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EFFICACY OF FIVE BURROW FUMIGANTS FOR MANAGING BLACK-TAILED PRAIRIE DOGS

Scott E. Hygnstrom
University of Nebraska-Lincoln, shygnstrom1@unl.edu

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

ABSTRACT: Current limitations on pesticides for managing prairie dog populations underscore the need for additional research on candidate compounds. I conducted this study to determine the efficacy and cost-effectiveness of two registered burrow fumigants (aluminum phosphide and gas cartridges) and three unregistered burrow fumigants (methyl bromide, chloropicrin, and a methyl bromide/chloropicrin mixture) for managing black-tailed prairie dogs. All five fumigants reduced burrow activity 94% to 97%, as measured by a plugged burrow technique. Total costs for materials and labor for the registered products, excluding application equipment, were nearly twice ($30.00 to $38.50) the cost of the unregistered fumigants ($15.25 to $16.25).

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INTRODUCTION

The black-tailed prairie dog *(Cynomys ludovicianus)* is an endemic species of the Great Plains region of North America. They are recognized for their unique ability to modify their habitat by clipping vegetation and constructing burrows, thus creating a patchwork habitat that benefits a wide variety of wildlife (Clark et al. 1982, Agnew et al. 1986, Foster and Hygnstrom 1990). Livestock producers, however, often perceive that prairie dogs compete with cattle, sheep, and goats for available forage (Hansen and Gold 1977, Hygnstrom and Virchow 1994). In addition, prairie dogs occasionally pose a threat to human health because they serve as a reservoir and host of *Yersinia pestis,* the bacterial agent of plague (Barnes 1990). As a result, prairie dog colonies have been reduced or eliminated through a variety of means to enhance economic returns from livestock production and to reduce the threat of plague epidemics.

Several materials and methods have been used in the past to manage prairie dog populations. Currently only three pesticides are registered by the United States Environmental Protection Agency (EPA) for use on prairie dogs: zinc phosphide, aluminum phosphide, and gas cartridges. Research and development of new pesticides for prairie dog management is needed because of limitations on use and the threat of loss of existing registered products. I initiated this study to determine the efficacy and cost-effectiveness of two registered and three unregistered burrow fumigants for controlling black-tailed prairie dogs.

METHODS

In fall 1990, I selected 15 typical 2- to 20-ha prairie dog colonies in central Nebraska. Four field assistants and I surveyed the towns four times for evidence of black-footed ferrets *(Mustella nigripes),* swift fox *(Vulpes velox),* burrowing owls *(Speotyto cunicularia),* and other nontarget wildlife before application of the fumigant treatments. The survey protocol was authorized by the Nebraska Game and Parks Commission. No evidence of ferrets was found and I am confident that we had no impact on nontarget vertebrates.

Sixty variable-sized plots were randomly located in these colonies, each consisting of 50 active prairie dog burrows. We identified active burrows by sign of recent excavation and lack of vegetation, spider webs, and debris in and around the burrows. We treated half of the burrows in each plot with one of five burrow fumigants. The other half were untreated and served as controls.

The burrow fumigants tested included Phostoxin® (55% aluminum phosphide, 45% inert ingredients, Degesch America, Inc., Weyers Cave, Virginia, USA); gas cartridges (six active ingredients, which after ignition, produce toxic gases; United States Department of Agriculture-Animal and Plant Health Inspection Service, Pocatello, Idaho, USA); Meth-O-Gas® (100% methyl bromide, Great Lakes Chemical Corp. [GLCC], West Lafayette, Indiana, USA); Chloropic® (96.5% chloropicrin and 3.5% inert ingredients, GLCC); and Brom-O-Gas® (98 % methyl bromide and 2 % chloropicrin [a warning agent], GLCC).

We applied aluminum phosphide according to label directions, by inserting a polyvinyl-chloride (PVC) pipe (1.3 m long x 5 cm in diameter) into a burrow, rolling three aluminum phosphide tablets through the pipe and into the burrow, and removing the pipe. To minimize loss of fumigant, we inserted a crumpled newspaper and packed soil into the burrow opening to form a tight seal. Adjacent burrows were also plugged with soil. Gas cartridges were applied according to label directions, by inserting a screwdriver into one end and stirring the contents, inserting a 14-cm fuse into the same end, lighting the fuse, holding the cartridge until the contents ignited, and tossing the cartridge into the burrow, fuse end first. We packed soil into the burrow opening and adjacent burrows to minimize the loss of fumigant from the burrow.

The methyl bromide, chloropicrin, and methyl bromide/chloropicrin mixture were contained in 50-pound (13.75-1) pressurized cylinders mounted on the back of a three-wheel all-terrain vehicle. A tank valve, 15 m polyethylene hose, and 1 m brass wand with a hand-operated release valve allowed application of the materials to the burrows. We inserted the wand into the burrow, and shoveled soil around it to help keep the pressurized gases in the burrow. We then squeezed the release valve for two seconds to inject approximately 10 ml of product into the burrow (FAO 1986), and removed the wand. We again, packed soil into the burrow opening and adjacent burrows to minimize loss of fumigant from the burrow. We left 25 active burrows untreated on half of each study plot, and plugged them in the same manner as the treated burrows to serve as controls. All treatment and control burrows were marked with engineering flags to facilitate identification. Twenty-four hours later, we examined the treatment and control burrows in each study plot for activity. Burrow activity was determined by the number of burrows opened by excavation. Percent reduction of burrow activity was calculated as follows: 100 - treatment burrows opened x JQO control burrows opened

We recorded and compared the amount of materials used and staff time required for the application of treatments at each study plot.

RESULTS AND DISCUSSION

All five burrow fumigants were very effective in reducing burrow activity (Table 1). The number of treatment and control burrows opened per study plot ranged from 0 to 3 and 20 to 25, respectively.

Table 1. Percent reduction of black-tailed prairie dog burrow activity by five burrow fumigants, as measured by a plugged burrow technique.

	n	%
Aluminum phosphide	250	97
Gas cartridges	250	95
Methyl bromide	300	96
Methyl bromide/chloropicrin	275	96
Chloropicrin	225	94

Over-the-counter prices paid for the five burrow fumigants in 1990 were as follows: aluminum phosphide—$50.00/flask (500 tablets), gas cartridges~$32.00/carton (100 cartridges), methyl bromide and methyl bromide/ chloropicrin mixture~$2.00/pound(262 ml), chloropicrin -$3.00/pound (275 ml). Material costs are provided for comparative purposes and are subject to change by volume, season, and geographic region. Material costs per ha treated for aluminum phosphide and gas cartridges were three to four times the cost of the three pressurized gases (Table 2). Costs for application equipment are not included in this analysis.

Table 2. Costs ($/ha at 1990 prices) of five burrow fumigants for managing black-tailed prairie dogs (does not include application equipment).

	Materials	Labor	Total
Aluminum phosphide	37.05	37.05	74.10
Gas cartridges	39.52	55.58	95.10
Methyl bromide	09.88	27.79	37.67
Chloropicrin	12.35	27.79	40.14
Methyl bromide/ chloropicrin	09.88	27.79	37.67

The most labor-consuming practice associated with burrow fumigation is burrow plugging. Although the staff time required to plug burrows is consistent for all treatments, the total labor costs for application of the aluminum phosphide and gas cartridges are higher than for the three pressurized gasses. Use of the three-wheel all-terrain vehicle and mobile application system reduces application times for the pressurized gases. Unfortunately, three-wheelers would not be practical for application of aluminum phosphide or gas cartridges.

Total costs of application of aluminum phosphide and gas cartridges are nearly twice the costs of the three pressurized gases. These expenses only include the costs of materials and labor to apply them. The costs of application equipment is likely to be higher for the three pressurized gases than for aluminum phosphide or gas cartridges. The equipment would have to be rented or purchased and depreciated over time.

Aluminum phosphide and gas cartridges are registered by EPA for managing black-tailed prairie dogs. Methyl bromide, chloropicrin, and mixtures of the two are used primarily for controlling insect pests in stored grain (FAO 1986). Their labels do include use recommendations for controlling rats and mice in structures, but the materials are not currently registered for controlling prairie dogs. Results from this study indicate that methyl bromide, chloropicrin, and a mixture of the two provide more cost-effective control of black-tailed prairie dogs than aluminum phosphide and gas cartridges and are of no greater environmental hazard than the two currently registered fumigants.

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