Efficacy of Zinc Phosphide and Strychnine for Black-tailed Prairie Dog Control

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Abstract

Three rodenticide treatments, zinc phosphide (prebaited) and strychnine (both with and without prebait), were evaluated immediately following treatment for efficacy of controlling black-tailed prairie dogs in western South Dakota. Active prairie dog burrows were reduced 95% with zinc phosphide, 83% with strychnine (prebaited), and 45% with strychnine without prebait. Zinc phosphide was the most effective in reducing active burrows of prairie dogs.

The black-tailed prairie dog (*Cynomys ludovicianus*) inhabits prairie regions of the western United States from Canada to Mexico, east of the Rocky Mountains and west of the tall grass prairie (Hall 1981). Prairie dog towns often encompass vast areas. Because prairie dog feeding and burrowing activities conflict directly with interests of ranchers and range managers, widespread control programs using rodenticides were begun in the late 1800's on the Great Plains (Merriam 1902). Prairie dogs are still considered a problem when they compete with cattle for forage plants (Hansen and Gold 1977). Most recent prairie dog control programs on federal, state, and private lands consist of poisoning prairie dogs with zinc phosphide on rolled oats after prebaiting with rolled oats (Schenbeck 1982).

Zinc phosphide has been widely used as a rodenticide since 1942-43 when strychnine supplies became limited during World War II (Timm 1983). More recently, zinc phosphide formulation and application rates have been developed for use in prairie dog control (Tietjen 1976). Strychnine has been used for prairie dog control since the late 1800's (Merriam 1902). These two rodenticides are widely used for prairie dog control throughout the western United States. However, comparative information of these two rodenticides for effective control of black-tailed prairie dogs has not been reported. This investigation was undertaken to compare the efficacy of rodenticides zinc phosphide (pre-baited) and strychnine with and without prebaiting for controlling black-tailed prairie dogs in western South Dakota.

Study Area

The study area was approximately 13 km south of Wall on the Buffalo Gap National Grasslands and Badlands National Park in west-central South Dakota. Climate was semiarid-continental and characterized by cold winters and hot summers. The average annual precipitation, based on climatological information over a 12-year period (1972-1983) from the weather station at Cedar Pass Visitor Center, Badlands National Park, was 40 cm. Most precipitation fell during the growing season as high-intensity thunder-

showers, which produced a wide range of amounts and intensities of rain for any given location. The mean annual temperature was 10° C, ranging from -5° C in January to 26° C in July.

Dominant grasses on the study area were blue grama (*Bouteloua gracilis*), buffalograss (*Buchloe dactyloides*), needleleaf sedge (*Carex eleocharis*), and western wheatgrass (*Agropyron smithii*). Scarlet globemallow (*Sphaeralcea coccinea*), prostrate bigbract verbena (*Verbena bracteata*), Patagonia Indianwheat (*Plantago patagonica*), and prairie dogweed (*Dyssodia papposa*) were major forbs.

Bison (*Bison bison*), pronghorn (*Antilocapra americana*), and mule deer (*Odocoileus hemionus*) were large herbivores which grazed in the Badlands National Park throughout the year. Cattle on the National Grasslands grazed the area from mid-May to the last of October each year. Stocking levels varied depending upon moisture and available forage. Mule deer and pronghorn grazed the National Grassland throughout the year.

Methods

Eighteen study sites were established on 15 prairie dog colonies that ranged in area from approximately 12 ha to 283 ha. Nine sites were untreated and 9 sites were treated with the rodenticides zinc phosphide (prebaited) and strychnine, with and without prebaiting; thus, each rodenticide treatment had 3 control and 3 treated sites. The 3 rodenticide treatments were clustered into 3 separate groups, approximately 13 and 16 km apart. Zinc phosphide treatments were applied to sites in the Badlands National Park because of administration constraints against the use of strychnine in such areas. The other 2 treatment groups, strychnine with and without prebaiting with steam-rolled oats, were assigned randomly to the 2 remaining clusters on the National Grasslands.

Steam-rolled oats from the U.S. Fish and Wildlife Service's Pocatello Supply Depot were used for both prebait and carrier. A 2.0% by weight active zinc phosphide and 1.5% Alcolec S¹ adhesive were applied to the oats. Strychnine alkaloid was applied to the oats as 0.5% by weight. Nontreated oats were applied as prebait for zinc phosphide and for 1 of the strychnine treatments during September 20-21, 1983. Active rodenticides on steam-rolled oats were applied during September 22-24, 1983.

Pretreatment counts for active prairie dog burrows were taken on all sites 1 week before application of rodenticides. Posttreatment sampling on all sites began on the fourth day after rodenticides were applied.

Black-tailed prairie dog burrows within 100- × 100-m grids on all sites, including controls, were plugged with soil before and after treatment with rodenticides. The total number reopened in 48 hours was recorded (Tietjen and Matschke 1982). Data were analyzed as mean number of active prairie dog burrows per site.

Statistical Evaluation

Analysis of covariance was used to compare each treated group (cluster) of sites with its respective control group. Pretreatment observations were used as covariates. Effect of treatment was estimated as the covariance-adjusted difference between treated and control sites for each rodenticide. After rejecting the hypothe-

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This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate state and/or federal agencies before they can be recommended.

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¹The use of Alcolec S (American Lecithin Co., Inc.) name is for the benefit of the reader; such use does not constitute an official endorsement or approval of any service or product by the U.S. Department of Agriculture to the exclusion of others that may be suitable.

sis of no treatment effect, and determining that variance among clusters was heterogenous, each treatment effect contrast was evaluated for significance based on a variance estimated only from the sites in each cluster. Comparisons among rodenticides were produced by forming pairwise contrasts of individual rodenticide treatment contrasts. Randomization procedures (Edgington 1980, Romesburg 1981) based on 10,000 random permutations of the data pairs among treatment groups were used to estimate statistical significance of the various contrasts.

Because omission of any effect due to poisoning was considered more serious than the potential incorrect declaration of a significant treatment effect, Type II error protection was produced by testing each contrast individually. However, some Type I error protection was afforded by testing individual contrasts only after first observing a significant ($P=0.10$) overall test of treatment differences using analysis of covariance (Carmer and Swanson 1973). Individual contrasts were considered biologically significant at $P=0.20$. Although admittedly unconventional, for the number of sites available for study, this significance criterion produces a power (probability of detecting a true difference) of approximately 0.80 for a contrast twice as large as its standard error. This was considered a reasonable combination of Type I and Type II error protection for this study (Carmer 1976).

Results and Discussion

Adjusted means for the zinc phosphide treatment showed a 95% reduction in active burrows ($P=0.017$) of the black-tailed prairie dog when compared to the control (Table 1). The application of

Table 1. Active burrows of black-tailed prairie dogs (mean/ha $\pm$ standard error) for pre- and posttreatment with rodenticides on treated and control sites. Pretreatment was used as covariate to obtain adjusted post-treatment means.

Treatment	Pre-treatment	Post-treatment	Adjusted effect	Significance level (control vs. treated)
Zinc phosphide (with prebait)				
Treated	55 $\pm$ 16	2 $\pm$ 1		
Control	59 $\pm$ 9	49 $\pm$ 10	-45.5 $\pm$ 8.8	0.017
Strychnine				
Treated	42 $\pm$ 6	15 $\pm$ 10		
Control	25 $\pm$ 6	24 $\pm$ 1	-14.5 $\pm$ 8.3	0.164
Strychnine (with prebait)				
Treated	55 $\pm$ 7	7 $\pm$ 3		
Control	54 $\pm$ 21	30 $\pm$ 13	-23.5 $\pm$ 6.5	0.035

strychnine without prebaiting reduced active burrows 45% ($P=0.164$). Adjusted means for strychnine (prebaited) showed a reduction in active burrows of 83% ($P=0.035$).

Comparisons among rodenticides showed zinc phosphide was more effective in reducing active prairie dog burrows than was strychnine without prebaiting ($P=0.034$) and strychnine with prebaiting ($P=0.075$). However, there was no difference in reduction of active burrows between strychnine with and without prebaiting ($P=0.391$).

Among the 3 rodenticide treatments tested, application of zinc phosphide bait with prebaiting was the most effective in reducing active burrows of black-tailed prairie dogs. Tietjen and Matschke

(1982) reported a 96% reduction in prairie dog activity with the use of zinc phosphide on the Pine Ridge Indian Reservation in southwestern South Dakota. Prebaiting was more effective than without prebaiting when zinc phosphide was used as a control agent for black-tailed prairie dogs (Tietjen 1976). Strychnine without prebaiting was the least effective of the 3 rodenticide treatments in our study, and was more variable in reducing active burrows of prairie dogs. Furthermore, zinc phosphide has been considered the least damaging to nontarget animals (Bell and Dimmick 1975, Schitoskey 1975, Tretjen 1976), when compared to strychnine (Rudd and Genelly 1956, Schitoskey 1975, Hegdal et al. 1981, Wood 1965, Hegdal and Gatz 1977). Thus, the rodenticide zinc phosphide should be highly considered for black-tailed prairie dog control on western rangelands because of its efficacy and lesser impacts on nontarget animals.

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