March 1983

EFFICACY OF SPRING BROADCAST RODENTICIDES IN THE HUDSON VALLEY, NEW YORK

Paul F. Steblein
Cornell University

Pamela N. Miller
Cornell University

Milo E. Richmond
Cornell University

EFFICACY OF SPRING BROADCAST RODENTICIDES IN THE HUDSON VALLEY, NEW YORK

Paul F. Steblein
Pamela N. Miller
Milo E. Richmond
New York Cooperative Wildlife Research Unit
Cornell University
Ithaca, New York 14853

INTRODUCTION

Subsequent to the prohibition of endrin use in New York State, a variety of alternate rodenticides and methods of rodenticide application have been examined in an effort to develop effective control measures for the pine vole, Pitymys pinetorum. These studies indicate that the manner in which the rodenticides are applied substantially influences their effectiveness in controlling pine voles. Specifically, in our experience placing poisoned bait directly in the animals' subsurface tunnel systems has proved to be the most effective means of vole control. However, this method of bait placement is both time consuming and expensive. An alternate more cost-effective method of applying rodenticides is that of broadcast application. However, broadcast applications of rodenticides have been inconsistant in their effects in controlling pine voles (Richmond et al. 1978). The equivocal results produced by this method may be related to the timing of its use on a seasonal basis. Traditionally, orchards have been treated in the fall after apple harvest, but prior to vegetation die-back when abundant food resources may influence bait acceptability (Steblein and Richmond 1982). Indeed, McAninch (1981) found that broadcast treatments were most effective in reducing vole population size when treatments were carried out after the senescence of ground vegetation in the fall. The influence of a spring broadcast prior to grass greenup on vole populations remains unexplored. Thus, in this study we examine the efficacy of two anticoagulants, Bromodiolone (Maki, Chempar) and Brodificoum (Volid, ICI Americas, Inc.), and a toxicant, zinc phosphide (ZP Rodent Bait, Bell Laboratories) when applied using broadcast techniques in early spring.

METHODS

Rodenticide testing was conducted in the towns of Clintondale (Ulster County) and Wallkill (Orange County) in the Hudson Valley of New York State. The experimental design consisted of a randomized complete block with replicates in three orchards. These orchards were similar in that 1) all trees were between 30 and 40 years in age, 2) the apple varieties were a mixture of red delicious and McIntosh, and 3) all three orchards were situated on a well drained silt/loam soil. The three orchards differed somewhat in regard to 1) the date of rodenticide application, 2) the stage of tree leaf bud development, and 3) ground vegetation (Table 1).

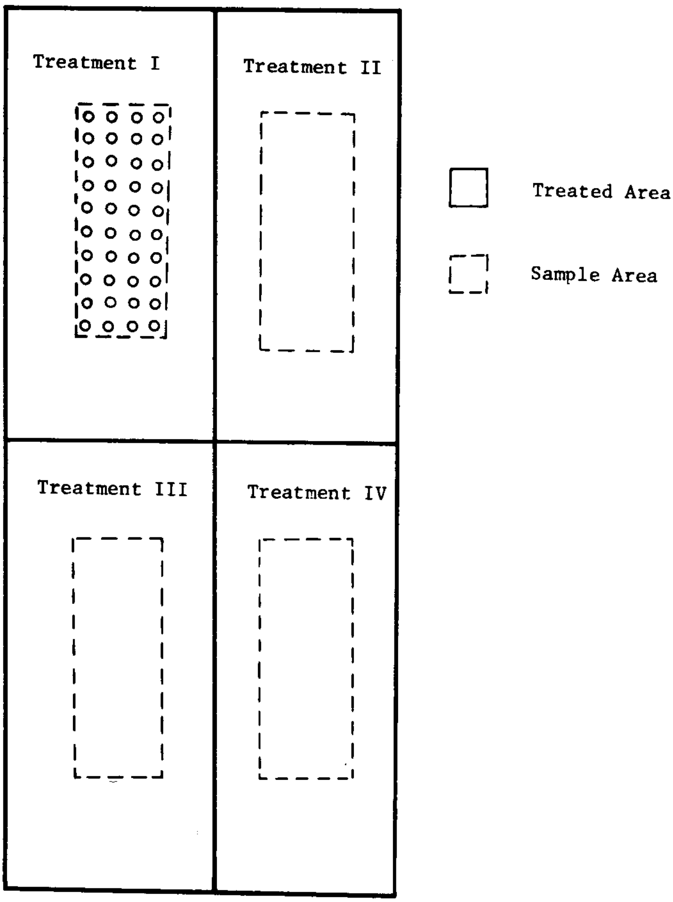

Figure 1. Experimental design for testing efficacy of spring broadcast application of 3 rodenticides.

Table 1. Description of orchards used in spring broadcast of brodificoum, bromodiolone, and zinc phosphide.

	B. Minard Orchard	Norwin I Orchard	Norwin II Orchard
Date of rodenticide application	2 April 1982	23 April 1982	30 April 1982
Stage of apple bud development	Silver tip	Green tip	Early pink
Ground cover composition ($\overline{X}$ %)			
Grasses	77.5	49.1	58.1
Forbs	21.2	25.4	31.1
Woody vines	0.5	24.2	5.1
Thatch	0.8	1.3	5.7

The three orchards were each subdivided into four experimental plots each of which consisted of a block of 40 trees (arranged 4 by 10) and an associated buffer zone (Fig. 1). Three of the plots were each treated with a different rodenticide while the fourth plot was untreated and used as a control. The rodenticides were hand broadcast (12 pounds per treated acre) contiguously beneath the dripzone of all trees in the treated plots.

Vole abundance was monitored by an apple-slice index which entailed placing a slice of apple directly into a vole tunnel at each tree. The apple was then covered with a small piece of tarpaper. If, after 24 hours, the apple slice was chewed or missing, or if the tunnel in which the apple was placed was plugged with soil, the tree at which the tunnel was located was classified as "active". An apple slice index was conducted once immediately before rodenticide treatment and at one, two, and six weeks after treatment. In addition, estimates of vole population size were made by live trapping (Sherman live traps) for 48 hour periods, once before application and at four week intervals after rodenticide application for 28 weeks.

RESULTS

Vole activity and numbers of voles underwent pronounced reductions on each of the rodenticide-treated plots (Table 2). Zinc phosphide treatment resulted in a rapid decline in vole activity during week one, but only a modest decline in vole activity followed during weeks two and six. In contrast, Bromodiolone and Brodificoum produced only moderate decreases in vole activity during week one, but resulted in pronounced decreases in vole activity during weeks two and six. These reductions in vole activity after rodenticide treatment paralleled by decreases in actual numbers of voles caught as indicated by the finding that at 4 weeks vole numbers were reduced by 99.4%, 84.7%, and 58.6% of pretreatment values on plots treated with Brodificoum, Bromodiolone, and Zinc Phosphide, respectively. Vole numbers and activity also underwent some decline on the control plots, but these reductions were much less substantial than those recorded from the treated plots (Table 2).

Table 2. Average percent reduction in vole activity and numbers relative to pretreatment values following a spring broadcast application of rodenticides in three orchards.

Treatment	Apple Slice Index (Activity) 1 week	2 week	6 week	Number Trapped 4 week
Control	+ 10.5	- 4.8	- 2.6	- 27.7
Zinc Phosphide	- 28.2	- 25.1	- 39.5	- 58.6
Bromodiolone	- 7.6	- 50.5	- 57.3	- 84.7
Brodificoum	- 17.4	- 62.7	- 79.9	- 99.4

Comparison of means with a two-way analysis of variance indicates the following relationships (Table 3):

1. Both the numbers of voles trapped and the levels of vole activity differed significantly among orchards during and after week four of this study.

2. Vole activity in the control plots differed significantly from that in the treated plots throughout the experiment. In addition, the average number of voles trapped differed in the treated plots and the control plot.

3. The average reduction in vole activity on the zinc phosphide treated plots was significantly less than that recorded on the Brodificoum and Bromodiolone-treated plots, whereas the levels of vole activity recorded from plots treated with the latter two rodenticides were similar throughout the sampling period in this study but significantly different from controls.

Lastly, examination of data for each of the three orchards indicates that the fewest voles were located in the orchard with the latest rodenticide-treatment data (Table 4). Conversely, the largest number of voles and the highest level of vole activity was found in the orchard treated earliest with rodenticide.

Table 3. Two-way analysis of variance results (F-value & significance) comparing rodentidice efficacy in three apple orchards.

Effects (E) & Contrasts (C)	Apple Sice Index (Activity) 1 week	2 week	6 week	Number Trapped 4 week
E Orchards	0.18	2.26	5.18**	4.58*
E Treatments	4.55**	23.59***	7.99***	21.59***
C Control vs Exper	9.71**	47.25***	17.80***	46.87***
C ZP vs Maki/Volid	0.72	20.01***	4.32*	16.08***
C Maki vs Volid	3.22	3.50	1.84	1.82

*p < 0.05 ** p < 0.01 ***p < 0.001

Table 4. Percent reduction in vole numbers and activity averaged for all treatments over three ocrchards following a spring broadcast application of rodenticides.

Orchard	Date	6 week activity index	4 week trap
B. Minard	2 April	-29.0	-55.2
Norwin I	23 April	-34.4	-66.2
Norwin II	30 April	-70.2	-79.8

DISCUSSION

Treatment of plots with rodenticides resulted in significant reductions in vole activity and numbers of voles relative to values obtained from untreated control plots. However, the rate of vole activity decrease differed among the treated plots. Specifically, zinc phosphide treatment produced a substantial decline in vole activity over a one week period, whereas bromodiolone and brodificoum required two weeks before significant reduction in vole activity was observed. These apparent differences in rodenticide activity may be related to the mode of action of the individual rodenticides. In laboratory tests, voles fed zinc phosphide died in one to two days (Richmond and Stehn, unpublished report), whereas four to six days were required for the anticoagulants (Chempar; ICI Americas) to exert their effects.

Despite the finding that the anticoagulant rodenticides required a slightly longer period of time for their effects to become measurable relative to the effects of zinc phosphide, the former ultimately were more effective at controlling voles than was zinc phosphide. Specifically, reductions in vole activity of 57.3% and 79.9% were obtained by week six with bromodiolone and brodificoum, respectively, whereas zinc phosphide resulted in only a 39.5% reduction in vole activity. Since these materials have been shown to be similarly lethal under laboratory conditions, the results suggest that either voles respond differently to these rodenticides under field conditions (initial bait acceptance differs) or that degradation of the individual pellet-types differs under field conditions with the anticoagulants remaining viable for a longer period.

Lastly, the results from this study suggest that application of rodenticides need not be carried out prior to the onset of vegetation growth in early spring. In this instance, a 30% reduction in vole activity was recorded for the orchard treated on 2 April whereas vole activity was reduced by 70.2% in the orchard treated 30 April. Indeed, it appears from this study that treating an orchard with rodenticide later in the season may be more effective for controlling voles than an earlier rodenticide treatment. The results seen here offer encouragement that broadcast treatments applied later in the fall should be reexamined as a method for delivering toxic baits. In addition, because the two anticoagulants tested in spring were so effective, the long range efficacy of these materials should be examined by monitoring treated populations into early winter or even the subsequent spring to obtain a measure of efficacy over the critical winter period.

LITERATURE CITED

Cengel, D.J., J.E. Estep, and R.L. Kirkpatrick. 1978. Pine vole reproduction in relation to food habits and body fat. J. Wildl. Manage. 42(4):822-833.

Chempar. Maki (Bromodiolone): Rodenticide technical bulletin. Chempar, Div. of Lipha Chemicals, Inc., New York, NY. 9 pp.

ICI Americas, Inc. Volid rodenticide: Technical information. ICI Americas, Inc., Agricultural Chemicals Div., Goldsboro, NC. 3pp.

McAninch, J. 1982. The efficacy of several broad-cast rodenticides in the mid-Hudson Valley, New York. Final Completion Report, Carey Arboretum, New York Botanical Garden. 21 pp.

Richmond, M., M. Dunlay, and R. Stehn. 1978. Efficacy data for baits prepared as candidate orchard vole control agents. Proc. Pine and Meadow Vole Symp. 2:52-60.

Steblein, P.F. and M.E. Richmond. 1982. Rodenticide evaluation in the Hudson Valley during 1980 & 1981. Proc. Pine and Meadow Vole Symp. 6:33-38.