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Montana Department of Agriculture
Environmental Management Division
Technical Services Bureau
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Field Evaluation of Bromadiolone Treated Bait for Control
of the Columbian Ground Squirrel

by

Daniel Sullivan

ABSTRACT

Field trails were conducted in Powell County, Montana during the summer of 1983 to determine the efficacy of oat groats treated with bromadiolone for control of the Columbian Ground Squirrel. A single application of 5 grams of 0.05% bromadiolone treated oat groats per active burrow resulted in an average reduction in squirrel activity of 90.3% (range 85.7% - 94.2%) 10 days post treatment.

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INTRODUCTION

Presently there is a lack of effective alternatives to traditional single dose field rodenticides such as strychnine, compound 1080 and zinc phosphide. Each of these traditional compounds has environmental, efficacy and/or economic disadvantages. These compounds have may an uncertain future regarding registration for use or may have restrictions added to their current registrations which may make their use ineffective or impractical.

Bromadiolone is an anticoagulant rodenticide that has been shown effective for control of commensal rodents (Marsh, et.,al. 1980, Meehan 1978, Redfern and Gill 1980) and has received federal registration for commensal rodent control (Lipha Chemical Co., Bell Laboratories). Recent studies have shown potential for control of ground squirrels (Sullivan 1982a, Baker 1980, Marsh 1977). Sullivan (1982b) found that single doses of bromadiolone treated bait were lethal to Columbian ground squirrels.

Bromadiolone has been shown to have a relatively low risk from secondary poisoning to certain species when compared with bromadiolone, strychnine and 1080 (Anon 1982, Mendenhall and Pank 1980, Anon undated). Bromadiolone, like other anticoagulants has an effective antidote (Vitamin K₁) which the traditional acute rodenticides do not. Should bromadiolone prove to be effective and economical under field situations it may be an alternative to the traditional acute rodenticides.

OBJECTIVE

The study objective was to determine the efficacy of a single application of bromadiolone treated bait for control of the Columbian ground squirrel under field conditions.

METHODS

Four treatment plots and one control plot colonized by Columbian ground squirrels were selected in Powell County, Montana near the city of Deer Lodge. Treatment plots were selected from isolated squirrel populations covering less than 3 acres where there was believed to be little potential for repopulation by squirrels from other areas.

Study plot 1 (Figure 1) was a small portion of a nonirrigated pasture vegetated with native and introduced grasses and numerous weedy plants, primarily thistle species. The study plot was intensely grazed by cattle and cattle were present during the study period. The irrigation ditch had been abandoned. Size of study plot 1 was 1.13 hectare (2.8 acres).

Study plot 2 (Figure 1) was a nonirrigated corner of a flood irrigated hay field. Vegetation on the plot was a mixture of alfalfa and various grass species. Plot 1 and 2 were separated

Figure 1. Study plots 1 and 2.

by a flowing creek lined with cottonwood trees and an ungrazed noncrop area vegetated with a dense cover of grasses and spotted knapweed. Only a few squirrels occupied this area. Size of study plot 2 was 0.81 hectare (2.0 acres).

Study plot 3 (Figure 2) was a dry hillside bordering a flood irrigated alfalfa field. Vegetation consisted of native grasses with some scattered alfalfa plants located at the north end of the plot. Size of study plot 3 was 0.2 hectare (0.5 acres).

Study plot 4 (Figure 3) was a coulee bordered on 3 sides by sprinkler irrigated barley. Vegetation consisted of native and introduced grasses. The west half of the plot received water from the irrigation system resulting in dense grass cover after 20 June. Size of study plot 4 was 0.48 hectare (1.2 acres).

Study plot 5 (Figure 4), the control site, was a dry hillside bordering a dry creek bed. Water is only present in the creek during spring run off. Vegetation was comprised of native grasses. This study plot was the driest and most sparsely vegetated of the 5 study sites. Size of study plot 5 was 0.40 hectare (1.0 acre).

Application of the bromadiolone bait was conducted on 5 July, 1983. Seeds from grasses and herbaceous plants were present and were being readily consumed by the squirrels. Young of the year were foraging independently at this time. The bait, 0.05% bromadiolone on hulled, slightly rolled oats, was applied by hand using a calibrated dipper at the rate of 5 grams (approximately 1 teaspoon) scattered near each active burrow. Each of the 4 treatment plots was treated in a similar manner. No bait of any kind was applied to the control plot.

Efficacy was measured on Plot 1 using visual counts to determine reduction in squirrel activity. Visual counts consisted of 3 counts using binoculars at 5 minute intervals each day for 3 consecutive days, pretreatment and posttreatment. Counts were conducted during the squirrels' morning foraging period. Posttreatment counts were conducted 8, 9, and 10 days posttreatment and 15, 16 and 17 days posttreatment. Percent reduction in activity was calculated using the following formula (Henderson and Tilton 1955):

$$\text{Percent Reduction in Activity} = \frac{\begin{array}{c} \text{No. Squirrels Counted} \\ \text{posttreatment} \\ \text{(Treated Plot)} \end{array} - \begin{array}{c} \text{No. Squirrels Counted} \\ \text{Pretreatment} \\ \text{(Control Plot)} \end{array}}{\begin{array}{c} \text{No. Squirrels Counted} \\ \text{Pretreatment} \\ \text{(Treated Plot)} \end{array}} \times 100$$

Figure 2. Study plot 3.

Figure 3. Study plot 4

Figure 4. Study plot 5 (control site).

Efficacy was measured on Plots 2, 3 and 4 by calculating the reduction in active burrows. All burrows or a minimum of 50 active burrows on each plot were flagged and closed with soil pretreatment and posttreatment. The number of burrows reopened was counted 2 days after closure. Posttreatment burrow closures were conducted 10 days and 17 days posttreatment using the same burrows as the pretreatment burrow closures. Percent reduction in active burrows was calculated using the following formula:

$$\text{Percent Reduction in Active Burrows} = 1 - \frac{\text{No. Holes Reopened Posttreatment (Treatment Plot)} \times \text{No. Holes Reopened Pretreatment (Control Plot)}}{\text{No. Holes Reopened Pretreatment (Treatment Plot)} \times \text{No. Holes Reopened Posttreatment (Control Plot)}} \times 100$$

Burrow closures were not used on Plot 1 because livestock tend to trample and remove flagging. Visual counts were not used on Plot 2, 3 and 4 because of high vegetation and lack of adequate observation points. Both burrow closure and visual counts were conducted on Plot 5 (Control plot).

RESULTS AND DISCUSSION

The average reduction in squirrel activity on treatment plots 1 through 4 was 90.3% (Range 85.7% - 94.2%) 10 days posttreatment. The average reduction in squirrel activity 17 days posttreatment on plots 1 through 4 was 85.4% (Range 71.4% - 100%) (Table 1).

Three squirrel carcasses, 2 on Plot 1 and 1 on Plot 4 were found 8 days posttreatment. No other squirrel or nontarget animal carcasses were observed during the study period. Bait acceptance was good to excellent on all treatment plots. On Plot 1 almost no residual bait could be found 2 days posttreatment. Residual bait was more easily observed on the remaining treatment plots probably because of the greater vegetation height and density making the bait more difficult for the squirrels to find. This was particularly true on plot 4 where the application of the bait was difficult because of the lack of open areas near burrows to place the bait.

Substantial rain from thunderstorms occurred on the treatment plots sometime between 12 and 48 hours post application of the bait. Although the majority of the bait appeared to be consumed by the squirrels prior to being rained on it is unknown to what extent the rain may have affected efficacy and acceptance of the bait.

A substantial decrease in active burrows was noted on the control plot 17 days posttreatment (Appendix 1). The date (22 July), combined with the dryness of the site, would indicate that reduction in active burrows may have been the result of a portion

TABLE 1. Percent Reduction In Ground Squirrel Activity Based On Visual Counts And Burrow Counts.

	10 Days Posttreatment	17 Days Posttreatment
Plot 1 (Visual Count)	88.7%	86.1%
Plot 2 (Burrow Count)	94.2%	100.0%
Plot 3 (Burrow Count)	85.7%	71.4%
Plot 4 (Burrow Count)	92.7%	84.1%
Average	90.3%	85.4%
Plot 5 - Control		
(Visual Count)	4.9%*	27.2%
(Burrow Count)	0%	49.0%

* increased activity

of the squirrel population beginning summer estivation. Although estivation may have been a factor on the treatment plots, field observation indicated it was probably not significant. The treatment plots had green vegetation and were relatively moist compared to the control plot. There was also an increase in squirrel activity on 3 of the treatment plots. As a result, the control plot was not used in calculating reduction in activity at 17 days posttreatment. A simple percentage calculation was used using pretreatment and posttreatment numbers on the treatment plots.

Increased activity at 17 days posttreatment may be a result of several factors. Although the treatment plots were selected to minimize repopulation from squirrels outside the study sites, some repopulation may have occurred. Posttreatment activity patterns on Plots 1 and 3 point toward new squirrels since the activity was on the edges of the plots with no activity in the center of the plots. Squirrels surviving or not yet dead from the treatment may also be a factor in squirrel activity on the plots at both 10 and 17 days posttreatment. Sullivan (1982b) found Columbian Ground Squirrels survived doses of bromadiolone up to 2.02 mg/kg and that death from lethal doses occurred up to 24 days posttreatment.

CONCLUSIONS

A single application of bromadiolone treated bait resulted in an average 90.3% reduction in ground squirrel activity 10 days after bait application. This percent reduction in activity is within the range generally believed to be acceptable for field rodent control. If a price competitive bait can be produced and registered, it will be an effective alternative to presently registered single dose field rodenticides.

Testing on larger acreages and under varied conditions would be useful in confirming results obtained in this study. Further testing may indicate that the bromadiolone concentration can be reduced without affecting efficacy (Sullivan 1982b).

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APPENDIX 1. VISUAL AND BURROW COUNT DATA

PRETREATMENT

PLOT NO.	NUMBER OF BURROWS CLOSED	NUMBER OF BURROWS REOPENED	VISUAL COUNTS (NO. OF SQUIRRELS)	AVERAGE OF VISUAL COUNTS
1	-	-	26,30,30	28.7
2	67	52		
3	43	35		
4	89	82		
5(Control)	57	51	20,20,22	20.6

10 DAYS POSTTREATMENT

1	-	-	3,3,4	3.4
2	67	3		
3	43	5		
4	89	6		
5 (Control)	57	51	20,22,23	21.6

17 DAYS POSTTREATMENT

1	-	-	4,3,5	4.0
2	67	0		
3	43	10		
4	89	13		
5 (Control)	57	26	14,16,15	15.0

APPENDIX 2. BAIT FORMULA

Squirrel Oat Groats*	10432.8 g	
Safflower Oil (Adhesive)	546.0 g	(600ml)
1% Bromadiolone Concentrate	585.0 g	
Alkali Fast Green 2-G (dye-powder)	27.0 g	
Total Weight	11590.8 g	(25.55 lbs)
Weight Active Ingredient	5.85 g	
Percent Active Ingredient	0.05047%	

Bait was mixed in a stainless steel bowl using stainless steel implements and by hand wearing rubber gloves. The oil, at room temperature, was added to the oats and mixed until grain was thoroughly coated. The dye was added to the concentrate and mixed until uniform. The dye-concentrate mixture was gradually dusted on to the grain and mixed thoroughly. The finished bait was spread onto plastic sheets and allowed to dry for 24 hours. The bait was then stored into sealed plastic bags until use.

The bait was made in 3 equal batches. The batches were combined and thoroughly mixed.

*Zellner Milling, Inc. Triangle Cereal Division
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