ZINC PHOSPHIDE AND PROLIN FOR CONTROLLING PRAIRIE VOLES IN VIRGINIA PINE PLANTATIONS[1]

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Damage to forest plantations, fruit orchards, and nurseries by mice of the genus *Microtus* has caused serious economic losses, particularly in northern and eastern North America (Cayford and Haig 1961; Jokela and Lorenz 1959; Libby and Abrams 1966; Littlefield, Shoomaker, and Cook 1946; Sartz 1970). In southeastern United States damage to plantations of pines is increasing in importance. Two species of *Microtus,* the prairie vole *(Microtus ochrogaster)* and the pine vole *(M. pinetorum),* are widely distributed and capable of inflicting serious damage.

This paper reports on the results of a field test designed to study the usefulness of two rodenticides for controlling prairie voles in Virginia pine plantations in Tennessee. The specific formulations tested were (1) whole oat *(Avena sativa)* groats coated with 1.5% and 1.0% solutions of zinc phosphide, and (2) water repellent paper tubes with an inner lining of cracked corn *(Zea mays)* treated with Prolin, an anticoagulant poison (0.05% warfarin and 0.05% sulfaquinoxaline).

METHODS AND MATERIALS

The study was conducted in a 7-acre plantation of Virginia pine *(Pinus virginiana)* located about five miles southwest of Crossville, Cumberland County, Tennessee. The plantation was established as a progeny test in February, 1967 with seedlings grown in 1966. Pine trees ranged from 2 to 6 feet in height, and about 1 to 4 inches in diameter at ground level during the study period. The site was an abandoned pasture with a moderate stand of fescue *(Festuca* sp.) and other grasses at the time of planting. Prairie voles were observed in the field at the time of planting, and were abundant in surrounding fields and older plantations. Two 1-acre study plots were established within the plantation in November, 1969. An additional 1-acre study plot was established in October, 1970.

Rodenticide application. Separate tests of zinc phosphide treated baits were conducted in the winters of 1969-70 and 1970-71. Depredations by voles were severe throughout the progeny test area in 1969, and immediate reduction of the population was necessary to prevent excessive losses of the experimental trees. Oat groats treated with 1.5% zinc phosphide were applied with a cyclone seeder at a rate of 10 pounds per acre. This application was made over the entire 7-acre area on January 9, 1970.

In the winter of 1970-71, each of three 1-acre plots was treated differently. One plot was treated with oat groats and zinc phosphide as in the previous year. A second plot was treated with Prolin mouse tubes distributed by hand in a grid pattern; each tube was 15 feet from its nearest neighbor. A third plot was retained as a control with no poison applied. The treatments were applied on November 14, 1970.

Population estimation. Population densities of voles on the study plots were estimated with the aid of live traps.

During winter of 1969-70, vole densities were estimated from trapping data using a method described by Eberhardt (1969). In 1970-71, live traps again were

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used to obtain population data for evaluating the success of the treatments. Total number of individuals captured during each trapping session was used to obtain pre-treatment and post-treatment means for each plot. Statistical comparison of these means utilized the t-test.

RESULTS

Zinc phosphide (1.5%) - 1969.

In 1969 an estimate of the vole population density was made approximately six weeks prior to application of the rodenticide. Densities on two 1-acre study plots were estimated at 114 and 111 voles per acre. Vole populations on the plots one month and three months following application of the rodenticide were too sparse to obtain reliable estimates using the method described by Eberhardt (1969). The sharp reduction in vole numbers was believed due to the treatment.

Zinc phosphide (1.0%) and Prolin tubes - 1970.

In September, 1970 vole densities of 95 to 117 animals per acre were present on the study area. However, it became apparent that repeated trapping over short time intervals created trap-response biases which precluded the use of capture-recapture information for expanding population estimates. Consequently, my evaluation of the effectiveness of the treatments was based on numbers of individuals captured before and after treatment rather than on estimates of population density expanded by using capture-recapture information.

Data presented in Table 1 indicate that both zinc phosphide and Prolin mouse tubes were effective in reducing vole populations. Mean numbers of individuals captured following treatment were significantly different ($P<0.05$) than pre-treatment means on both treated plots. Mean number of individuals captured on the untreated check plot did not vary significantly over the test period.

DISCUSSION AND CONCLUSIONS

Significant reduction of numbers of prairie voles was accomplished through the application of both zinc phosphide and tubes containing the anticoagulant poison, Prolin.

Of the two rodenticides tested in 1970, Prolin tubes produced the greater and more rapid reduction of the prairie vole population. The major proportion of the reduction occurred within four days following placement of the tubes on the study plot. These data suggest that this anticoagulant poison can be used in a single-application type of control program, rather than being restricted to a maintenance type of program with periodic replacement of baits as is usually recommended for anticoagulant poisons. The Prolin tubes were found and utilized quickly by the prairie voles. Within four days after placement, 47 of 50 tubes examined had been utilized; many of them were nearly devoid of bait material.

In 1969, reduction of the vole population was effectively accomplished with one application of 1.5% zinc phosphide at a rate of 10 pounds of bait per acre. The number of voles on the plot treated with 1.0% zinc phosphide in 1970 was significantly reduced also ($P<0.05$), but this rodenticide seemed less effective than Prolin, and also was less effective than the 1969 application of 1.5% zinc phosphide. I conclude that its high degree of effectiveness, coupled with its relatively low cost of application, make oat groats treated with 1.5% zinc phosphide a suitable rodenticide for use in extensive forest plantations.

Reduction in the vole population was temporary (over-winter), but sufficiently long in duration to protect the plantation from damage for the critical winter period when feeding depredations by the voles are most frequent. However, neither a single application of zinc phosphide on a grain bait nor

Prolin tubes will give permanent protection to a young pine plantation through the 3 to 7 year period when it is susceptible to vole damage.

LITERATURE CITED

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Table 1. Numbers of prairie voles captured in live traps on the study plots, September-December, 1970.

Date	Treatment Prolin tubes	Zinc phosphide	Control
Pre-treatment			
September	35	- -	44
October	30	50	49
November (11-14)	28	39	36
Mean	31.0	44.5	43.0
Post-treatment			
November 17-20	4 a	7	35
December	0	9	19
Mean	2.0	8.0	27.0

a Two of these animals died in live trap. Cause of death appeared to be internal hemmorhage, symptomatic of anticoagulant poisoning.