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Zia Siddiqi
Chemical Research International, Toronto, Ontario, Canada

W. D. Blaine
Chemical Research International, Toronto, Ontario, Canada

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Zia Siddiqi and W. D. Blaine
Chemical Research International
232 Norseman Street
Toronto, Ontario, Canada
M8Z 2R4

Abstract: A poisoned bait feeder station is being evaluated for a long term meadow vole control in Ontario apple orchards. This bait station can maintain a bait supply even under deep winter snow cover, commonly experienced in Ontario, when voles inflict extensive tree damage. Latest generation of acute anticoagulants, encapsulated zinc phosphide, and commercial formulation of zinc phosphide treated cracked corn bait in the bait stations are evaluated against the conventional broadcast application of the zinc phosphide treated cracked corn.

Introduction: Meadow vole, Microtus pennsylvanicus, is the most common field rodent found in Ontario and causes extensive damage to orchards and hardwood plantations (Radvanyi, 1974a, 1974b). The damage is usually most serious when their normal food supply is limited especially under deep snow cover during winter when occasionally voles breed (Brooks et al. 1976). The Ontario Ministry of Agriculture and Food (Ells and Hikichi, 1979) suggests that the orchards can be prevented by mowing the sods regularly, cleaning up trash from bases of fences, keeping ground clean around tree base, use of pitfalls, and especially protecting the young trees by galvenized wire mesh tree guards. Poisoned baits containing zinc phosphide, diphacinone, or chlorophacinone are commercially available. In the fall, before the ground is covered with snow, it is recommended to lightly distribute the bait just inside the drip line of the tree, in bait stations, or in a line along each side of the tree row. The bait may be distributed with a fertilizer or seed spreader. In problem orchards and where mice move in from adjacent fields or woods, repeated application of bait is necessary. Moist conditions will determine the choice and effectiveness of bait formulations. Under such prevailing conditions, especially under a deep winter snow cover, limiting control in the fall would be ineffective unless the voles were completely eliminated and there is no reinvasion. Therefore, the extended winter season and the possibility of winter breeding produce a major problem in

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vole control in Ontario (Brooks and Schwarzkopf, 1981).

During 1971 - 72 studies were carried out in southern Ontario to determine if the meadow vole population could be controlled successfully by broadcasting anticoagulant poisoned grain. This control method was effective only temporarily and rapid reinvasion and high rate of reproduction brought the population back to higher levels. In 1973, poisoned bait feeder stations were placed and found very effective in providing an inexpensive long term rodent control (Radvanyi, 1974a). These findings were again reported when the poisoned bait feeder stations reduced the tree girdling damage from 50 percent to 1 - 2 percent (Radvanyi, 1980). The advantages of this type of feeder were described in detail by Radvanyi (1974a).

This 3-year study is being carried out to evaluate the effectiveness of the Radvanyi type poisoned bait feeder stations for a long term meadow vole control in Ontario apple orchards and also to evaluate some of the acute anticoagulants as compared to the conventional broadcast application fo 2% zinc phosphide treated cracked corn in the fall.

Methods and Materials: Four heavily vole infested apple orchards were selected to conduct studies on control of meadow voles. The orchards are located in Orono, Region of Durham; in Norval, Region of Peel; in Milton, Region of Halton; and in Belwood, Region of Wellington. The inverted "T" type bait stations were constructed by using a schedule 20 ABS plumbing pipe of 4 cm diameter, an ABS vent tee, and an ABS test cap for covering the bait station. The bait station measured 60 cm high and the two outer sides of 30 cm each. The outer ends were cut at 45° angle to give a canopy effect. The caps were sprayed with a fluoroscent orange paint for ease in locating the stations. The bait stations were placed at a rate of 25/hectare and held by a plastic tie to a 2.5 cm wide wooden peg driven about 30 cm deep into the ground. A large wide mouth plastic funnel was used to fill the stations. The bait stations were placed in such a fashion that these do not interfere with other orchard operations. An experimental plot at least consisted of 60 trees in 6 rows 10 trees long, and the middle five trees in the centre two rows are used for data collection purposes. The area of plots varied from location to location according to the tree spacing which ranged from 5m to 10 m. There are 4 - 5 rodenticide treatments at each location with three replications in a randomized block design. The following rodenticides are being evaluated in the bait stations: (i) Bromadiolone, 0.005%, in oat groats; (ii) Brodifacoum, 0.005%, in pellets; (iii) Chlorophacinone, 0.005%, in oat groats; (iv) Encapsulated Zinc Phosphide 2%, in oat groates (Hooker Chemicals); and the Waxed Mouse Bait 2, the conventionally used product containing 2% zinc

phosphide in cracked corn. The control treatment consisted of the conventional broadcast application of the Waxed Mouse Bait 2 at a rate of 15 kg/ha. The amount of bait per station varied from 500 to 800 gm depending upon the formulation. Vole population in the experimental plots before the bait station placement was estimated by live trapping fo 5 consecutive days. A modified Sherman type live trap was used (Radvanyi, 1978) with a bait consisting of rolled oats, walnuts, raisins, ground beef, peanut butter, and corn syrup. The trap was also provided with a ball of cotton and a slice of apple. Ten traps were used in each plot. Trapped animals were marked by toe clipping and released. Exhaustive snap trapping was conducted after 30 days of station placement. The bait stations are monitored at regular intervals and refilled, as and when necessary, to maintain the bait supply. Further estimation of vole population will be carried out in spring and fall of 1982 to draw conclusion on effectiveness of the bait stations and the anticoagulants on long term meadow vole control in Ontario apple orchards.

Results and Discussion: At this point in time the collected data has not been statistically analyzed. The live trapping indicated that other than Microtus pennsylvanicus, Sorex cinerus were present at two locations (Orono and Milton) and Peromyscus maniculatus at one location (Belwood) where no voles were captured. The rodenticide treatments, rate of application, number of voles/plot (live trapped), and number of voles/site (snap trapped) are presented in Table 1 for Orono, in Table 2 for Norval, in Table 3 for Milton, and in Table 4 for Belwood. The snap trapping data shows less voles/site in all broadcast treatments showing its immediate effect in reduction of vole population. The cost of constructing 25 bait stations needed to cover one hectare was calculated at approximately $60.00 which does not include labor. (Table 5). Table 6 presents the cost comparison of single application of the commercially available rodenticides through the conventional broadcast application to the application of the same product when used through the poisoned bait feeder stations (single filling). It is assumed that one filling may last for 3 - 4 months and the bait station may last for about 5 years.

Table 1. Number of Microtus pennsylvanicus at Orono, Ontario, 1981.

Treatments	% a.i.	Rate kg/ha	Voles/Plot (Schnabel) Oct. 26-30	Voles/Site Nov. 30-Dec. 2
1. Waxed Mouse Bait 2*	2	15	67	0.4
2. Encapsulated ZP	2	12	51	0.5
3. Bromadiolone	0.005	12	40	0.7
4. Brodifacoum	0.005	20	36	0.6
5. Chlorophacinone	0.005	12	57	0.6

*Broadcast application

Table 2. Number of Microtus pennsylvanicus at Norval, Ontario, 1981.

Treatments	% a.i.	Rate kg/ha	Voles/Plot (Schnabel) Nov. 2-6	Voles/Site Dec. 3-5
1. Waxed Mouse Bait 2*	2	15	26	0.3
2. Waxed Mouse Bait 2	2	12	83	0.7
3. Brodifacoum	0.005	20	76	0.6
4. Bromadiolone	0.005	12	80	0.4
5. Chlorophacinone	0.005	12	69	0.5

*Broadcast application

Table 3. Number of Microtus pennsylvanicus at Milton, Ontario, 1981.

Treatments	% a.i.	Rate kg/ha	Voles/Plot (Schnabel) Nov. 5-9	Voles/Site Dec. 7-9
1. Waxed Mouse Bait 2*	2	15	52	0.8
2. Waxed Mouse Bait 2	2	12	36	1.1
3. Encapsulated ZP	2	12	50	0.8
4. Bromadiolone	0.005	12	28	1.3

*Broadcast application

Table 4. Number of Peromyscus maniculatus at Belwood, Ontario, 1981.

Treatments	% a.i.	Rate kg/ha	Deer Mice/Plot (Schnabel) Nov. 9-13
1. Waxed Mouse Bait 2*	2	15	8
2. Waxed Mouse Bait 2	2	12	12
3. Brodifacoum	0.005	20	3
4. Chlorophacinone	0.005	12	8
5. Bromadiolone	0.005	12	9

*Broadcast application
Note: Snap trapping could not be carried out due to snow cover.

Table 5. Material cost of constructing 25 bait stations needed to cover one hectance

Materials	Cost* $
ABS Pipe Sch. 20, 4 cm diam.	32.00
ABS Vent Tee	15.00
ABS Test Cap	5.00
Glue	2.50
Wooden Pegs	3.25
Plastic Ties	1.00
Total	$ 58.75

*Excluding labor.

Table 6. Cost comparison of using commercial available rodenticides as conventional broadcast method and in the bait stations

Rodenticides	Broadcast Single Application $/ha*	Single Filling of Bait Stations $/ha*[1]
1. Waxed Mouse Bait 2 (Zinc Phosphide)	11	12
2. Ramik Brown (Diphacinone)	33	40
3. Rozol (Chlorophacinone)	40	48

*Does not include labor.

1. Does not include cost of bait stations @ about $60/ha, a one time investment for about 5 years.

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