4-1-1987

Efficacy of Aluminum Phosphide for Black-Tailed Prairie Dog and Yellow-Faced Pocket Gopher Control

P. Rodger Moline
Texas Tech University

Stephen Demarais
Texas Tech University, steve.demarais@msstate.edu

Efficacy of Aluminum Phosphide for Black-Tailed Prairie Dog and Yellow-Faced Pocket Gopher Control[1]

P. Rodger Moline and Stephen Demarais[2]

Abstract. The efficacy of aluminum phosphide was tested on a total of 300 active black-tailed prairie dog (Cynomys ludovicianus) mounds and 68 active yellow-faced pocket gopher (Pappogeomys castanops) tunnels during June-August, 1986 on the southern Great Plains in Lubbock County, Texas. Efficacy of aluminum phosphide was higher than controls ($P < 0.001$) for both species. Efficacy was higher for black-tailed prairie dogs (94.7 - 96.0%) than for pocket gophers (61.5 - 85.7%). Soil porosity and moisture appeared to influence efficacy for yellow-faced pocket gophers.

INTRODUCTION

Black-tailed prairie dogs (Cynomys ludovicianus) and yellow-faced pocket gophers (Pappogeomys castanops) can be nuisances to ranchers, farmers, and urban dwellers on the southern Great Plains. However, in spite of the significant effects prairie dogs have on forage availability (Hansen and Gold 1977), short-term benefits of prairie dog control to cattle grazing may be limited (Klait and Hein 1978). Based on animal unit gains, control of prairie dogs in South Dakota using toxic bait may not be economically feasible (Collins et al. 1984).

Additional justification for control of prairie dogs and/or pocket gophers involves public health (Collins et al. 1984) and damage to agricultural crops (Chase et al. 1982), urban gardens, and landscapes. Pocket gophers can cover up to one-fourth of the ground surface with mounds and castings in one year (Turner 1973).

Aluminum phosphide is a commercially available burrow fumigant (Phostoxin, Degeshe Co., Inc.)[3] that emits hydrogen phosphide gas. Initial field tests of aluminum phosphide for control of black-tailed prairie dogs in Kansas indicated an efficacy of 80%[4]. The efficacy of aluminum phosphide for control of yellow-faced pocket gophers has not been reported. We evaluated the efficacy of aluminum phosphide for control of black-tailed prairie dogs and yellow-faced pocket gophers on the southern Great Plains.

This research was supported by the Graduate School and the Department of Range and Wildlife Management, Texas Tech University. We thank D. B. Wester for statistical advice and L. M. Smith, E. G. Bolen, and J. K. Jones, Jr. for manuscript review. This is publication T-9-476 of the College of Agricultural Sciences, Texas Tech University.

METHODS

The study was conducted during June - August, 1986, on 80 ha of the Texas Boys Ranch, located approximately 10 km northeast of Lubbock, Lubbock County, Texas. The shortgrass prairie vegetation on the study area is dominated by blue grama (Bouteloua gracilis) and buffalograss (Buchloe dactyloides). Mean annual precipitation is 46 cm (Blackstock 1979). The study area was grazed by cattle until 3 months before treatment.

Two trials were conducted for each species, with a treatment area and a control area assigned randomly within each trial. Two trials were conducted during June 1986 on one contiguous black-tailed prairie dog colony that was arbitrarily delineated into 4 20-ha sampling units. One trial on yellow-faced pocket gophers was conducted on arbitrarily delineated control and treatment areas during June, 1986. The second trial on yellow-faced pocket gophers consisted

---

[1] Paper presented at the Eighth Great Plains Wildlife Damage Control Workshop, Rapid City, S. D., April 28-30, 1987.

[2] P. Rodger Moline and Stephen Demarais are Graduate Research Assistant and Research Scientist, respectively, in the Range and Wildlife Management Department, Texas Tech University, Lubbock.

[3] Reference to trade name does not imply endorsement.

[4] Boggess, E. K. 1979, Aluminum phosphide for prairie dog control. Unpublished report. Kansas State University, Cooperative Extension Service, Garden City.

of 2 separate control and treatment populations sampled during August, 1986.

The trials on black-tailed prairie dogs and the first trial on yellow-faced pocket gophers were located in Estacado clay loam, a friable, moderately alkaline, dark brown clay loam 36 cm thick. The second trial on yellow-faced pocket gophers was located in Midessa fine sandy loam, a friable, moderately alkaline, brown sandy loam about 18 cm thick.

Six uniformly located soil samples were collected within each trial site at a depth of 45 cm. Soil moisture and porosity were calculated because these variables affect gas diffusion (McClean 1981) and may affect efficacy of a fumigant such as aluminum phosphide. Soil moisture and porosity were estimated using drying oven and water displacement techniques, respectively.

Occupancy of each burrow was established prior to sampling. All prairie dog mounds in each sampling unit were filled with soil and numbered. Pocket gopher tunnels were opened and numbered. Attempts were made to open only one tunnel per pocket gopher burrow system. A pocket gopher tunnel was considered discrete from other burrow systems if it was in an area with fresh mounds and/or earth plugs (Reid et al. 1966) which was spatially separated from other similar areas of activity. Occupancy of mounds and tunnels was determined 2 days later by checking for opening and closure, respectively.

Active burrows were treated with 2 3-gram pellets of aluminum phosphide. The openings of all active prairie dog mounds were plugged with plastic trash bags containing 5-10 kg of soil. The plastic-bag plug was covered with loose soil. One pocket gopher tunnel opening in each burrow system was plugged with loose soil piled onto a cardboard plug.

Seven days after treatment all burrows were checked for activity using the same methods used to determine pretreatment occupancy. Efficacy was calculated using the following formula: Efficacy = 100 x [(No. of Pretreatment Active Burrows - No. of Posttreatment Active Burrows) - No. of Pretreatment Active Burrows]. Efficacy was compared between aluminum phosphide treatment and control within each trial using a chi-square test.

RESULTS AND DISCUSSION

Three hundred black-tailed prairie dog mounds and 68 yellow-faced pocket gopher tunnels were sampled. Efficacy of aluminum phosphide treatment was higher than controls (P 0.001) for both species (Table 1). Efficacy was higher for prairie dogs (94.7-96.0%) than for pocket gophers (61.5-85.7%).

Although toxic gases have been used for vertebrate pest control for many years, there is relatively little efficacy data available from controlled experiments (Elias et al. 1983). Our 94.7-96.0% efficacy results exceed the 80% control of black-tailed prairie dogs using aluminum phosphide in dry soils in Kansas[4] The Kansas results were only an approximation because burrows were not tested for activity prior to treatment. We found no reports on control of yellow-faced pocket gophers using aluminum phosphide, but results exceeded Miller's (1954) generalization that best control of "gophers" with "gases" ranges from 50-60%.

Table 1. Results of application of aluminum phosphide to active black-tailed prairie dog mounds and yellow-faced pocket gopher tunnels in the southern Great Plains, June-August, 1986.

Species	Active Pre-treatment N	Active Post-treatment N	Efficacy[a] %
Black-tailed Prairie Dogs			
Treatment A[b]	75	3	96.0
Treatment B[b]	75	4	94.7
Control A	75	69	8.0
Control B	75	65	13.3
Yellow-faced Pocket Gophers			
Treatment A[b]	21	3	85.7
Treatment B[b]	13	5	61.5
Control A	21	21	0.0
Control B	13	13	0.0

[a] See text.
[b] Efficacy of treatment higher than respective control ($P < 0.001$).

Various biological and chemical controls have been used against prairie dogs and pocket gophers. Grazing deferment reduced prairie dog populations in Kansas (Snell and Hlavachick 1980) and South Dakota (Uresk et al. 1982). Opinions vary as to the impact coyotes have on pocket gopher and prairie dog populations (Snell and Hlavachick 1980, Baroch and Poche 1985). Herbicide treatment reduced forbs and resulted in an 87% decline in northern pocket gopher (*Thomomys talpoides*) populations 1 year after treatment (Keith et al. 1959). Herbicide treatment failed to reduce black-tailed prairie dog populations in Montana because the animals switched from a diet of forbs to grasses (Fagerstone et al. 1977). Toxic baits can be up to 100% effective in controlling pocket gophers (Baroch and Poche 1985) but may not be economically feasible (Collins et al. 1984).

Soil moisture and porosity may affect the efficacy of burrow fumigants (McClean 1981). Diffusion rate, the main factor influencing spread of aluminum phosphide gas through rabbit burrows (Oliver and Blackshaw 1979), is related to both soil moisture and porosity. Increased soil moisture would positively affect the rate of aluminum phosphide diffusion and thus its efficacy by increasing the rate of gas generation (Oliver and Blackshaw 1979) and reducing the amount of air-filled pore space (McClean 1981). A greater relative loss of gas into the surrounding pore spaces, resulting in decreased efficacy, would be expected in soils with greater porosity. The efficacy of aluminum phosphide was lower in the second trial on yellow-faced pocket gophers (Table 1). The positive impact of higher soil moisture apparently was negated by the greater soil porosity in the second trial (Table 2).

Our results indicate that aluminum phosphide is a highly effective burrow fumigant for black-tailed prairie dogs and yellow-faced pocket gophers. Additional research is needed concerning the effect of soil moisture and porosity on efficacy. The cost effectiveness of aluminum phosphide control of burrowing rodents needs to be evaluated relative to other management alternatives, particularly in urban environments.

Table 2. Soil porosity (%) and moisture (%) at 45 cm depth at the time of treatment with aluminum phosphide.

Species	N	Porosity $\bar{X} \pm SE$	Moisture $\bar{X} \pm SE$
Black-tailed Prairie Dogs			
Treatment A	3	49.1 ± 0.5	3.3 ± 0.2
Treatment B	3	48.5 ± 0.5	4.5 ± 0.9
Control A	3	47.2 ± 1.0	4.1 ± 0.4
Control B	3	48.2 ± 1.7	4.7 ± 0.5
Yellow-faced Pocket Gophers			
Treatment A	3	49.1 ± 0.5	3.3 ± 0.2
Treatment B	3[a]	63.7 ± 0.3	22.2 ± 2.0
Control A	3	47.2 ± 1.0	4.1 ± 0.4
Control B	3[a]	63.7 ± 0.3	22.2 ± 2.0

[a]Data for treatment B and Control B represent 3 samples collected randomly over both areas.

LITERATURE CITED

Baroch, J., and R. M. Poche. 1986. Preliminary field evaluation of a new formulation of Rozol (chlorophacinone) bait against pocket gophers in Colorado. Proc. Great Plains Wildl. Damage Control Workshop 7:138-144.

Blackstock, D. A. 1979. Soil survey of Lubbock County, Texas. United States of Agric., Soil Conserv. Serv. 105pp.

Chase, J. D., W. E. Howard, and J. T. Roseberry. 1982. Pocket gophers. Pages 239-255 in J. E. Chapman and G. A. Feldhamer, eds. Wild mammals of North America: biology, management and economics. The Johns Hopkins Univ. Press, Baltimore, Md. 1146pp.

Collins, A. R., P. Workman, and D. W. Uresk. 1984. An economic analysis of black-tailed prairie dog (Cynomys ludovicianus) control. J. Range Manage. 37:358-361.

Elias, D. J., P. J. Savarie, D. J. Hayes, and M. W. Fall. 1983. A simulated burrow system for laboratory evaluation of vertebrate control fumigants. Proc. Vertebr. Pest Control and Manage. Materials 4:226-230.

Fagerstone, K. A., H. P. Tietjen, and G. K. LaVoie. 1977. Effects of range treatment with 2,4-D on prairie dog diet. J. Range Manage. 30:57-60.

Hansen, R. M., and I. K. Gold. 1977. Black-tailed prairie dogs, desert cottontails and cattle trophic relations on shortgrass range. J. Range Manage. 30:210-214.

Keith, J. O., R. M. Hansen, and A. L. Ward. 1959. Effects of 2,4-D on abundance and foods of pocket gophers. J. Wildl. Manage. 23:137-145.

Klait, L. E., and D. Hein. 1978. Vegetative differences among active and abandoned towns of black-tailed prairie dogs. J. Range Manage. 31:315-317.

McClean, G. S. 1981. Factors influencing the composition of respiratory gases in mammal burrows. Comp. Biochem. Physiol. 69(A):373-380.

Miller, M. A. 1954. Poison gas tests on gophers. Calif. Agric. 8:7,14.

Oliver, A. J., and D. D. Blackshaw. 1979. The dispersal of fumigant gases in warrens of the European rabbit, Oryctolagus cuniculus (L.). Aust. Wildl. Res. 6:39-55.

Reid, V. H., R. M. Hansen, and A. L. Ward. 1966. Counting mounds and earth plugs to census mountain pocket gophers. J. Wildl. Manage. 30:327-334.

Snell, G. P., and B. D. Hlavachick. 1980. Control of prairie dogs - the easy way. Rangelands 2:239-240.

Turner, G. T. 1973. Effects of pocket gophers on the range. Pages 51-61 in G. T. Turner, R. M. Hansen, V. H. Reid, H. P. Tietjen, and A. L. Ward, eds. Pocket gophers and Colorado mountain rangelands. Colorado State Univ. Exp. Station Bull. 554S. Fort Collins, Co. 90pp.

Uresk, D. W., J. G. MacCracken, and A. J. Bjugstad. 1982. Prairie dog density and cattle grazing relationships. Proc. Great Plains Wildl. Damage Control Workshop 5:199-201.