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MANAGING PIUTE GROUND SQUIRRELS IN CROPLAND IN SOUTHWEST UTAH

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ABSTRACT

The Piute ground squirrel, (*Spermophilus mollis*) previously known as a subspecies of Townsends ground squirrel, populations on agricultural lands are increasing in southwest Utah. A small, gray squirrel found predominantly in the Great Basin, the Piute ground squirrel can cause significant damage to alfalfa, grasses, and other agronomic crops. The reduction in alfalfa and other crop yields and the cost of controlling Piute ground squirrels to farmers in western Utah exceeds hundreds of thousands of dollars annually (Nelson et al. 2012). Squirrels have increased in infested areas each year and are showing up in places not previously found. Previous control programs such as shooting, flooding, treating with zinc phosphide and gopher bait have not been effective. For the past several years Utah State University Extension has conducted trials to determine which baits are most accepted and when is the best time to apply them. We conducted 2 experimental case studies to test the effectiveness of Rozol (a pelleted bait) and Fumitoxin to reduce ground squirrel numbers in southern Utah. Both Rozol and Fumitoxin reduced ground squirrel numbers in our treated sites.

INTRODUCTION

Ground squirrels are troublesome rodent pests for farmers and homeowners. The Piute ground squirrel is commonly found in the Great Basin of Utah and Nevada (Biotics Database, 2005). The species is found in western Utah along the Nevada border, but has also been found in central Utah. It was formerly considered a sub-species of Townsend's ground squirrels, but have now been recognized as separate species. The Piute ground squirrel eats grasses, seeds, alfalfa, other agronomic crops, and sometimes meat. The species mates in late winter or early spring, and females produce a litter of five to ten young, about 24 days after mating. Because of its affinity for crops, the Piute ground squirrel can cause major agricultural damage in areas with large populations (Nelson et al., 2012).

Piute ground squirrels live in colonies and construct underground burrows that have several entrances. They hibernate during the coldest part of the winter. Males usually become active above ground 1-2 weeks before the females in the spring, sometimes as early as late January, but usually in early February. A few may be active above ground throughout the year. Breeding occurs immediately after hibernation. The young are born after a 4-to 5-week gestation period with 2 - 10 young per litter. Generally, only 1 litter is produced each year (Merritt et al., 2010). Densities of the ground squirrel populations can range from 2 to 50 or more per acre. At higher densities it is difficult for a farmer to obtain a profit from the harvest, due to the amount of damage incurred to the property and crop (Nelson et al., 2012).

Managing Piute ground squirrel populations can be challenging because of a combination of climate, ground squirrel biology, and approved pesticides labeled for use in Utah. Additionally, while much is known about Townsend's ground squirrels, little research has been conducted on the subspecies Piute ground squirrel in particular. When managing vertebrate pest populations, ideally, control efforts target females to result in the greatest impact to the population size (Van Horne et al., 1997); however, if treatment cannot occur before females give birth, controlling all segments of the population during their short active season is necessary. Utah's current control programs for Piute ground squirrels target the animals when the adults first emerge from hibernation and begin to breed, usually starting in the middle of February and lasts until the alfalfa greens up around the middle of March. Since emergence is related to soil temperature, in some years Piute ground squirrels do not emerge until early March. This limits the window of opportunity for effective ground squirrel control. Therefore, producers need a variety of options available for controlling the population under varying soil conditions.

RODENTICIDE BAITS

Rodenticide-treated baits have traditionally been the mainstay of ground squirrel control. Diphacinone and other anticoagulant rodenticides are considered multiple feeding toxins, meaning that a ground squirrel must feed on the bait multiple times over several days to ingest a toxic dose (Nelson et al., 2020). Anticoagulant rodenticides have low primary toxicity concerns (that is, mortality of nontarget wildlife that directly consume the toxicant), partly because they require multiple feedings to acquire a toxic dose and because they can be applied in bait stations that are not generally accessible to nontarget species. Most lethal control methods, such a toxic bait, require bare ground before they can be applied, which in southern Utah, can sometimes be as late as mid-March in

southern Utah (Nelson et al., 2020). As a result, in many years there is a span of 1-3 weeks in which female ground squirrels are still active above ground (i.e. they are still breeding) and the ground is suitable to apply licensed toxic bait to reduce ground squirrel populations.

There are two registered pesticides and delivery mechanisms registered for use in Utah on ground squirrel species. Wilco (Wilco Distributors, Lompoc, CA) makes a pelletized bait with a 0.005% diphacinone solution, registered to manage Townsends' ground squirrels in Utah. However past research has determined that Piute ground squirrels will not collect or consume this bait (M. Nelsen, personal communication). Previous to our case studies, there were no licensed grain baits available for use to control Piute ground squirrels in Utah. There were a few registered pesticides used to treat ground squirrel species in other states. Rozol consists of a grain bait with 0.005% chlorphacinone, and is labeled for use on black-tailed prairie dogs (*Cymomys ludovicianus*, Liphatech, Milwaukee, WI).

FUMIGATION

If one cannot target the female Piute ground squirrels prior to their producing offspring, managing the population during the active season is problematic. Once alfalfa begins to grow, toxic grain bait treatments have little effect. Ground squirrels select their forage based on water and protein content (Van Horne et at., 1997, particularly as the season progresses into summer. While seeds and grains are important to their diet, consumption of seeds decreases in dry conditions. Consequently, once it begins to grow, alfalfa is more desirable than dried grain or even the surrounding native shrub habitat. Fumigation is a possible alternative to baits; it is not dependent on ground squirrel diet or behavior. Fumigation is the practice of systematically filling a ground squirrel tunnel system with poisonous gas, most often aluminum phosphide or gas cartridges. However, it is lethal to all mammals, and therefore you must have an applicator's license to use it. Additionally, it is often more costly than toxicant baits (Baldwin, 2012). Once the gas has dissipated from the burrows, it is gone from the ecosystem; furthermore, there are no secondary hazards to predators that scavenge the squirrel carcasses.

There are few studies that have measured the effects of fumigation on controlling ground squirrels; these studies have determined that fumigation methods – including pressurized carbon monoxide, aluminum phosphide tablets and gas cartridges – may be an effective tool under certain conditions (Baldwin et al., 2012). For example, aluminum phosphide tablets are most effective with moist soil conductions. Fumigation is most effective when applied following ground squirrel emergence from hibernation and before the squirrels have time to reproduce. However, fumigation during other times of the year, such as during pup-rearing may also be effective; recently born squirrels, too young to venture above ground to be baited or trapped, are effectively controlled by fumigants.

The few studies that exist on ground squirrel lethal baits and fumigation occur outside in the Intermountain west, with different soils and climate to this region of the United States. Therefore, we determined to study a new method of rodenticide bait and fumigation as possible effective methods to control Piute ground squirrels in southern Utah. We were limited in our ability to use these non-registered methods; therefore, we consider these as case studies that promote future research.

METHODS

Because we were using products in a way that is not currently registered in Utah, we consulted with the Utah Department of Agriculture and Food to determine our ability to research the use of these products as the first step in conducting research to change the product registration. As per our consultation, we limited each type of application to 1 acre per treatment type. All the case studies took place on or near crop ground that was planted to alfalfa. The squirrels prefer alfalfa to other crops or grasses.

Ground Squirrel Surveys:

Survey methods were the same for each part of the study. We conducted 2 indices to measure a change in ground squirrel populations: visual counts and active burrow indices. Visual counts were conducted on days with <50% cloud cover and sustained winds <20 mph, to reduce the influence of weather on monitoring ground squirrel activity. Pre-treatment visual surveys were conducted on each study plot for a total of 3 days, 1-3 days prior to the beginning of the baiting. We made the surveys for 3 consecutive days, and randomly assigned the order in which study plots are surveyed. Post-baiting surveys began 7 days after the initial application of control, and continued for 3 days.

Visual counts were conducted from within a truck, roughly 300 feet from the study plots. Upon arrival to a study plot, the observer waited 5 minutes before starting the survey, to minimize the effects of human disturbance on squirrel activity. We determined 5 minutes was adequate because after that amount of time, squirrels near the truck resume their activity. Using binoculars, the observer began to count squirrels on one side of the field, excluding the buffer, and slowly panned across the field for 2 minutes. The observer recorded the number of ground squirrels counted. The observer then waited 5 minutes and repeat the process two more times, for a total of 3 surveys. The highest number of squirrels counted per 2-minute scan was recorded as the official count.

Active burrow indices were conducted pre- and post-treatment. Three days before the beginning of the trials, all burrows were covered, in each treatment plot and the control plot. Active burrows, indicated by fresh excavated soil, will be flagged. After 48 hours, we resurveyed the plots, checking each flagged burrow and looking for any fresh new burrows. If any had been opened, we considered these active burrows. After the post-treatment visual count surveys were completed, we repeated the active burrow count indices.

Rozol Spot Treating

This portion of our study was conducted March 3 – March 16, 2016. For the treatment, we used a 1-acre field. Additionally, we had one 1-acre field for control, which had no pesticides applied. Each plot was selected such that there was a minimum of 20 ground squirrels visibly present in the survey area. The perimeter of each plot (63.7m x 63.7m) was mark with colored flagging. Around each plot, a 61m. buffer was also marked with flagging (of an opposing color). The buffer zone was included in the pesticide application, but not the surveys for squirrel activity. Each study area (and buffer) was separated from the next study area by at least 91m.

To apply Rozol, we used a grain bait with 0.05% Diphacinone and 95% inert ingredients. Because this was an experimental use of the product, we referred to label instructions for pocket gopher control and prairie dog control. Using ≤ ¼ cup per burrow hole, we applied the bait directly at each active ground squirrel hole. All active holes were treated on the same visit. The control field was visited in a similar manner to the treated fields, but without any application of poison or placebo bait. We treated all burrow openings that appeared to be active during the pre-treatment, applying the bait to the study area as well as the buffer zones.

Fumigation Methods

We tested the effect of fumigation to control ground squirrel numbers by using Fumitoxin (55% Aluminum phosphide, 45% inert ingredients), a restricted use fumigant. Our study on fumigation was conducted May 22 – June 1, 2018. For this treatment we created 1 treatment and one control plot, each 1 acre. Each plot was selected such that there was a minimum of 20 ground squirrels visibly present in the survey area. Each plot was 91m x 44.2m, surrounded by a 61m buffer on 3 sides. The fourth side was a low-density paved road, approximately 30m wide.

To apply the fumigant, we place Fumitoxin in each cluster of active ground squirrel holes, according to the manufacturer's instructions. Wearing proper protective equipment 2 persons entered the field and applied Fumitoxin to each cluster of active ground squirrel burrows. Four tablets were placed into an active burrow. The hole was then packed with dirt to prevent gas from escaping; as gas was discovered exiting other holes, these holes were also filled in with dirt. Application was repeated until all active holes were closed. We treated all active holes in the study plot and the buffer area. The control plot was visited in the same manner, however, no Fumitoxin was applied.

RESULTS AND DISCUSSION

Baits

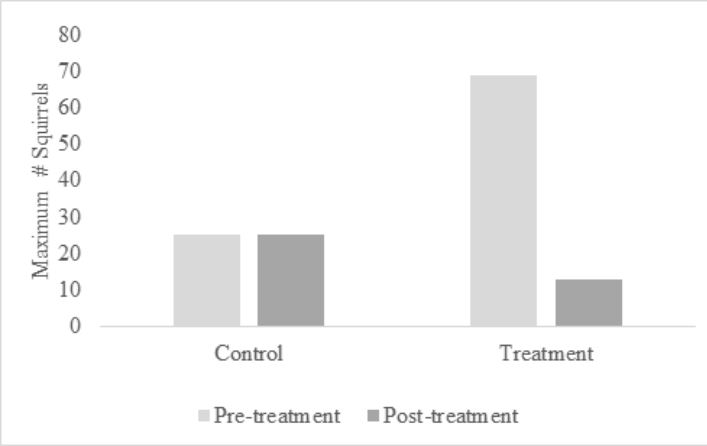

Figure 1. The maximum number of ground squirrel counted during visual surveys pre- and post-spot treatment with Rozol grain bait Milford, Utah, March 3-22, 2017.

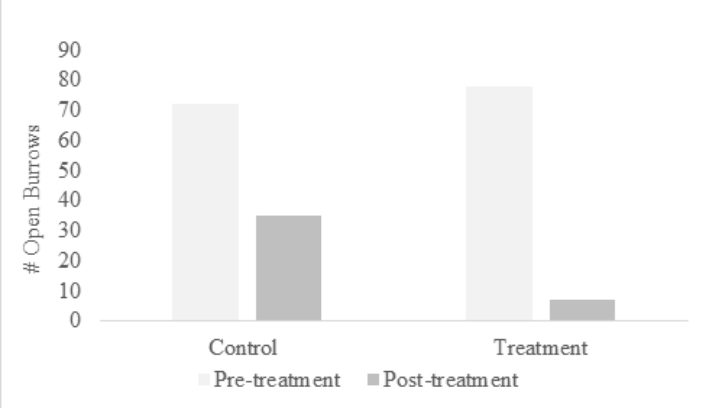

Figure 2. The number of active burrows detected pre- and post-spot treatment with Rozol grain bait, Milford, Utah, March 3-22, 2017.

The results of our case studies suggested that spot treatment of Rozol was effective at reducing squirrel abundance (Figure 1 and 2). During our study, we counted 81% less ground squirrels on our treated site after the treatment; ground squirrel detections did not change in the control site. During our study, both the treated and control sites exhibited a reduction on open squirrel burrows; however, the treatment plot experienced an 91% reduction, whereas the control plot experienced a 51% reduction. Therefore, we conclude that the Rozol treatment was effective at reducing ground squirrel numbers.

Anticoagulant baits generally require two to four weeks, and sometimes longer, to control populations (Nelson et al., 2020). We noticed a sharp reduction in survey counts within the first two weeks; however, the population continued to decline for nearly three weeks. We recommend that operators maintain bait levels in stations for at least 3 weeks, to ensure the highest level of efficacy in the bait application. In conjunction with these results, the State of Utah has issued a Section 24(c) Special Local Need Label for the Rozol Vole Bait (0.05% Diphacinone) for the control of the Piute ground squirrel. This label allows for bait station baiting and spot baiting.

Our study determined that Rozol could be used to reduce ground squirrel populations prior to the alfalfa growing season. We recommend additional research to determine the efficacy and specific timing that would increase the efficacy of this product. For example, spot baiting was effective, but would most likely be

more time consuming than using bait stations. When spot baiting, operators must ensure that all active burrows receive the bait, by scattering bait near each active burrow opening, as specified by the label. If there are small areas that need to be targeted, this method would be efficient; however, bait stations will be more efficient in areas where general control is needed, or in larger production operations.

Fumigation

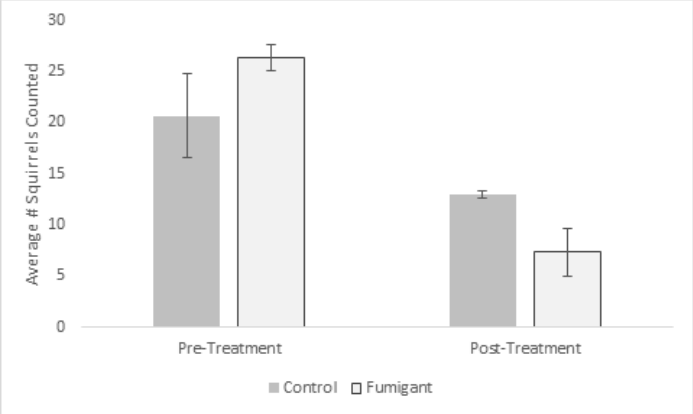

Figure 3. The average number of ground squirrels counted in a plot treated with Fumitoxin and a control plot, Milford, Utah 2018.

We observed similar number of ground squirrels in our control (20.7 ± 1.3) than the treatment plot (26.3 ± 4.1) prior to the application of Fumitoxin. Based on our post-treatment counts, Fumitoxin reduced ground squirrel numbers in our treatment plot (7.3 ± 0.3) compared to our control plot (13 ± 2.3). One day after treatment, we counted 1 ground squirrel on the treated plot, and 9 squirrels in the control plot. Three days later the treated plot showed visual counts of 5 squirrels. We suggest that this increase in ground squirrel numbers indicates how quickly an area can become recolonized.

Our study resulted in 97% control of ground squirrels when using the Aluminum Phosphide tablets. Because of the possible danger to humans, the application of aluminum phosphide can be labor intensive: proper protective equipment must be worn, each active burrow must have up to 4 tablets inserted into the burrow and then be covered with dirt.

Fumigation is most effective in spring, or at other times when soil moisture is high such as immediately after irrigation. Moist soil helps contain the gas within the burrow system or may be required to properly activate certain fumigants (e.g. aluminum phosphide). We recommend additional research to expand the study into different soil types, where moisture may differ. Additionally, future research may measure efficacy of this treatment type, including an economy of scale, compared to other treatment options.

CONCLUSIONS

Past research suggests that rodenticide treated baits are the most economical of all approaches to population reduction and hence have traditionally been the mainstay of ground squirrel control (Hazen et al., 1992). Diphacinone and other anticoagulant rodenticides are considered multiple feeding toxins, meaning that a ground squirrel must feed on the bait multiple times over several days to ingest a toxic dose. Our study measured up to 75% control of ground squirrels when Rozol, a pelleted bait, was applied before alfalfa began to green up in the spring. When baiting before the alfalfa growing seasons is not possible, fumigation may be an alternative option. Our case study suggests that Fumitoxin can successfully reduce ground squirrels in silty clay loam soil conditions.

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