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Field Evaluation of Three Strychnine Concentrations for Controlling Townsend's *Pocket* Gophers

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Among requirements for the reregistration of strychnine, the Environmental Protection Agency (EPA) requires efficacy data from strychnine paste-alfalfa baits prepared with strychnine alkaloid paste (NV 830009). The EPA reviewed the data originally submitted by the state of Nevada for registering this strychnine alkaloid paste label and determined that more field efficacy data were needed to maintain the current registration. Therefore, additional efficacy data for strychnine paste-alfalfa baits on Townsend's pocket gopher (*Thomomys townsendi*) was requested from the state of Nevada

Strychnine paste-alfalfa bait concentrations for controlling Townsend's pocket gophers under field conditions were selected based on the results of two toxicological laboratory studies. In the first study, conducted by Matschke and McCann (1992), none of the concentrations (0.5%, 1.0%, 1.5%, and 2.0%) consistently resulted in 100% mortality. In that study, pocket gopher mortality was only 30% (N = 30) for the currently registered 0.5% concentration. Concentrations of 1.0%, 1.5%, and 2.0% yielded mortality rates of 70% (N = 40), 90% (N = 10), and 79% (N = 39), respectively. When the

strychnine concentration was increased to 3.0%, pocket gopher mortality was 97% (N = 34) (Matschke et al. 1992a).

Following the laboratory studies, we evaluated a 3.0% strychnine paste-alfalfa bait on Townsend's pocket gophers in a small-scale field study (Matschke et al. 1992b). Pretreatment, on one hundred 1/50-acre sample plots, pocket gophers had constructed new mounds in 92% (46 of 50) and 98% (49 of 50) of the sample plots on the control and treatment sample plots, respectively. Posttreatment, pocket gopher mound building activity increased to 94% (47 of 50) on the control sample plots, and decreased to 16% (8 of 50) on the 3.0% strychnine sample plots. Pocket gopher activity on the strychnine-treated sample plots differed significantly from the control sample plots ($P < 0.01$). Because pocket gopher mound building or feeder plug activity declined dramatically (82%) under field conditions after application of the 3.0% strychnine paste-alfalfa bait, we decided additional field studies were warranted to further evaluate the efficacy of the 3.0% and lower concentrations.

In this study, we evaluated three strychnine paste-alfalfa baits under field conditions:

(1) 0.50% - the currently registered concentration; (2) 1.5% - the concentration that achieved 90% mortality in two laboratory tests (Matschke and McCann 1992, Matschke et al. 1992a); and (3) 3.0% - the concentration that produced 97% mortality in the laboratory (Matschke et al. 1992a) and an 82% reduction in pocket gopher mound building activity in the field (Matschke et al. 1992b).

Study Site procedure

Our study site was located near Winnemucca, Humboldt County, Nevada on a 97.9 ha (241.9 acre) ranch on the southern 1/2 of Section 6, T-35N, R-37E. On this site, four treatment units (each 0.4 ha (1.0 acre)] were established in a 52.2 ha (129 acre) circular irrigated alfalfa (*Medicago sativa*) field. The units were separated by at least 100 m. The center pivot irrigation system was not operated during the study.

Bait Formulation

Strychnine alkaloid paste preparation The Formulation Unit of the Chemical Development and Registration Section at the Denver Wildlife Research Center, (DWRC) prepared a 3.2% paste and a 10.0% paste, as well as a 0.0% control paste; the concentrations are % (wt/wt). The DWRC's Analytical Chemistry Section assayed the three paste formulations. The 3.2% and 10.0% strychnine alkaloid paste samples assayed at 3.18% (SE = 0.04, N = 3), and 10.7% (SE = 0.0, N = 3), respectively. Each of 0.0% strychnine alkaloid paste samples assayed below the limit of detection (LOD) of 0.02% (N = 3).

Strychnine paste-alfalfa bait preparation The 0.5% and 1.5% strychnine pas alfalfa baits were prepared from the 3.18 strychnine alkaloid paste. The 3.0 strychnine paste-alfalfa bait was prepare from the 10.7% strychnine alkaloid past The control (0.0%) paste-alfalfa bait wl prepared in the same manner but without the strychnine alkaloid. The baits we' prepared at the study site on the day a baiting. Had these baits been analyzed the moisture content would have caused large variability in the analysis. Therefore the EPA did not require these baits to be analyzed.

Pretreatment Tapping

Live-trapping occurred on April 21, 22, and 23, 1992: 16 animals (0 males, 16 females) on unit 1, 17 animals (2 males, 15 females) on unit 2, 18 animals (4 males, 14 females) on unit 3, and 19 animals (3 males, 16 females) on unit 4 were captured, radio-equipped, and released.

Baiting

In the early morning of April 25, 1992 (Day 1), the four bait concentrations were randomly assigned to the four treatment units is follows: 0.0% (unit 2), 0.5% (unit 1), 1.5% (unit 4), and 3.0% (unit 3) and applied in that order. Each active pocket gopher burrow system was treated. Probing with a metal rod provided access to the burrow. If possible, each active burrow system was baited in five different locations. At each location, the probe hole was enlarged and a approximately 10 g of bait was inserted. The hole was then sealed with paper, covered with soil, and its location flagged. To maintain

consistency, the persons assisting with the study were each assigned to either baiting or probing. The amount of bait applied per treatment unit was determined, based on the density of the pocket gophers per treatment unit.

Mortality Measurements

Pretreatment - On each treatment unit, pocket gophers were livetrapped, weighed, and anesthetized with metaphane before attaching a 6.5 g radio-transmitter (one band at either 164., 166., or 167. MHz) with a neck collar. After recovery from anesthesia, each animal was released at its capture site. The position of each radioequipped pocket gopher was determined daily for 2 consecutive days before applying the bait. If movement had occurred, the new position was flagged and recorded.

Treatment, Day 1 - After baiting, no human activity occurred on the four treatment units until 1845h when each radio-equipped animal was located underground and its position flagged.

Posttreatment, Day 2 - Beginning at midday, each pocket gopher was tracked. If movement had occurred, the new position was flagged. Any gopher without movement for two consecutive days was considered dead and its carcass was recovered. All carcasses were sexed, weighed, and examined for alfalfa bait in their cheek pouches.

Posttreatment, Days 3-7 - All pocket gophers were tracked at least once a day. Any pocket gophers that did not move for two consecutive days were considered dead and their carcasses recovered as soon

possible. Carcasses recovered were handled as described for Day 2.

Posttreatment, Day 8 - The dead, radioequipped pocket gophers located underground were excavated. Survivors were killtrapped to recover carcasses and radio transmitters. Three survivors escaped the killtrapping, survived attempts to kill them with gas cartridges, and were left on the treatment units. The percentage of mortality was computed for radioequipped pocket gophers recovered on each treatment unit.

Statistical Analysis for Mortality Data

Due to small sample sizes, Fisher's Exact Test was used to analyze the data from the field study. The following null hypotheses were tested: (1) the percent of dead pocket gophers was the same for the four treatment units, (2) the percent of dead pocket gophers was the same for the three strychnine treatment units, and (3) the percent of dead pocket gophers was the same for each individual strychnine treatment unit and the control unit.

Field Study Results

Pretreatment Radio Tracking

Two of the 70 radio-equipped pocket gophers were lost during the pretreatment tracking period. On treatment unit 1, one animal was never located after release.

On treatment unit 4, the transmitter of one animal without the carcass was recovered 2.3 cm underground the day after the animal was released.

Baiting

The boundaries of the treatment units were enlarged on April 25, 1992 to accommodate radio-equipped pocket gophers which had moved outside the existing boundaries. All treatment units were then baited. The enlarged areas were: Unit 1 - 0.89 ha (2.2 acres); Unit 2 0.61 ha (1.5 acres); Unit 3 -0.61 ha (1.5 acres); and Unit 4 - 0.77 ha (1.9 acres). Results of the baiting were as follows:

Strychnine	Kg of bait per bait	No.	Mean amount of bait of bait
0.0%	1.418	191	7.4
0.5%	2.717	242	11.2
1.5%	3.514	209	16.8
2.0%	1.789	193	9.3

Posttreatment Mortality

Mortality among the radio-equipped Townsend's pocket gophers posttreatment

	<u>Strychnine concentration</u>			
	0.0%	0.5%	1.5%	3D%
Survived posttreatment	10	3	4	3
Animals that died posttreatment	(9.1%)	(66.7%)	(71.4%)	(80%)
Transmitter only recovered	4	6	2	1
Could not locate		2	0	2 2
Total		17	15	18 18

Fisher's Exact Test indicated differences among mortality rates for the four treatments ($P < 0.0001$). No differences

were detected when Fisher's test was applied to the three strychnine treatments ($P = 0.212$).

A difference in mortality rate was indicated in each case when Fisher's test was applied to the 2 x 2 contingency tables comparing each strychnine treatment to control ($P = 0.0001$ for 0.5%, $P = 0.0037$ for 1.5%, $P = 0.0010$ for 3.0%).

Non-target Mortality

On April 27, 1992 (2 days posttreatment), we found the head, wings, and body feathers of a short-eared owl (*A. sio flammeus*) in the alfalfa southwest of treatment unit 4 (1.5%). Judging by the lack of body tissue and the appearance of the remains, this bird died pretreatment and determination of any strychnine residue by chemical analysis was impossible.

Mortality on the Surface and

On April 30, 1992, (Day 5 posttreatment), we found a desiccated pocket gopher carcass with only skin and bones remaining on the surface of unit 1 (0.5%). This animal also appeared to have died pretreatment.

All 29 radio-equipped pocket gophers that died were recovered underground, at depths ranging from 10.2 cm (4 inches) to 121.9 cm (48 inches), with a mean of 67.1 cm (26.4 inches). These animals were excavated posttreatment on Days 2 (1 animal), 3 (20 animals), 4 (5 animals), 6 (1 animal), 8 (1 animal), and 9 (1 animal). The animals recovered on Days 8 and 9 probably died days before they were

excavated. The animal excavated on Day 8 was in the same location since Day 4. The animal excavated on Day 9 was decomposed, and no movement had been recorded for three days before excavation. Six of the 29 animals (21%) had bait in their cheek pouches, and green dye from the bait was visible inside the cheek pouches of a seventh animal.

Discussion

Since no differences in mortality were detected among the three strychnine treatment units, the optimum strychnine concentration of those tested for control of Townsend's gophers was not identified. The 13% difference in mortality that separated the lowest (0.5%) from the highest concentration (3.0%) was less than the 57% difference in mortality reported for the same two concentrations under laboratory conditions (Matschke and McCann, 1992; Matschke et al. 1992a). This 13% difference in mortality under field conditions may reflect the actual response of the pocket gophers to the strychnine baits. Until a better method of attaching radio-transmitters to Townsend's pocket gophers can be developed, alternate methods (closed hole technique or mound building activity) than radio-telemetry should be considered to evaluate mortality. The small sample size of the recovered radio-equipped pocket gophers affected the sensitivity of the test for detecting differences in mortality among treatments by reducing the statistical power of the tests and by precluding the use of more sensitive statistical methods such as Pearson's Chi-square.

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