may be quickly consumed by a subset of grasshoppers and other insects, resulting in less control of some grasshopper species. Although there is a general relationship between the amount of bait applied and grasshopper mortality (see the chapter on multiple concentrations and rates of carbaryl–bran bait in this section), more bait is not necessarily better. Lower rates can give adequate control, particularly when grasshopper densities are relatively low (less than 25 per square yard).

Summary

The rather modest degree of overall control achieved by the insecticidal bait treatments in these tests was a result of the species composition of grasshoppers (fig. II.15–3). The presence of a high proportion of bran-rejector species diluted the effect of the treatments on total densities of grasshoppers. For example, treatments had no effect on *Aeropedellus clavatus*, the second most abundant species of grasshopper in the study plots. In contrast, treatments caused up to 96-percent reductions in densities of the most abundant species, *Aulocara elliotti*, a species that is known to consume baits.

An increase in the amount of bait can increase grasshopper mortality slightly, but this added control is not likely to be economical in many situations (see section II.3, “Sprays *versus* Baits”). Under certain conditions, however, it may be useful to increase the dosage of bran bait. For example, higher dosages can be used if the goal is to obtain high levels of grasshopper mortality (greater than 80 percent) in environmentally sensitive areas where insecticidal sprays cannot be used. These sensitive areas may include riparian habitats or sites with endangered plant and animal species.

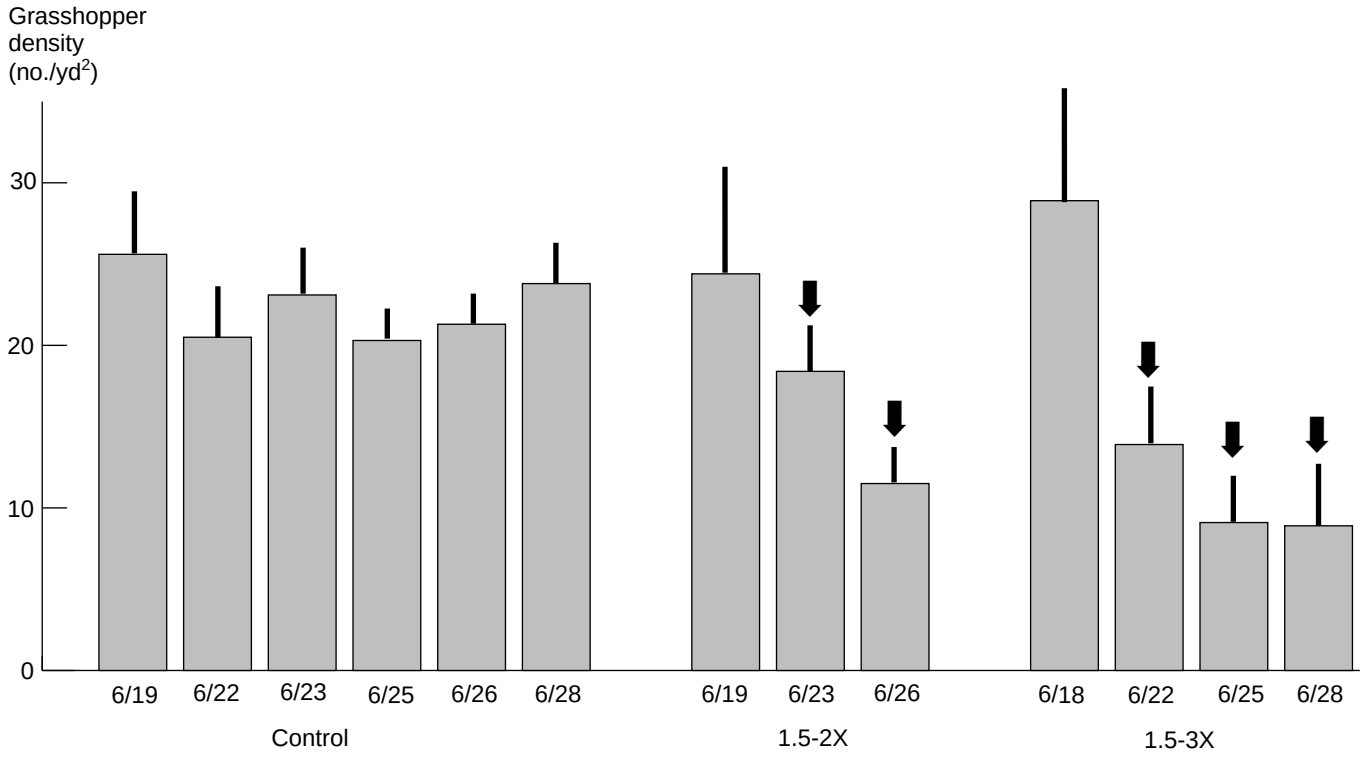

Figure II.15–2—Grasshopper densities (number/yd^2) in plots left untreated (control), treated two times with 1.5 lb/acre (1.5-2X), and treated three times with 1.5 lb/acre (1.5-3X). June 18–19 values represent pretreatment densities. Arrows indicate densities after treatments. Bars indicate 1 SEM.

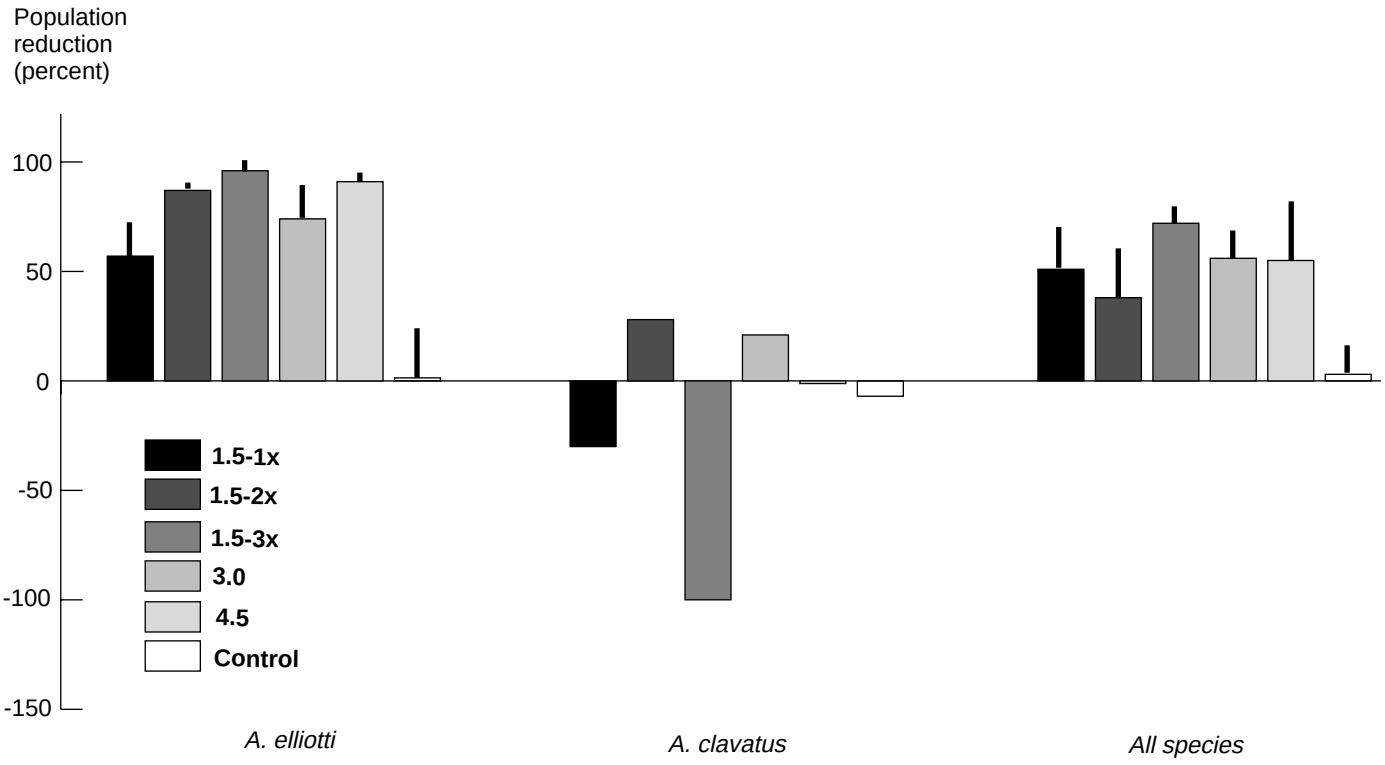

Figure II.15–3—Mean percent reduction in densities of *A. elliotti* (a bran acceptor), *A. clavatus* (a bran rejector), and all species combined, in treatment and control plots 7 days after initial treatments. A negative percent reduction indicates an increase in densities. Bars indicate 1 SEM. Standard errors for *A. clavatus* (not shown) ranged from 18.5 to 165.3.

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