A COMPARISON OF SELECTED RODENTICIDES FOR THE CONTROL OF THE COMMON VALLEY POCKET GOPHER (Thomomys bottae)

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ABSTRACT: The common valley pocket gopher (Thomomys bottae) has become a serious agricultural pest in certain regions of the Lower Colorado River Basin. The mechanical burrow-builder is the most economical and effective method of controlling this pest although many growers and some researchers have reported less-than-satisfactory results when using this technique with currently available rodenticides. Six formulations of three toxicants including strychnine, zinc phosphide and diphacinone were applied with the burrow-builder to assess their efficacy. Results indicated that negligible control is achieved with 0.35 and 0.5% strychnine although these are the most commonly used formulations in Arizona. Diphacinone also produced negligible control. Zinc phosphide was clearly the most effective of the compounds tested with 45% control achieved. More work with this compound is warranted.

INTRODUCTION

The common valley pocket gopher (Thomomys bottae) has become a serious agricultural pest in certain regions of the Lower Colorado River Basin. Fluctuations in the density, geographic replacement, species diversity and taxonomic makeup of this gopher have been subjected to much study and speculation (Smith and Patton 1980). There is general agreement that the number of pocket gophers in this region has increased with the proliferation of irrigated agriculture and the corresponding establishment of flood-control dams, inland water courses, roads and perennial and abundant food sources.

This hypothesis is substantiated by population studies which indicate that significant gopher populations existed in this region only on the California side of the Colorado River near Yuma prior to the early 1900s (Grinnell and Hill 1936). The construction of flood-control dams beginning in the early 20th century is thought to have reduced the periodic drowning of gophers inhabiting low-lying regions adjacent to the river. The subsequent placement of inland water courses and roadways which accompanies the development of irrigated agriculture has facilitated the dispersal and establishment of dense and growing populations of T. bottae.

The population size of T. bottae has today reached serious economic levels in many agricultural areas of the Colorado River Basin. Alfalfa is the crop that is most heavily damaged. Considerable damage is caused to ditch banks and other water-containment structures in flood-irrigated areas, although the most serious infestations have been found in sandy-soil, sprinkler-irrigated regions where gophers cause significant reductions in yields and extensive damage to harvest machinery.

CONTROL TECHNIQUES

Several control techniques have been used. The location, degree of infestation, irrigation technique and time of year are major factors which determine the economic feasibility and efficacy of a control program.

Trapping, using the Macabee or California gopher box trap, hand-baiting or fumigation are effective techniques only when the infestation is light or the affected area is small. These control methods have been most effective in flood-irrigated areas where the degree of infestation is generally lighter and more confined. Repellents have been found to be short-lasting and ineffective.

Sprinkler-irrigated alfalfa fields are an ideal habitat for the pocket gopher to thrive. Population numbers have reached levels in many of these fields that cannot be economically or effectively controlled by trapping or hand-baiting.

The mechanical burrow-builder, designed and developed in the late 1950s, has proven to be the most effective control method where the infestation is high and covers a large area. This is a mechanically-drawn implement that constructs a subterranean burrow containing poison bait. This device has been used successfully across the country (Sargeant and Peterson 1962, Marsh and Cummings 1977). In recent years, however, many growers and some researchers have reported less-than-satisfactory results when using this technique with currently available rodenticides. (Salmon and Gorenzel 1981)

The purpose of the present study was to assess the efficacy of selected rodenticides applied with the mechanical burrow-builder.

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STUDY AREA

This study was conducted on the south Yuma Mesa, approximately 10 miles south of the city of Yuma, Arizona. Mean annual precipitation on this old terrace of the Colorado River ranges from 2 to 4 inches and mean annual air temperature ranges from 72 to 76 degrees F. The soils are deep, excessively drained sands belonging to the Rositas series. Elevation is approximately 190 feet.

The agriculture on the south Yuma Mesa is dominated by irrigated citrus, small grains and alfalfa. Experimental sites were located in 3-year-old established alfalfa fields irrigated by center-pivot sprinkler systems and heavily infested by the pocket gopher *Thomomys bottae*.

METHODS AND MATERIALS

Practical problems have been encountered in trying to develop an accurate, rapid and reliable method of measuring pocket gopher control. One method of approximating population numbers by counting new signs of activity, i.e., mounds and earth plugs, has been tried with varying degrees of success (Reid et al. 1966). Another method which is frequently used to measure control involves probing and opening a hole in the subterranean gopher tunnel or runway. The control index is, in this case, based upon the number of holes left open or closed. When both indices were used in the same series of experimental plots, a correlation coefficient of .48 was found between the data obtained using both methods. There may be various explanations for this low correlation. Among these explanations is the possibility that one or both of the methods are unreliable for approximating the amount of control achieved. Another possible explanation is that the number of replications was insufficient.

The open-system method was felt to give more positive indication of control and was used in the present study. The procedure involved probing and opening 20 randomly selected systems in each plot. The plots were approximately 1/4 acre in size and were set in a randomized block design with 2 replications. A buffer region surrounded each plot. Those systems that were plugged 24 hours later were flagged and marked. Each plot was then treated with one of six formulations applied with the burrow-builder driven at 20 feet intervals and constructing a burrow 8 to 10 inches below the surface. The amount of bait deposited is determined by the bait size, the intervals dropped and the size of plate in the bait hopper. The machine was set to drop the maximum amount of bait. The amount of bait applied to each plot is given in Table 1. The marked systems were reopened after 1 and 2 weeks. If after 24 hours the system remained open, it was counted as control; if not, it was counted as no control.

Table 1. Kind and amount of bait applied with the burrow builder.

Bait	Lbs./A	Lbs./1000 feet
Milo	10.4	4.7
Oats	0.93	0.42
Rolled oats	1.6	0.76
Ramik brown[1]	4.8	2.2
Gopha-Rid pellets[2]	5.8	2.7
Wheat	6.5	2.3

[1]Trade name of 0.005% diphacinone manufactured by Velsicol

[2]Trade name of 2% zinc phosphide pellets manufactured by Bell Laboratories

Many toxicants have historically been used as rodenticides and thousands of compounds have been tested for rodenticidal activity. The compounds most frequently used for gopher control have included sodium monofluoroacetate (Compound 1080), zinc phosphide, Gophacide (an organic phosphate manufactured by Chemagro Corp.), strychnine and multiple-dose anticoagulants including the hydroxycoumarins and indandiones (Clark 1975). Various baits have been used with these toxicants. Grains have been used most commonly with the mechanical burrow-builder. Grain acceptance trials indicated that milo was the preferred bait followed by barley, wheat, and oats, respectively. Strychnine, zinc phosphide and diphacinone were the toxicants used in the present study.

Strychnine alkaloid is currently the most commonly used toxicant for control of the pocket gopher in Arizona. It is the quickest acting of the single-dose rodenticides and is registered for gopher control in Arizona at a maximum concentration of 0.5%. This toxicant has a characteristic bitter taste although the pocket gopher has shown no bait-shyness after receiving a sublethal dose.

Zinc phosphide became popular when the availability of strychnine was hindered during World War II. Its popularity was shortlasting, however, with the appearance of 1080 and the anticoagulants in the late 1940s and 1950s (Hood 1972). This is the slowest acting of the acute rodenticides, although death from asphyxia normally occurs within 24 hours of ingestion.

A 2% formulation of zinc phosphide on pelletized bait is currently registered for gopher control in Arizona only in noncrop rights of way. When used in the mechanical burrow-builder these pellets are crushed in the bait-feeding mechanism and soon impede its operation.

Zinc phosphide has a characteristic phosphorus odor that may serve as an attractant. Bait acceptance by the pocket gopher has been good.

The anticoagulant baits are multiple-dose rodenticides that must be consumed several times over a period of days. Two groups of these compounds are registered as rodenticides in the U.S.: the hydroxycoumarins (warfarin and Fumarin) and the indandiones (diphacinone and chlorophacinone). Some work has been done in recent years to develop and register a single-dose anticoagulant, although these toxicants have yet to be registered for control of the pocket gopher in cropland.

Ramik Brown, a 0.005% formulation of diaphacinone manufactured by Velsicol, fed well through the burrow builder but held up only for a few days in contact with moist soil. These compounds have been used successfully in the control of commensal rodents although they have not gained much acceptance in the control of the pocket gopher.

RESULTS AND DISCUSSION

Results obtained after one and two weeks of application are presented in Table 2. These results are preliminary and inconclusive due to the limited number of test plots established. It is possible, however, to make the following observations based upon these results:

Table 2. Control achieved from the application of selected rodenticides through the mechanical burrow builder.

Bait Applied	Control after 1 week (%) Rep 1	Control after 1 week (%) Rep 2	Control after 2 weeks (%) Rep 1	Control after 2 weeks (%) Rep 2
2% zinc phosphide-treated milo	40	45	45	45
0.35% strychnine-treated milo	15	10	10	5
0.005% diphacinone (Ramik Brown)	5	10	0	5
2% zinc phosphide pellets (Gopha-Rid)*	20	20	-	-
1.78% zinc phosphide-treated wheat*	5	10	-	-
0.5% strychnine-treated oats*	5	0	-	-

*Evaluated only after one week.

Negligible control was achieved with both strychnine formulations: the 0.5% oats and the 0.35% milo. These formulations are widely used, however, in Arizona.

Recent studies conducted in California have indicated that formulations of strychnine-treated bait as high as 2.66% in one study failed to achieve acceptable control when applied by the mechanical burrow-builder (Salmon and Gorenzel, personal communication). Furthermore, some speculation has been raised concerning the development of bait resistance by gopher populations that have been successfully controlled with strychnine for many years. There is a good possibility that gophers accepting 0.35% and 0.5% strychnine-treated baits are receiving a sublethal dose of the toxicant.

The multiple-dose anticoagulants appear to be unacceptable for the control of gophers. The mode of action, in which the toxicant must constitute a substantial part of the animals' diet over a period of days, makes it unlikely that good control can be achieved with this compound. The formulation used in the present study held up only a few days when in contact with soil moisture. Additionally, it would be difficult to supply enough toxicant through the burrow-builder to last several days.

Zinc phosphide was clearly the most efficacious of the three toxicants applied. Results indicate that the formulation was a major factor affecting the amount of control achieved. A 2% formulation on milo achieved 45% control, whereas a 1.78% formulation on wheat achieved only 5 and 10% control and 2% pellets achieved 20% control.

Forty-five percent control is unacceptable although these results indicate that further work with zinc phosphide is warranted. A formulation that will feed well through the mechanical burrow-builder and be attractive to the gopher is desirable.

The condition of the artificial burrow constructed is a factor that should be emphasized. A smooth, solid burrow constructed at the right depth and spacing to intercept the maximum number of existing systems is necessary. Tractor drivers frequently fail to understand the sensitivity of the burrow-builder and the importance of constructing a good burrow containing an adequate amount of bait.

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