Title
Current improvements in baiting pine and meadow voles

Journal
Proceedings of the Vertebrate Pest Conference, 10(10)

ISSN
0507-6773

Authors
Byers, Ross E.
Merson, M. H.

Publication Date
1982

CURRENT IMPROVEMENTS IN BAITING PINE AND MEADOW VOLES

ROSS E. BYERS and M.H. MERSON, Department of Horticulture, Winchester Fruit Research Laboratory, College of Agriculture and Life Sciences, Virginia Polytechnic Institute and State University, Winchester, Virginia 22601

ABSTRACT: Excellent control of pine voles (Microtus pinetorum) and meadow voles (M. pennsylvanicus) was achieved with several commercially pelletized anticoagulant baits applied as single hand-placed or broadcast treatments. A new pelletized formulation of zinc phosphide (Zn_3P_2) was shown to kill approximately 30% more voles when compared to another surface-coated 2% Zn_3P_2 corn-and-oat formulation. Hand-placed cellophane or plastic-packaged rodenticides were effective when placed in vole runways under cinder blocks and split tires.

INTRODUCTION

Surface-coated zinc phosphide (Zn_3P_2) grain bait, applied by hand in vole trails or broadcast on the surface at 6-11 kg/ha, has been a standard practice for meadow vole control for many years. This method, however, was not sufficiently effective against pine voles (Byers, et al. 1976). For this reason, ground-cover sprays of endrin (Horsfall 1956 a,b) and chlorophacinone (Horsfall et al. 1974) were developed in 1956 and 1970, respectively. After approximately 10 years of annual endrin use, a pine vole strain was found which was approximately 10 times more resistant to endrin than voles collected from untreated orchards (Webb and Horsfall 1967). This discovery led to a better understanding of the failure of endrin in orchards where growers were previously satisfied with endrin. Chlorophacinone was cleared under state labels at the lowest effective rate (0.22 kg/ha) since this anticoagulant was expensive to produce and formulate. Inconsistent results obtained in subsequent years were probably the result of 1) choosing a rate too low for average orchard conditions, 2) differences in ground-cover plant communities resulting in less exposure to voles (i.e., bluegrass sod - no surface trails), 3) poor application technique, and/or 4) rainy weather soon after treatment (Byers 1975, Byers et al. 1976, Byers 1978).

Currently the future of ground-cover sprays for microtine control is not bright. Chemicals chosen must have a high level of mammalian toxicity in order for active ingredient rates to be sufficiently low for chemical production and formulation costs. Persistence on the ground cover is a desirable feature for control of invading animals, but not desirable when primary nontarget hazards are a consideration. Active ingredient rates for ground-sprayed chemicals may require 100-400 times more chemical than baits formulated for hand-placement or broadcast treatments; thus, any new chemical will likely be too expensive for practical use. Ground-spraying also requires more expensive equipment, higher energy, labor, and water requirements than broadcast-baiting. Contaminated containers and spills into streams and ponds, even though accidental, will likely be a consideration in the clearance of any new ground-spray material.

A major shift in research led to the evaluation of hand-placed anticoagulant baits for pine vole control (Byers 1978, 1981, Byers et al. 1982). Recent laboratory and field evaluations of at least one Zn_3P_2 pelleted formulation has shown wide differences in mortality when compared to surface-coated grain baits (Merson and Byers 1981, Byers et al. 1982). Broadcast treatments of anticoagulant baits showed that rates of 22 kg/ha of a 0.005% chlorophacinone bait would give excellent control (Byers 1978). Further, studies eventually indicated that low rates of the acute anticoagulant (brodifacoum) gave excellent control and the pelletized ZP rodent bait from Bell Laboratories was much superior to surface-coated Zn_3P_2 grain formulations. The idea that pine voles would not sufficiently surface to contact broadcast baits was proved to be wrong.

The apple industry within the last 10 years has utilized ground-cover sprays, cultivation and herbicide banding, hand-placed and broadcast bait treatments for the control of pine voles. This report will summarize the results of significant field and laboratory experiments on this important pest.

MATERIALS AND METHODS

A method for rapid censusing of vole activity (apple indexing) was used in combination with exhaustive dead-trapping at the termination of each experiment (Byers 1981). The apple-indexing technique used the consumption of strategically-placed apples as a means of censusing the vole activity in the animals' runway system. This method required little equipment, did not depend on highly-skilled labor and allowed the monitoring of a large number of plots within a single 24-hour period.

Ideally, each plot consisted of 48-54 trees per plot (4 rows wide and 12 trees long, or 3 rows wide and 18 trees long) with the interior 12 trees used for data collection and dead-trapping. This plot design allowed 1 border row between plots and 3 border trees between the plots within the row. Prior to treatment of each plot, 2 activity sites were established by selection of the most active runs and holes within the drip line of the tree and covered with a one-third asphalt shingle. Whenever a rather low population existed, some of the interior trees which were not infested were skipped. Plots of this nature were increased in size in such a manner that approximately 12 interior trees had sites which appeared active upon first placement of apple monitor sites.

Whole apples with a 3-4 cm diameter sector removed from the cheek were placed at each site. After 24 hours the apples were checked for vole tooth marks, and the activity was recorded as "high" or "slight."

The classification "high" is given to apples having a semisphere of 2.5 cm removed from the apple. Each preactivity reading from each plot was ranked from high activity to low activity and assigned to blocks. Each treatment was then randomized within each block. Treatment effects were monitored at various intervals after treatment using the apple-indexing technique. After approximately 3 weeks each experiment was terminated with a dead-trapping of active sites for a 5 day period.

A cultural experiment was initiated at the West Virginia University Experiment Farm with Dr. Roger Young in July 1974 (Byers and Young 1978). Three replicates of approximately 40 trees per plot for each treatment were arranged in a randomized complete block design. Treatments were as follows: 1) control - mowed only, 2) cultivation + residual herbicide (July + November), 3) cultivation (November only), 4) cultivation (May, July, and November), and 5) herbicide only (July). The herbicide strip was made the same width as the cultivation strip (3 meters wide). Since the trees were planted 6 x 6 meters, only one monitor site was used per tree.

Broadcast and hand-placed treatments were applied to mature apple tree plantings with trees spaced at 90 trees/ha (Table 1). Interior plot monitoring was based on 12-30 trees depending on vole activity.

Table 1. Field evaluation of broadcast and hand-placed rodenticides for pine vole control in orchards treated November 14-15, 1979 (from Byers et al. 1982).

Treatment	Rate (kg/ha)	Rate (lbs/A)	% Activity[y] Nov. 9	% Activity[y] Nov. 30	Voles/plot (Dec. 3-7)	Voles/site (Dec. 3-7)	% Control
1. Control	--	--	89 a[z]	87 a	31.7 a	1.25 a	--
2. Volid[w] -- 0.005% BFC	21	19	88 a	15 def	0.7 d	0.03 d	98
3. Volid[w] -- 0.0025% BFC	20	18	85 a	6 ef	0.3 d	0.01 d	99
4. Volid[w] -- 0.001% BFC	19	17	88 a	5 ef	0.7 d	0.02 d	98
5. Volid[w] -- 0.005% BFC	29	26	85 a	5 ef	0.3 d	0.02 d	98
6. Volid[x] -- packet 0.005% BFC	8	7[x]	87 a	4 ef	1.0 d	0.03 d	98
7. Rozol[w] -- 0.005% CPN (French)	25	22	88 a	0 f	0.3 d	0.01 d	99
8. Rozol[w] -- 0.005% CPN (USA)	24	21	88 a	33 bcd	2.7 d	0.11 d	91
9. Maki[w] -- 0.005% BDL	22	20	87 a	44 bcd	4.7 cd	0.19 cd	85
10. Ramik[w] -- 0.005% DPN	24	21	84 a	51 bc	6.0 cd	0.24 bcd	81
11. Ramik -- 0.005% DPN	11	10[x]	85 a	40 bcd	10.7 bc	0.41 bc	67
12. ZnP[w] -- 2% Corn + Oats	21	19	85 a	67 ab	14.0 b	0.49 b	61
13. ZnP -- 2% Corn + Oats	6	5[x]	85 a	59 abc	11.0 bc	0.42 bc	66
14. ZnP[w] -- 2% Pellet	28	25	89 a	29 cde	2.7 d	0.10 d	92
15. ZnP -- 2% Pellet	6	5[x]	89 a	19 def	1.7 d	0.07 d	94

[w]Treatment was broadcast in a band under tree limbs.

[x]Treatment was hand-placed at two locations under shingles at each tree.

[y]Apples placed in 2 holes or runs 5 - 15 cm below the soil surface on opposite sides of the tree trunk were examined 24 hours after placement. Percent activity refers to all sites with vole tooth marks on the apple.

[z]Mean separation, within columns by Duncan's multiple range test, 5%. Three replicate plots per treatment.

A comparison of split tires or cinder blocks as site covers for placement of plastic-package bait was conducted in a mature planting with 48 trees/acre and one monitoring site per tree. Each treatment was replicated 3 times with 40 sites/replicate plot.

RESULTS

Cultivation after harvest (Fig. 1, treatment 2) caused a significant reduction in vole activity in 1974, 1975 and 1976. In 1974 the effect was short lived and the activity rise was probably related to vole colonies re-establishing their runway system. The disruption of the ground cover and existing trail system also made hand baiting more difficult. Ground-cover sprays and broadcast-baiting of the cultivated strip would also be impaired, but control may be achieved if toxicants are applied to the 1-meter strip of vegetation adjacent to the cultivated strip.

The bare-soil treatment developed by a residual herbicide strip in July (treatment 3) was of little value for control of an existing pine vole population in 1974, 1975 or 1976. These results are in contrast to a previous experiment in which bare soil maintained with herbicides prevented the establishment of a pine vole population.

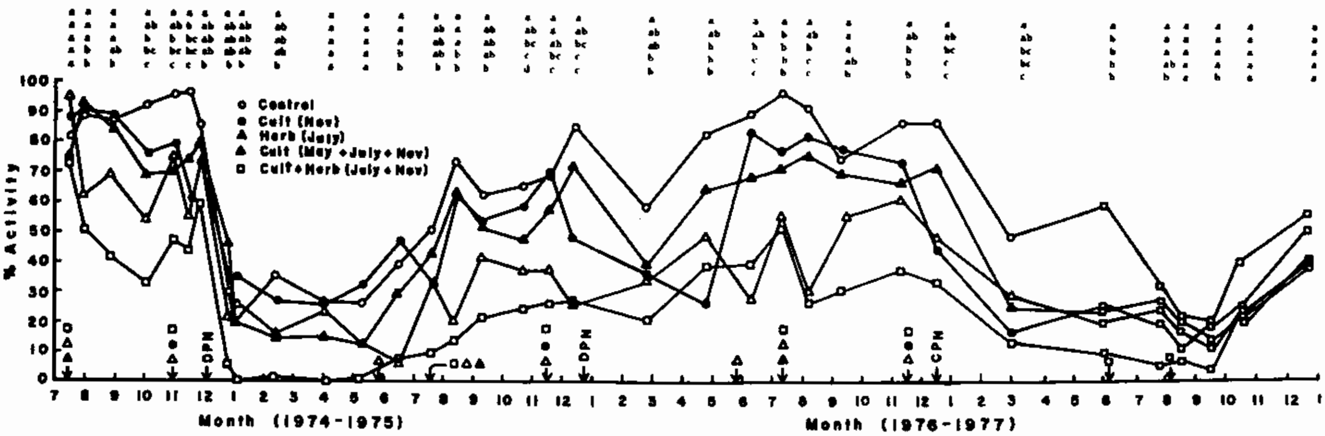

Fig. 1. Effect of orchard culture, DPN, and CPN hand-placed baits on pine vole activity. Point separation within columns by Duncan's multiple range test, 5% (from Byers and Young 1978).

Three cultivations per year (treatment 4) caused significant reductions in vole activity in 1974, 1975 and 1976. Cultivation plus residual herbicide application (treatment 5) was the most successful treatment for reducing vole activity.

Broadcast treatments of BFC at active ingredient levels from 0.005% to 0.0005% gave excellent control of pine voles (Table 1). Cellophane place packs of 0.005% BFC containing 70 g of bait gave excellent control (treatment 6). A grain-based 3.2 mm diameter 0.005% CPN pellet marketed in France appeared to give better control than the wax-based 4.8 mm diameter pellet currently sold in the USA markets. The hand-placed and broadcast treatments of a pelleted Zn_3P_2 from Bell Laboratories (treatments 14, 15) were superior to surface-coated grain baits (treatments 12, 13).

Placement of BFC or Zn_3P_2 place packets under either split tires or cinder block stations in the spring of 1979, fall of 1979 and fall of 1980 did not completely control the animals. Some packets (5-15%) were not opened after each baiting even though voles were known to be present by apple indexing (Fig. 2). We feel that sufficient numbers of animals existed to continue to supply animals in the area in both years as indicated by the high number of packets opened (Fig. 2). Place packs did not reduce the number of hand-placed treatments necessary but a low population level was maintained over a long period of time. Place packs under cover may be quite useful for perimeter baiting or maintenance of bait under snow cover when invasion from surrounding areas are a potential hazard.

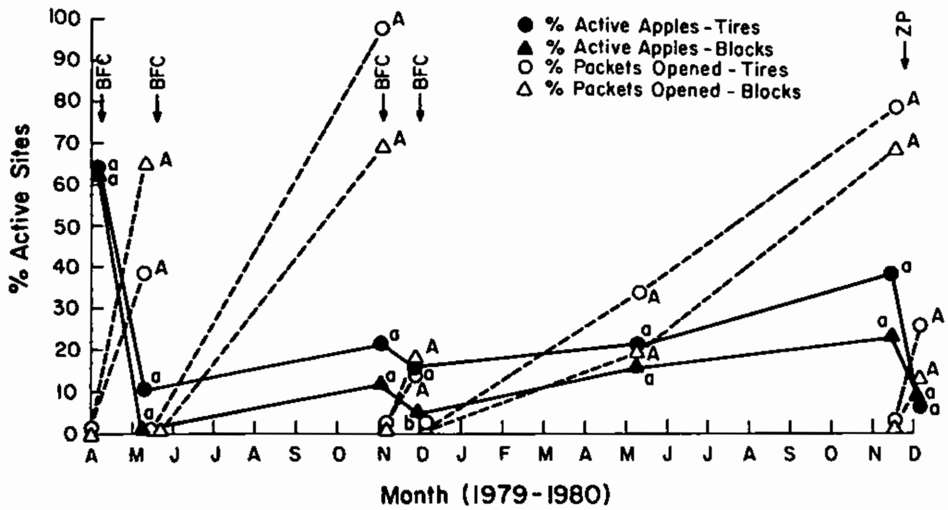

Fig. 2. Effect of BFC or ZP packets on % active apples in a 24-hour period (——) and % of packets opened (---) when replacement packets were placed under split tires or cinder blocks. Mean separation by date by Duncan's multiple range (5% level) for either % packet opening (A, B) or % active apples (a, b) (from Byers et al. 1982).

One serious failure of broadcast-baiting we believe may be related to the ground-cover plant material. One orchard treated with ZP in the fall of 1981 had a bluegrass sod with a heavy thatch buildup. Vole runways were numerous under the thatch but no runways came to open-ended runways similar to what is normally found with clump-type grasses such as orchard grass or Kentucky 31 fescue. The treatment had little if any effect on the pine vole population. This experience appears to be similar to the failure of ground-cover sprays in bluegrass sod as suggested by Horsfall et al. (1974) for endrin and chlorophacinone.

DISCUSSION

The choice of control methods will firstly depend on the reliability of the control method and secondly its cost relative to other available methods. Currently both endrin and chlorophacinone materials are about $33 per ha plus $11 application costs. Broadcast rates of chlorophacinone (22 kg/ha), ZP rodent bait (11 kg/ha) and Volid (11 kg/ha) are approximately $22, $12, and $16/ha, respectively, for materials plus $3/ha for application costs. Hand-placed baits would cost about $10, $2 and $10, respectively, plus $4 application cost per ha. The advantage to broadcast application is the rapid coverage of large tracts of land in short time periods. Experience has shown that good weather is essential for 2-3 days after broadcast applications so that the voles will find sufficient quantities of bait. Control with hand-placement of bait under covers is not as affected by wet weather as are broadcast baits (Byers 1981).

LITERATURE CITED

BYERS, R.E. 1975b. Effect of hand baits and ground sprays on pine vole activity. HortScience 10:122-123.

BYERS, R.E., R.S. YOUNG and R.D. NEELY. 1976. Review of cultural and other control methods for reducing pine vole populations in apple orchards. Proc. 7th Vert. Pest Conf., Monterey, Calif. p. 242-254.

BYERS, R.E. 1978. Performance of rodenticides for the control of pine voles in orchards. J. Amer. Soc. Hort. Sci. 103:65-69.

BYERS, R.E. and R.S. YOUNG. 1978. Effect of orchard culture on pine vole activity. J. Amer. Hort. Sci. 103:625-626.

BYERS, R.E. 1981. Pine vole control with anticoagulant baits in orchards. J. Amer. Soc. Hort. Sci. 106:101-105.

MERSON, M.H. and R.E. BYERS. 1981. Laboratory efficacy of some commercial zinc phosphide baits used for control of meadow and pine voles in orchards. HortScience 16:49-51.

BYERS, R.E., M.H. MERSON, and S.D. PALMATEER. 1982. Control of orchard voles with broadcast baits. J. Amer. Soc. Hort. Sci. (in press).

HARTGROVE, R.W. and R.E. WEBB. 1973. The development of benzyprene hydrolase activity in endrin susceptible and resistant pine mice. Pesticide Biochemistry and Physiology 3:61-65.

HORSFALL, FRANK, JR. 1956a. Pine mouse control with ground-sprayed endrin. Proc. Amer. Soc. Hort. Sci. 67:68-74.

______________. 1956b. Rodenticidal effect on pine mice of endrin used as a ground spray. Science 123:61.

______________, R.E. WEBB and R.E. BYERS. 1974. Dual role of forbes and rodenticides in the ground spray control of pine mice. Sixth Vert. Pest Conf., Anaheim, Calif. 112-125 p.

WEBB, R.E. and F. HORSFALL, JR. 1967. Endrin resistance in the pine vole. Science 156:1762.

________, W.C. RANDOLF and FRANK HORSFALL, JR. 1972. Hepatic benzpyrene hydroxylase activity in endrin susceptible and resistant pine mice. Life Science 11(2):477-483.