# COMPARISONS OF STRYCHNINE AND ZINC PHOSPHIDE IN PRAIRIE DOG CONTROL

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## ABSTRACT

Efficacy and safety are primary considerations in registration and use of toxicants for vertebrate pest control. Strychnine (0.5%) and zinc phosphide (2%) are currently registered by EPA for prairie dog control, but continued registration is uncertain. Two percent zinc phosphide bait has been suspected of producing lower and more erratic results than strychnine bait. In our study in western Nebraska in fall 1984, indices based on changes in burrow activity showed no difference in efficacy ($\underline{P}$=0.66) or variability ($\underline{P}$=0.7) of control for strychnine and zinc phosphide, however neither toxicant consistently gave effective control of black-tailed prairie dogs. Costs for proper control (prebait and poison) were similar for strychnine and zinc phosphide. For clean-up of surviving prairie dogs, fumigation with aluminum phosphide was more effective than shooting and more cost effective than shooting combined with fumigation. Observed nontarget wildlife losses (4 horned larks and 2 lagomorphs) were small and of doubtful biological significance. Availability of both strychnine and zinc phosphide is part of the flexibility needed in an integrated approach to prairie dog control. Also, there is need for additional toxicants or methods that will give more consistently efficacious control.

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## INTRODUCTION

The black-tailed prairie dog (*Cynomys ludovicianus*) is an abundant rangeland pest of increasing concern to farmers and ranchers in the Great Plains. In western Nebraska, prairie dog populations increased approximately 60% between 1970 and 1980 (Nebraska Game & Parks, unpubl. data). Although little data are available since 1980, landowner complaints suggest that an upward trend has continued to the present. Notable increases also have been observed in other areas of the Great Plains (Fagerstone 1981).

Prairie dogs and associated grazing wildlife have been reported to reduce total forage availability to livestock by 24 to 37% on established prairie dog towns (Hansen and Gold 1977, O'Meilia 1980, Hyde 1981). However, prairie dogs increase the perennial grasses that are heavily utilized by livestock (Bonham and Lerwick 1976, Gold 1976, Coppock 1980). Since the effects vary among geographical areas and plant communities (Fagerstone 1981), there is no consensus on the amount of rangeland damage that is caused. In most situations economic loss is likely and long term rangeland damage is possible when substantial livestock grazing occurs on active prairie dog towns.

Poison grain bait is the most practical and cost effective technique for controlling prairie dogs (Boddicker 1983). Strychnine and zinc phosphide are the only toxicants currently federally registered for this purpose, although Compound 1080 was widely used in the past and is still used in Colorado for prairie dog control. In 1980 the U.S. Environmental Protection Agency (EPA) proposed cancellation of strychnine for prairie dog control (EPA 1980a, 1980b). The Scientific Advisory Panel reviewing EPA's recommendations on strychnine withheld support for cancellation in part because of uncertainty concerning zinc phosphide's efficacy. More recently EPA indicated intentions of suspending manufacture and sale of zinc phosphide baits manufactured under U.S. Fish and Wildlife Service labels because of failure to provide EPA with specific supportive data (Henderson 1984, R. Kelly USFWS pers. comm.).

Efficacy and safety are important considerations in future registration and use of toxicants for prairie dog control. An objective of this study was to test the efficacy of 0.5% strychnine and 2% zinc phosphide baits for prairie dog control. We also report on the value of various techniques for clean-up following poison grain treatments, costs associated with control operations, and potential hazards to nontarget wildlife.

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## METHODS

In fall 1984, 18 prairie dog towns from 1 ha to 8 ha in size were selected for study in the mixed-grass prairie of western Nebraska. Prairie dog populations were not determined, but towns contained 100 to 125 burrows/ha. Approximately one-third of all burrows were active. Prairie dog towns were located in Box Butte, Cheyenne, Morrill, Scotts Bluff, and Sioux counties.

The towns were randomly divided into 2 groups. Half were prebaited with untreated steam-rolled oats prior to application of steam-rolled oats treated with 2% zinc phosphide (U.S. Fish and Wildlife Service, Pocatello, Idaho). The remaining towns were prebaited with untreated whole oats prior to the application of whole oats treated with 0.5% strychnine alkaloid and containing a yellow dye (South Dakota Dept. of Agriculture, Pierre, South Dakota). All baits were fresh and in good condition. Baits were applied in the manner and at rates specified on the product labels. Clean-up of surviving prairie dogs was attempted with fumigation (aluminum phosphide, Phostoxin®, using 3 tablets per burrow entrance), shooting, or a combination of the two. Only burrows that apparently were active after toxic grain treatments were fumigated.

Prior to control, prairie dog towns were surveyed for nontarget wildlife and assessed for potential problems. Landowners were questioned about certain at-risk wildlife species occuring the vicinity of the study sites. No evidence of black-footed ferrets (Mustela nigripes) was found at any site. During the prebaiting activities, landowners were trained individually in the proper application of toxic bait. Within 10 days of prebaiting, the landowners applied the toxicant. During the 1 to 4-day period following bait application, towns were searched twice for dead nontarget wildlife. Subjective evidence was used in determining cause of death for any nontarget animals found. Necropsies were not conducted.

Percent burrow activity on each town was calculated by marking and plugging a sample of burrows and counting the number reopened. Efficacy was determined by the change in burrow activity before and after baiting (Boddicker 1983). Change in burrow activity was also recorded on 9 untreated sites.

## STATISTICAL ANALYSIS

Prairie dog towns for both the strychnine and zinc phosphide-treated groups were ranked by the percent reduction in burrow activity. A Wilcoxon Rank Sum test was used to compare efficacy of strychnine and zinc phosphide. Moses' test was used to determine if the variability in reduction of prairie dog activity was different for the two toxicants (Hollander and Wolfe 1973).

## RESULTS

There was no difference ($P$=0.66) in percent reduction of burrow activity between strychnine (median = 69, $\bar{X}$=69, $N$=9) and zinc phosphide (median = 66, $\bar{X}$=66, $N$=9) baits (Table 1, Figure 1). A small reduction in burrow activity was observed on the untreated towns (median = 2, $\bar{X}$=12, $N$=9). Standard deviations in the reduction of burrow activity were similar for strychnine (21.4%) and zinc phosphide (18.7%) treatments ($P$=0.7).

Shooting during fall and winter was an ineffective clean-up technique, removing less than 1 prairie dog per town. Shooting in combination with fumigation was less cost effective than fumigation alone because it added labor while removing few additional prairie dogs. Of the burrows that were fumigated ($N$=84), 12% were reopened by prairie dogs.

Cost of materials including prebait was $3.21/ha for strychnine and $2.15/ha for zinc phosphide treatments. The prebaiting and toxic bait application required 2.4 hrs/ha of labor. Clean-up fumigation with aluminum phosphide cost $0.60/burrow in materials and required 0.09 hrs/burrow of labor to find and fumigate the surviving prairie dogs. When labor costs were considered to be $5.00/hr, the total cost for control, including both labor and materials (prebaiting, toxic bait application, and fumigation) was $20.09/ha for strychnine treated towns and $19.03/ha for zinc phosphide treated towns.

The total area treated was 14.2 ha with strychnine and 20.2 ha with zinc phosphide. Three horned larks (*Eremophila alpestris*), a cottontail rabbit (*Sylvilagus floridanus*), and a blacktail jackrabbit (*Lepus californicus*) were found dead on strychnine treated towns, and 1 horned lark was found dead on a zinc phosphide treated town. Timing of mortalities and proximity of carcasses to toxic bait suggest that these animals died from consumption of toxic bait. Seven prairie dogs were found dead above ground on strychnine treated towns, and none were found on zinc phosphide treated towns. Although nontreated towns were not systematically searched, no dead nontarget wildlife or prairie dogs were observed on nontreated towns or on treated towns prior to application of the toxic bait.

STRYCHNINE

| % Reduction | Rank |
|---|---|
| 100 | 17.5 |
| 87 | 16 |
| 85 | 15 |
| 84 | 14 |
| 69 | 12 |
| 63 | 6 |
| 50 | 5 |
| 47 | 4 |
| 37 | 1.5 |

mean ($\bar{X}$) = 69
median = 69
rank sum = 91

ZINC PHOSPHIDE

| % Reduction | Rank |
|---|---|
| 100 | 17.5 |
| 83 | 13 |
| 68 | 10.5 |
| 68 | 10.5 |
| 66 | 9 |
| 65 | 8 |
| 64 | 7 |
| 44 | 3 |
| 37 | 1.5 |

mean ($\bar{X}$) = 66
median = 66
rank sum = 80

Table 1. Percent reductions in burrow activity and resulting nonparametric ranks for 0.5% strychnine and 2% zinc phosphide treated prairie dog towns in western Nebraska, fall 1984.

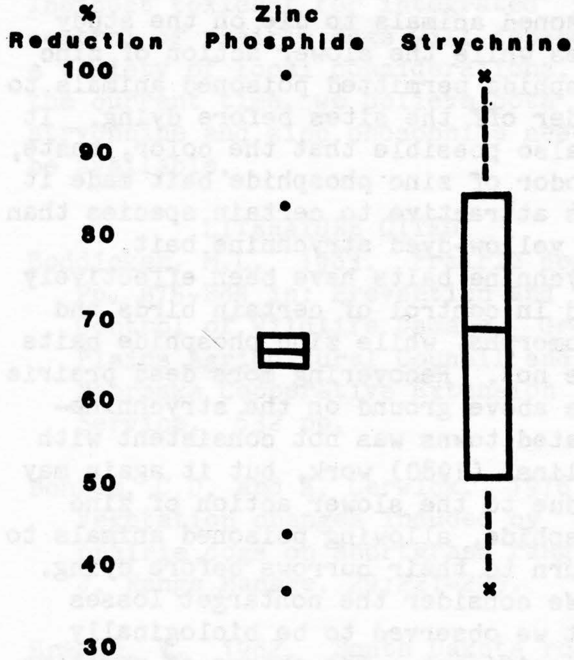


Figure 1. Distribution of percent reduction of burrow activity on strychnine (N=9) and zinc phosphide (N=9) treated prairie dog towns in western Nebraska, fall 1984. Inner horizontal bars represent medians and means, X's represent extreme data points, and dots represent distribution outliers. Three-quarters of the observations lie above the lower end of the box, and three-quarters lie below the upper end of the box for each treatment.

DISCUSSION

Efficacy, cost, and safety are important considerations when conducting prairie dog control using toxic baits. Previous research on strychnine and zinc phosphide baits for prairie dog control has demonstrated that under some conditions, both are capable of producing high levels of control. In Montana, reduction in black-tailed prairie dog activity for prebaited sites treated with 0.44% strychnine (N=3) and 2% zinc phosphide (N=3) baits averaged 96.7% and 84.9%, respectively (Sullins 1977, Record 1978). Subsequently, 2 sites were controlled similarly resulting in 95.7% and 95.6% reduction in activity for strychnine and zinc phosphide baits, respectively (Sullins 1980), where percent reduction in prairie dogs was estimated by visual counts conducted before and after treatments. In another Montana study without prebaiting, 2% zinc phosphide (N=1), 0.44% strychnine (N=1), and 0.05% 1080 (N=1) baits produced 30%, 57%, and 92% reductions in prairie dog activity, respectively (Swick 1976). In South Dakota, Brakke (1982) achieved 92% reductions using prebaiting followed by either strychnine or zinc phosphide bait. Tietjen (1976) obtained prairie dog reductions ranging from 77.2% to 96.2% (based on burrow activity) in Nebraska, Colorado, and Montana while using the currently recommended prebaiting and baiting practices with 2% zinc phosphide. Without prebaiting, his results with zinc phosphide ranged from 43.5% to 72.1% reduction. In Nebraska, Timm and Johnson (unpubl. data) achieved 72.7% control (N=1) using zinc phosphide without prebaiting, and 87.4% control (N=3) with zinc phosphide following prebaiting.

In our study, strychnine and zinc phosphide treatments gave poorer control than that obtained by Sullins (1977, 1980) in Montana, or in zinc phosphide trials by Timm and Johnson (unpubl. data) or by Tietjen (1976). Results were also variable from site to site. Our use of the burrow activity index, as compared to Sullins' (1980) use of visual counts of prairie dog activity, makes comparisons between these studies difficult. Both techniques give only an indication of population reduction, and actual percent control is unknown. Despite this limitation, ranking prairie dog towns by activity reduction was possible and use of nonparametric procedures were appropriate in evaluating and comparing efficacy.

Previous studies indicate that control may be less effective with zinc phosphide than with strychnine

(Boddicker 1983), and that zinc phosphide bait may produce more varied results than strychnine (Sullins 1980). Although both toxicants were of variable effectiveness, there was no difference ($P$=0.66) in efficacy between the 0.5% strychnine and 2% zinc phosphide treatments. Standard deviations of reduction in burrow activity for strychnine (21.4%) and zinc phosphide (18.7%), Moses' test for dispersion differences between these treatments, and the box plots (Figure 1) indicated similar variances for these toxicants. The high p-values imply that even with large sample sizes, no differences in efficacy or variability of control would be found.

For most situations present in western Nebraska, we regard a level of control greater than 80% to be adequate; in our study, this level of efficacy was obtained on only 4 of 9 strychnine treated sites and 2 of 9 zinc phosphide treated sites. Reduction in prairie dog activity was less than 50% on 4 of 18 sites (2 of 9 sites in each treatment group). The cause for these poor levels of control was unknown, but at three of the four sites where less than 50% reduction was observed, grass appeared to be taller and more dense than on other sites. Although vegetation measurements were not taken, we suspect these existing food supplies may have competed with grain baits and thereby lowered bait acceptance.

In our study, control with strychnine bait cost $1.06/ha more than control with zinc phosphide bait, the difference being due to bait costs. Labor costs were high because all baiting was done on foot. Compared to the total cost of control of $20.09/ha (including labor and materials for prebaiting, toxic bait application, and fumigation), this difference in bait cost is relatively minor.

The observed nontarget mortalities apparently resulted from direct consumption of toxic bait. Finding more dead nontarget animals on strychnine treated towns was consistent with results in Montana (Sullins 1980). This may have been a result of strychnine's faster action, causing poisoned animals to die on the study sites while the slower action of zinc phosphide permitted poisoned animals to wander off the sites before dying. It is also possible that the color, taste, or odor of zinc phosphide bait made it less attractive to certain species than the yellow-dyed strychnine bait. Strychnine baits have been effectively used in control of certain birds and lagomorphs, while zinc phosphide baits have not. Recovering more dead prairie dogs above ground on the strychnine-treated towns was not consistent with Sullins' (1980) work, but it again may be due to the slower action of zinc phosphide, allowing poisoned animals to return to their burrows before dying.

We consider the nontarget losses that we observed to be biologically insignificant. The chance of negative impact on unendangered wildlife populations from direct or secondary poisoning while correctly using either of these toxicants is remote. It is possible that prebaiting increased hazards to nontargets by attracting them to the site and conditioning them to consume the grain bait. Further, prebaiting approximately doubles the labor cost involved in control. Therefore, all other factors being equal, a toxicant which is efficacious without prebaiting may be less hazardous to nontarget animals as well as more cost-effective.

Results of this study suggest that both strychnine and zinc phosphide baits give similar but variable results when used for control of black-tailed prairie dogs. Fumigation with aluminum phosphide can be used effectively as a clean-up method following toxic grain bait treatment. Cost differences for the two grain baits tested were small in comparison to the total cost of the control operation. Hazards to unendangered nontarget wildlife may exist, but they are not likely to be of biological significance. There is also need for additional toxicants or other cost effective control methods that can be used safely to provide consistent, high levels of prairie dog control. The best toxicant for integrated control of prairie dogs will depend on a variety of local considerations. At the current time, we believe both strychnine and zinc phosophide need to be available.

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