A COMPARISON OF SEVERAL POCKET GOPHER BAITS IN THE FIELD

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ABSTRACT: Two field trials were conducted to determine the effectiveness of anticoagulant baits in pocket gopher (Thomomys bottae) control. In the first trial, burrow systems were baited once with chlorophacinone 0.005% on rolled oats and embedded in paraffin to form a wax block. The systems were arranged in a one systemwide line bordering a clean vineyard. Infestation of the vineyard was prevented for 2 months; after that, gophers did bypass the barrier of treated systems and entered the vineyard.

In the second trial two anticoagulant baits, chlorophacinone 0.005% on rolled oats and embedded in paraffin, and diphacinone 0.0052% on various grains and embedded in paraffin, were compared to strychnine-treated 0.29% whole wheat grain bait. Fifteen individual gopher systems were baited in each of three replications and monitored for 8-½ months. Both of the anticoagulant paraffin block-type baits achieved significantly greater long-term gopher control than the strychnine-treated loose grain bait.

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INTRODUCTION

Situation

Damage caused by pocket gophers (Thomomys bottae) is a major economic problem in agricultural crops and gardens in Sonoma County, California. Gopher control is a continuous frustration to many. Note the "backyard-type" remedies that are always surfacing such as feeding chocolate laxatives and chewing gum, or scaring gophers away with various vibrating or noisy devices. Some people swear by these methods; others just swear.

Well-documented methods of gopher control include setting traps and hand or mechanical baiting with strychnine-treated grain (Salmon and Lickliter 1984). These methods have the disadvantages of being time consuming and expensive and dependent upon perfect soil conditions. One of the major drawbacks in all of the control methods is that they are short-lived and require repeated applications to maintain success. Strychnine is also currently under review by regulatory agencies; its use will likely become more restrictive, and formulation rates may be lowered. The commonly used commercial rates of strychnine-treated grain bait in Sonoma County are 1.7 to 2.6% for mechanical baiting and 0.29% for hand baiting, even though higher rates are registered (Salmon and Gorenzel 1981).

A New Concept

The use of anticoagulant toxicants made into bait blocks with a suitable grain and paraffin wax has the potential to kill the initial gopher and new invading gophers, offering long-term control with fewer treatments (Tunberg et al. 1984). Paraffin is used to moisture-proof baits so that they will remain acceptable longer to hold ample bait for multiple feeding and for easy handling (Marsh and Plesse 1960).

Wax bait blocks containing various grains and anticoagulant toxicants such as chlorophacinone, bromadialone, diphacinone, and warfarin have been demonstrated to kill gophers in limited laboratory and field trials. In the field, bait blocks are transported to nests and food caches, consumed, and made available for invading gophers (Marsh 1977, Tunberg et al. 1984, Marsh 1986, Poche 1986).

Anticoagulant poisons also offer a good degree of safety for nontarget species (Stimman and Clark 1981).

MATERIALS AND METHODS

Trial I (May 1987)

For our initial work we designed a trial to observe the effectiveness of an anticoagulant bait block to prevent the movement of gophers from a high population area into a new vineyard. The vineyard had been fumigated and was free of gophers.

The Agricultural Commissioner's Office produced an anticoagulant, wax bait block (see Sonoma County bait block, Trial II below). We treated 8 gopher burrow systems (replicated twice) with four 100-gram chlorophacinone bait blocks each and monitored gopher activity weekly for 8 weeks and once again at 19 weeks. The treatments were in a one systemwide (approximately 25 feet wide) line on one side of the vineyard with adjacent untreated check areas containing the same number of gopher systems. Monitoring methods were the same as for Trial II.

Trial II (March 1988)

In a heavily gopher-infested 200-acre pasture we set up a randomized block design experiment with 15 systems in each treatment area. Each area was separated by at least 50 feet of inactivity, and each individual gopher burrow system was separated by at least 25 feet. Initially each system was opened and checked the next day for plugging to determine activity. Three replications were used for the following treatments.

1. Strychnine 0.29% in whole wheat grain. Each system was baited with 1 tsp. of grain bait in each of 2 locations with a probe into the tunnel, and in 2 locations where we opened holes in the system. A total of 4 tsp. = 4 to 5 g each = 16 to 18 g of bait was used per system.
2. "Eaton's Answer" paraffin bait block: various grains, peanut butter, diphacinone .0052%. Four bait blocks were placed into each system, 2 in each of two

opened burrow tunnels. Each bait block was approximately 4 oz. or 113 g, and measured 12 cm x 4 cm x 3 cm.

3. Sonoma Country paraffin bait block: rolled oats, chlorophacinone .005%. The block contained 25 to 30% paraffin. Four bait blocks were placed into each system, 2 in each of two opened burrow tunnels. Each bait block was approximately 4 oz. or 113 g and measured 10 cm x 4 cm x 3 cm.
4. Untreated check (i.e., control plot).

Two holes were opened in each system and checked the next day for activity at 1 week intervals for the first 6 weeks and monthly thereafter for 2 months. One final check for activity was made 6 months later.

The Sonoma County bait blocks were laboratory test-fed to four wild captured adult female pocket gophers (T. bottae). The first gopher died on the 7th day following the start of the test and all four gophers were dead by the 15th day. The mean day to death was 12.7 days. Bait consumption ranged from 51.6 to 79.8 g. The 1/4 lb (4 oz. = 113 g) bait block was enough to kill one pocket gopher and, in some cases, enough for two.

Laboratory test feeding of the "Eaton Answer" bait bar was conducted on 10 pocket gophers (T. bottae). Total mean consumption was 59.5 g or approximately one-half of a 114.5-g bar. All the gophers died within a 20-day period, with the mean day to death 11.7 days. Deaths ranged from 6 to 20 days and 8 out of 10 were dead within 13 days. Both of the laboratory tests were conducted at the Institute of Ecology, University of California, Davis. In both laboratory feeding trials, the animals became ill and bait consumption dropped to near zero at approximately 4 to 5 days prior to death.

RESULTS

Trial I (May 1987)

At least 2 baits were taken by a gopher in each treated system; 38% took 2 baits, 38% took 3 baits, and 24% took all 4 baits. By the 3rd week an average of 25.0% inactive systems was noted. Gopher control increased up to 62.5% inactive systems by the 5th week and 69.0% by the 7th week.

During the 8th week, however, activity increased to 37.5% inactive systems (see Table 1). Treated systems adjacent to the untreated check systems became active by the 8th week. Several gophers had also moved past the treatment line into the vineyard.

Table 1. Percentage reduction in gopher activity (degree of control), Trial 1.

Weeks after treatment	Sonoma block	Untreated check
1	0	0
2	0	0
3	25.0	0
4	50.0	0
5	62.5	6.3
6	50.0	6.3
7	68.8	12.5
8	37.5	0
19	37.5	0

Even though gophers overran the treated systems, 37.5% remained inactive when checked 19 weeks after treatment. The untreated check systems remained highly active throughout the entire trial period.

Trail II (March 1988)

At least 1 bait block was accepted and moved by 93% of the gopher systems in the first week. There was no difference in acceptance between the two types of paraffin bait blocks. Many gophers accepted and moved all 4 of the bait blocks. Strychnine-treated grain bait acceptance was not determined other than to just monitor system activity.

The first week after treatment the strychnine-treated systems were the only ones to show any control with a 24.0% reduction in activity. Reduction in activity by the bait blocks, however, quickly equaled or surpassed the control achieved by the strychnine (see Table 2 and Fig. 1).

Table 2. Percentage reduction in gopher activity (degree of control), Trial II.

Weeks after treatment	Sonoma block	Eaton block	Strychnine grain	Untreated check
1	0	0	24.0	0
2	38.0	18.0	35.3	4.7
3	68.7	35.3	48.7	2.0
4	75.3	55.3	46.7	4.7
5	78.0	40.0	44.2	8.7
9	80.0	73.3	40.0	11.3
14	78.0	62.0	33.0	15.3
39	80.0	71.3	51.3	15.3

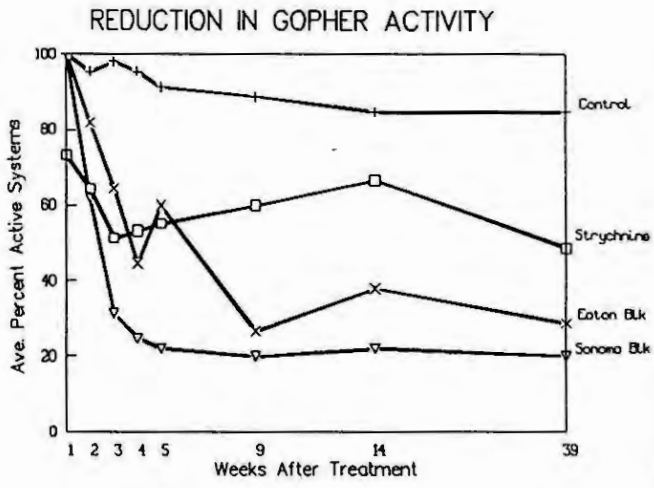

Figure 1. The results (i.e., percentage of gopher activity reduction) for the three different types of baits when measured over time and compared with an untreated "control" area.

In May, 5 weeks after treatment, each of the three replicate areas treated with the Sonoma County paraffin chlorophacinone bait block showed very little activity, with an average of 78% inactive systems. The strychnine grain bait and Eaton diphacinone bait-bar-treated areas showed considerable activity, with an average of 44.6% and 40% inactive systems, respectively. In the untreated check areas, almost every system was active, with an average of 8.6% inactive systems.

In August, 3 months after treatment, activity in the Sonoma County paraffin bait block areas essentially remained unchanged, with an average of 79% inactive systems. Activity in the Eaton bait-block-treated areas declined to an average of 68% inactive systems, and in the strychnine-treated areas activity increased to an average of 36% inactive systems.

At the end of 8-½ months, the average percentage of inactive systems was: check, 15.3%; strychnine, 51.3%; Eaton bait block, 71.3%; and Sonoma County bait block, 80%.

Analysis of the data based on Duncan's multiple range test indicated significant differences at the 1% level among the four treatments (see Table 3a). The first week differences were significant only between strychnine and the other materials. During weeks 2 to 5, significant differences changed back and forth between the two anticoagulant baits and strychnine. The clearest differences occurred in the 9th week when the anticoagulant baits were both significantly different from the strychnine and the untreated check, which were not different from each other.

Analysis at the 5% level showed more separation among the four treatments (see Table 3b).

Table 3a. Significant difference[a] in gopher activity Trial II based on Duncan's multiple range test for treatment means.

	Average number of active gopher systems (out of 15)							
Weeks after treatment	1	2	3	4	5	9	14	39
Date	3/15	3/22	3/29	4/4	4/12	5/10	6/14	12/7
Son. Blk.	15.0 A	9.3 B	4.7 C	3.7 B	3.3 B	3.0 B	3.3 C	3.0 B
Eaton Blk.	15.0 A	12.3 AB	9.7 B	6.7 B	9.0 A	4.0 B	5.7 BC	4.3 B
Strychnine	11.0 B	9.7 B	7.7 BC	8.0 B	8.3 AB	9.0 A	10.0 AB	7.3 AB
Untreated	15.0 A	14.3 A	14.7 A	14.3 A	13.7 A	13.3 A	12.7 A	12.7 A

[a]Level of significance 1%

Table 3b. Significant difference[b] in gopher activity Trial II based on Duncan's multiple range test for treatment means.

	Average number of active gopher systems (out of 15)							
Weeks after treatment	1	2	3	4	5	9	14	39
Date	3/15	3/22	3/29	4/4	4/12	5/10	6/14	12/7
Son. Blk.	15.0 A	9.3 B	4.7 C	3.7 C	3.3 C	3.0 D	3.3 B	3.0 C
Eaton Blk.	15.0 A	12.3 AB	9.7 B	6.7 BC	9.0 B	4.0 C	5.7 B	4.3 BC
Strychnine	11.0 B	9.7 B	7.7 B	8.0 B	8.3 B	9.0 B	10.0 A	7.3 B
Untreated	15.0 A	14.3 A	14.7 A	14.3 A	13.7 A	13.3 A	12.7 A	12.7 A

[b]Level of significance 5%

DISCUSSION

The data in Figure 1 is very helpful when applied to the standard S-shaped population curve that shows how a population of animals starts out slowly but then reproduces rapidly to a carrying capacity and then levels off. From our data, we can quickly see that bait blocks, especially Sonoma Country bait blocks, will give gopher control up to the 80th percentile. This control technique thus suppresses the population to a point where it will increase slowly. The 0.29% strychnine grain bait, on the other hand, reduced the gopher population to the 50th percentile where we can expect rapid population recovery to the carrying capacity.

Wax bait blocks are easy to handle and can be safely used in both agriculture and backyard applications. The bait blocks should be placed underground in the main tunnel. The tunnels are then plugged and covered with soil to exclude light and air. If bait blocks are placed in clean-out tunnels, they may be pushed out to the surface. Underground placement should safely separate the toxicant from nontarget animals and children. Gloves can be worn to keep the anticoagulant chemical from touching the skin.

The bait blocks are very easy to handle, especially if packaged individually or in sheets that can be easily separated. The shelf-life should be longer than grain baits because of the hot wax incorporation, which helps kill grain insect pests and resists moisture degradation.

It is hoped that with the data from this and other studies a new anticoagulant wax bait block can be EPA-registered for use in California on pocket gophers. We believe that one application of this product can extend the gopher population control time by several weeks to perhaps several months.

Future research in anticoagulant paraffin bait blocks should include a study to determine how long the bait blocks will remain palatable and chemically active under differing moisture conditions. Radio telemetry would be necessary in field trials. Also, more work should be done on differing strychnine percentages. Strychnine grain bait 0.50% for hand baiting should be used in the next study because lower percentage rates do not give adequate control.

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