April 1991

CONSUMPTION OF ZINC PHOSPHIDE-TREATED, BROMETHALIN-TREATED, AND UNTREATED OATS BY PRAIRIE DOGS AT BAIT STATIONS

Dallas R. Virchow
University of Nebraska, Panhandle Research and Extension Center

Scott E. Hygnstrom
University of Nebraska-Lincoln

CONSUMPTION OF ZINC PHOSPHIDE-TREATED, BROMETHALIN-TREATED, AND UNTREATED OATS BY PRAIRIE DOGS AT BAIT STATIONS

DALLAS R. VIRCHOW, *Department of Forestry, Fisheries and Wildlife, University of Nebraska, Panhandle Research and Extension Center, 4502 Avenue I, Scottsbluff, NE 69361*

SCOTT E. HYGNSTROM, *Department of Forestry, Fisheries and Wildlife, University of Nebraska, Lincoln, NE 68583-0819*

Proceedings 10th Great Plains Wildlife Damage Conference
(S.E. Hygnstrom, R.M. Case, and R.J. Johnson, eds.)
Published at the University of Nebraska-Lincoln, 1991.

Currently, zinc phosphide is the only toxicant registered in bait formulations for controlling prairie dogs *(Cynomys* spp.). Zinc phosphide-treated oats has been registered as a rodenticide for control of black-tailed prairie dogs (C. *ludovicianus)* for decades. However, its efficacy and weatherability have been questioned in recent years (Marsh 1987).

In contrast, bromethalin is a relatively new acute rodenticide that has been used as an alternative method of control for anticoagulant-resistant commensal rodents (Spaulding and Jackson 1982). Its activity involves the uncoupling of the oxidative phosphorylation process in the central nervous system mitochondria (Van Lier and Ottosen 1981). Both acute and chronic toxicity of bromethalin result in visible signs, such as lethargy and weakness in the hind legs, that have been observed in field studies (Jackson et al 1982).

Black-tailed prairie dogs populations have increased recently in Nebraska: aerial coverage of prairie dog towns has increased from 6,000 in 1975 ha to 35,200 ha in 1988 (F. Andelt, pers. commun.). It is possible that the significant limitations on the use of the relatively few prairie dog toxicants available has reduced their use and precipitated a recent increase in prairie dog populations. There is a need for new, environmentally-safe, and cost-effective methods of prairie dog control. We tested the relative efficacy of *2%* zinc phosphide-treated oats and 0.008% bromethalin-treated oats for controlling black-tailed prairie dogs.

METHODS

We conducted the study on a 22-ha black-tailed prairie dog colony in western Nebraska during August 1990. The colony had been active at the site >20 years. Human activity had historically been infrequent at the site and no livestock use occurred during the study. Black-footed ferret *(Mustela nigripes)* searches were conducted before and during the study but no evidence of ferrets was found. The colony was 1,613 m wide by 161 m long, and bounded by an irrigation canal along one side of the long axis and by bluffs of shallow soil overlooking the site on the other side.

Eight grids of 5 bait stations each were arranged linearly along the prairie dog town. Each grid measured 48.4 m^2 with 1 bait station at each corner and 1 station at the center (Fig. 1). Stations were made from 10 cm polyvinylchloride pipe, patterned after the design of S. Baril and tested for Columbian ground squirrel *(Spermophilus columbianus)* control (Sullivan 1982). Another 50.6 m^2 grid was superimposed over this grid to sample mound activity. Grids were placed a minimum of 80.6 m apart. Prebait was placed in all bait stations for a 7 day-period immediately prior to the baiting period. Prebait consisted of 630 g of crimped, whole oats. At the end of the prebait period, oats were removed, air dried, and weighed.

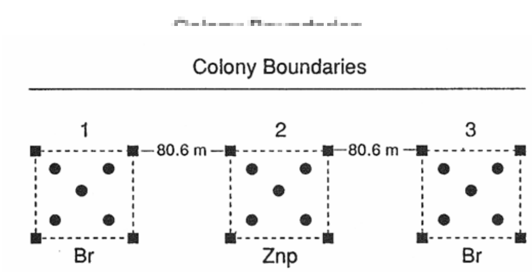

Fig. 1. Five-station grid design for testing the efficacy of zinc phosphide- and bromethalin-treated oats for controlling prairie dogs.

Either 2% zinc phosphide-treated (U.S. Department of Agriculture, Pocatello Supply Depot, Pocatello, Idaho) or 0.008% bromethalin-treated (Purina Mills, Inc., St. Louis, MO) oat baits were placed into stations the day following prebait removal. Bait concentrations were selected to reflect currently registered concentrations for prairie dogs and commensal rodents, respectively. Treatments of zinc phosphide and bromethalin were alternated between adjacent grids. The same bait was used for each of the 5 bait stations in each grid. All stations in grids 1, 3, 5, and 7 received 691 g of bromethalin-treated oats. All stations in grids 2, 4, 6, and 8 received 541 g of zinc phosphide-treated oats. Bait was left for 7 days, removed and weighed, and returned to the stations for an additional 14 days. The bromethalin bait was retested at Purina Mills, Inc. laboratory and found to be 0.0077% bromethalin.

A pre-treatment indirect census of the prairie dog population was made in late June via a 24-hour active burrow count. All mounds and holes within the 50.6 m^2 grids were plugged and checked for activity 24 hours later. Activity was defined as any burrow which had been opened from the inside during the preceding 24-hour period. Post-treatment activity was measured in mid-July using the same method.

In addition, pre- and post-treatment direct censuses were made from an observation post on bluffs located about 90 m from the colony on 3 consecutive mornings. A scan with binoculars was made every 15 minutes to count numbers of individuals above ground at the colony. The viewing field consisted of approximately 1/3 of the area of the colony. Both methods were used in this study to corroborate findings. Visual observations were used to determine possible changes in behavior due to sublethal doses of baits.

To determine efficacy we compared the bait consumption levels for the 2 treatments and the relative reduction in prairie dog activity in the treatment grids.

RESULTS

Prairie dogs consumed an average of 185 g of untreated oats at the 40 bait stations during the 7-day pre-baiting period (Table 1). Prebait consumption averaged 19 g per station per day in those stations that were later to receive bromethalin. Pre-bait consumption averaged 34 g per station per day in those stations that were later to receive zinc phosphide. Most of this difference could be accounted for by 2 stations in grid 8 where 934 and 1,586 g consumed. The consumption at these 2 stations accounted for 57% of the total pre-bait consumed in the 20 bait stations that were to receive zinc phosphide. Further-more, of the 20 stations that were to receive zinc phosphide, 8 stations had pre-bait consumption levels between 100 and 500 g, and 3 stations had levels greater than 500 g. In contrast, of the 20 stations that were to receive bromethalin, only 6 had pre-bait consumption levels between 100 and 500 g, and only 1 had a level exceeding 500 g.

Table 1. Average daily consumption of untreated oats, zinc phosphide- and bromethalin-treated oats at bait stations.

	Consumption (g/station/day)		
7-day <u>prebait period</u>			
Untreated oats	26 (Avg 40 stations)	19 (Bromethalin)	34 (ZnP)
1st 7-day <u>prebait period</u>			
Zinc phosphide-treated oats	5		
Bromethalin-treated oats	69		

Each entry represents 20 stations.

Bait consumption during the first week following pre-baiting, averaged 69 g per station per day for the 20 bromethalin stations and only 5 g per station per day for the 20 zinc phosphide stations. Bait consumption declined for both baits during the second and third weeks of baiting. Consumption at stations containing bromethalin bait averaged 22 g per station per day. Consumption at stations containing zinc phosphide bait averaged only 2 g per station per day.

During the entire 3-week baiting period, bromethalin and zinc phosphide baits were consumed at the rate of 27 g and 2.3 g per station per day, respectively. Bait consumption was probably under-reported for bromethalin-treated oats because bait stations were not re-supplied due to unavailability of bait. The entire contents of 7 bromethalin-baited stations were consumed during the first week of baiting. Four additional stations were emptied during the second and third weeks of baiting. In contrast, no zinc phosphide baited stations were emptied during the 3-week baiting period.

A comparison of pre-treatment and post-treatment prairie dog populations on the colony by two different census methods revealed no significant change (Table 2). Active mound counts are shown as cumulative for all zinc phosphide and bromethalin treatments. Visual observations revealed no significant change in population samples.

Table 2. A comparison of visual observations and active mound counts to census pre-treatment and post-treatment populations of prairie dogs.

	Visual observations	Active mound counts
Pre-treatment	43.7	120
Post-treatment	45.7	122

No significant change occurred in prairie dog population samples from pre-treatment to post-treatment for either type of bait (Table 3). Pre-treatment active mound counts ranged from 7 to 21 mounds per grid.

Post-treatment counts ranged from 8 to 25 mounds. On the 4 grids treated with bromethalin, no average net change occurred in active mounds. A 4% increase in active mounds occurred from pre-treatment to post-treatment with zinc phosphide.

Table 3. A comparison of prairie dog active mound counts when zinc phosphide- and bromethalin-treated oats are applied at bait stations*.

	Number of active mounds	
	Pre-treatment	Post-treatment
Bromethalin	66	66
Zinc phosphide	54	56

"Each entry represents 2.4 hectares and 20 bait stations.

No visual changes in behavior, such as lethargy or hind leg weakness, were observed which would indicate sublethal doses of either type of bait. The viewing field included portions of bromethalin and zinc phosphide treatment areas as well as portions of untreated areas at the colony. No carcasses of prairie dogs or nontarget organisms were found above ground when bait consumption was first monitored 7 days into the treatment period.

DISCUSSION

Bait stations have several advantages as a management tool. Correct timing and geographical placement can more adequately target a particular species or population without risk of unwanted consumption by other species or populations. Stations also preserve the quality of bait offered and conserve the quantity of bait consumed versus that wasted, thereby lowering costs of application.

The amount of bait consumed at bait stations on prairie dog towns is dependent on several factors. One source of variability is the palatability and attractiveness of the bait, and its relationship to prebait characteristics. Both the zinc phosphide and bromethalin treatment baits were similar in consistency to the untreated prebait. Palatability between treatments may have differed greatly, however, because of the different active ingredients and relative concentrations.

The increase in average daily consumption of bromethalin-treated oats over untreated oats, used as a prebait, may indicate increased palatability as well as familiarity with the bait. As animals become more familiar with particular stations which contain attractive bait, more animals within the coterie may be recruited. In addition, vegetable oils used in the formulation of the bromethalin bait versus mineral oil used in zinc phosphide baits may affect consumption levels.

Consumption may also vary between prairie dog towns due to size and age of town, size and shape of coteries, availability of natural foods, topography, and competitor, predator, or human influences. Social interactions between ages and sexes of prairie dogs may also present a confounding factor in bait consumption.

Another source of variability is in placement of stations relative to the distance from other stations and active burrows or feeding areas. We used the results from 2 pilot projects to determine correct placement and spacing of bait stations. Bait stations were placed at 32.3 m intervals in grids. During January 1990, a 10-day prebaiting period with untreated oats showed consumption at only 20% of the 42 stations during the first 3 days. After 7 days, 76% of the bait stations were visited by prairie dogs. However, at the conclusion of the 10 days, 20% of the bait stations remained unattended. There was no uniformity inconsumption of pre-bait across either of 2 grids, 1 for each of zinc phosphide or bromethalin baits. Stations that were visited early in the period continued to be visited daily and the highest consumption levels occurred here. The same pattern of fidelity to certain bait stations continued throughout the baiting period, indicating that prairie dogs may habituate to station locale regardless of type of bait used. Results indicated that stations should be placed within 32.3 m of each other within a treatment to make bait available to all prairie dogs within the area.

Feeding patterns, such as those expressed above, may become less dramatic as prairie dogs become habituated to all stations but it is still somewhat dependent on the palatability of subsequent baits. Baits left for a period of 5 weeks in bait stations during January and February, 1990 indicated that all 21 stations that contained bromethalin bait were eventually visited with bait consumption commonly exceeding 500 g and, in 4 cases, exceeding 1,500 g. By contrast, only 1 station that contained zinc phosphide had greater than 25 g removed during the previous 5 week period.

Time of year and weather conditions influence consumption because they affect above-ground activity. Weather conditions during the January, 1990 study played an important role in total daily consumption. High winds during the third 3-day period of prebaiting reduced prairie dog activity which affected the total amount of prebait consumed. Bait consumed during the second 3-day period increased more than fourfold over that consumed during the first 3-day period. Consumption was reduced by 30% during the third 3-day period when high winds again reduced aboveground activity and feeding.

The low consumption levels of zinc phosphide bait at bait stations during the current study may have been due to average daily high temperatures from 90 to more than 100 degrees F. during July, 1990. However, the heat could not account for differences in consumption levels between the 2 baits. Attractiveness of bait and social interactions may influence travel distances to bait stations and consumption levels.

The pilot projects also illustrated that large quantities of bait could be consumed at individual bait stations. In 4 cases, the rate of prebait consumption during the January, 1990 study exceeded 100 g per day. The magnitude indicates that aggregate feeding patterns may be present, perhaps with the majority of coterie members feeding at a single station.

The marked differences in bait consumption between zinc phosphide-treated oats and bromethalin-treated oats, which occurred in the present study, were supported by previous findings. A November, 1989 pilot study presented bromethalin and zinc phosphide during a 3.5-day period in bait stations following a 3.5-day prebait period. The average daily consumption for bromethalin-baited and zinc phosphide-baited stations were 74 and 11 g, respectively. In this study, reopened mound activity did not show a significant change under either type of bait treatment.

Field trials of other researchers have indicated that 0.005% bromethalin is very effective against commensal rodents (Jackson et al. 1982). Choice feeding trials have indicated mortality rates of commensal rodents greater than 95% with only 1 day of exposure to bromethalin baits. Bromethalin has been found to be effective within the range of 2.4 to 4.8 mg/kg of body weight for

Norway rats *(Rattus norvegicus)* in choice-efficacy studies (Jackson et al 1982).

LD50 levels have not yet been established for prairie dogs. The average daily consumption of 69 g per bait station per day for 1 week of 0.008% bromethalin-treated oats should result in an intake of 550 mg of active ingredient. At the 5 mg/kg lethal dosage established for Norway rats, this should represent a quantity sufficient to kill -100 1-kg prairie dogs per bait station.

CONCLUSION

Two percent zinc phosphide-treated crimped oats appear to be less palatable to black-tailed prairie dogs than 0.008% bromethalin-treated crimped, oats when fed at bait stations in August. Earlier pilot projects indicate that the differences in consumption levels between baits are also present during November and January.

Prairie dog numbers from activity counts and activity at plugged mounds were not reduced by either treatment of bromethalin or zinc phosphide baits presented at bait stations during August, 1990 nor in a preceding study in November 1989 at a different colony. Evidence from pilot projects suggests that it is unlikely that the differences in consumption levels between the 2 baits was affected by the proximity of adjacent treatments.

Absolute consumption levels at bait stations may be affected by weather conditions, time of year, population densities, or sociality of the animal. Relative consumption levels between baits or stations may be affected by palatability or by microenvironmental conditions at each site.

LITERATURE CITED

Dubbock, A. C. 1982. Pulsed Baiting—A new technique for high potency, slow acting rodenticides. Proc. Vertebr. Pest Conf. 10:123-136.

Jackson, W. B., S. R. Spaulding, R. B. I. Van Lier, and B. A. Dreikorn. 1982. Bromethalin—a promising new rodenticide. Proc. Vertebr. Pest Conf. 10:10-16.

Marsh, R. E. 1987. Relevant characteristics of zinc phosphide as a rodenticide. Proc. Great Plains Wildl. Damage Control Workshop, 8:70-74.

Spaulding, S. R. and Jackson, W. B. 1982. Field methodology for evaluating rodenticide efficacy. Proc. ASTM Symp. Vertebr. Pest Control and Manage. Materials. 4:183-198.

Sullivan, D. 1982. Bait stations as a means of rodenticide presentation to control Columbian ground squirrels. Tech. Rept. 82-3. Montana Dept. Agric. Environ. Manage. Div. Tech. Serv. Bureau.

Van Lier, R. B. L. and L. D. Ottosen. 1981. Studies on the mechanism of toxicity of bromethalin, a new rodenticide. The Toxicologist 1:114.