

Title: Using a Spot-Treatment Method to Control Townsend's Ground Squirrels (*Spermophilus townsendii mollis*) in Irrigated Crop Ground

Location of Project: Beaver County, Utah

Total Grant Award: \$10,000.00

Project Personnel: Mark Nelson (Project Leader). Nicki Frey (Project Co-leader)

Project Duration: February 1, 2016 – February 1, 2017.

Summary of Project

We studied a method of spot-treating, which is directly treating only active burrows. We tested this method using Rozol Vole bait and Ditrac Ground Squirrel bait. Additionally, Nevada uses cabbage laced with zinc phosphide to control Townsend's ground squirrels. We also tested this method in Utah. We conducted three different trials using these baits. The first trial comparing Rozol and Ditrac baits were very effective because they were conducted in March before the alfalfa greened up. We repeated the trial in May and the results were very poor because the squirrels ate the alfalfa instead of the baits. In May we also conducted a trial using concentrated zinc phosphide on cabbage and the study was quite successful. The concentrated zinc phosphide can only be purchased through USDA and has to be applied using gas masks. More work on getting this labeled in Utah will have to be done before this method can be recommended for use to control the ground squirrels in Utah.

Objectives of Project:

1. To train farmers impacted by ground squirrels about integrated pest management approaches to Townsend Ground Squirrels in irrigated crop ground.
2. To determine the effectiveness of spot treatment of Ditrac Ground Squirrel Bait, Rozol Vole Bait and concentrated Zinc phosphide to control ground squirrels.
3. To determine the effectiveness of using bait stations in May, when juveniles come above ground, to control ground squirrel densities.
4. To pursue labeling baits for ground squirrel control in Utah.

Results of Project and Evaluation and Impact:

Townsend's ground squirrels, subspecies Piute ground squirrel, (*Spermophilus townsendii mollis*) populations on agricultural lands in Beaver County, Utah are increasing. Hundreds of acres of alfalfa ground in western Beaver County are currently infested with the ground squirrel. High populations of ground squirrels can compete with livestock for forage; destroy food crops, golf courses, and lawns; and can be reservoirs for diseases such as plague. Their burrowing activities alter irrigation systems. Burrow mounds not only cover and kill vegetation, but can damage haying machinery.

Our current control programs target the ground squirrels from when they first come out of hibernation, before they start breeding, usually starting in the middle of February and lasts till the alfalfa greens up around the middle of March. This is only a 30-day - or less - window of control. Sometimes, due to snow or cold temperatures, this window of application might only last 2-3 weeks. Unfortunately, it appears our current method is not flexible in order to coincide with the biological activity of ground squirrels each spring.

Study Area

Field trials were conducted in cooperation with local alfalfa producers in Beaver County. Beaver County is considered high desert, part of the Great Basin. Native vegetation communities consist of sagebrush-steppe in the valleys, transitioning into pinyon-juniper along the hillsides. Most farmers conduct irrigated agriculture, for alfalfa and wheat, in the valleys of the county.

Survey Methods

Field trials will consist of the following treatment types: A) spot treating ground squirrel burrows with either Ditrac or Rozol; B) spot treating ground squirrel burrows with Ditrac, distributing Rozol via bait stations and C) treating cabbage with zinc phosphide and baiting in fallow corners of irrigated agriculture. We will use fields of farmers that are willing to cooperate with our study.

Ground Squirrel Surveys: Survey methods were the same for each part of the study. These surveys were repeated in entirety for each part of the survey (A,B, or C). 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 4 days, 1-3 days prior to the beginning of the baiting. We attempted to make them 4 consecutive days, and randomly assigned the order in which study plots are surveyed. Post-baiting surveys began 7 days after the initial application of bait.

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, squirrel 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 average number of squirrels counted per 2-minute scan was recorded as the official count. Visual surveys were conducted for 3 consecutive days immediate prior to baiting. Seven days after baiting, we repeated the 3-day visual surveys in each plot.

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. 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.

Spot Treating with Ditrac or Rozol:

For each compound, we used a 1-acre field. Additionally, we had one 1-acre field for control, which had no pesticides applied; for a total of 3 acres in this study. Each plot was selected such that there was a minimum of 20 ground squirrels visibly present in the survey area. The perimeter of the plots (209' x 209') was mark with colored flagging. Around each acre a 200 ft. 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 300 feet.

To apply the Ditrac, we used label instructions as approved for California ground squirrels in Utah to determine the amount of pesticide to use. This was similar to methods used in California from which we derived our study methods. We used a standard $\frac{1}{4}$ cup measuring cup to calculate the appropriate amount of pesticide to distribute, and spread the pesticide near each active squirrel burrow hole. To apply Rozol, we referred to label instructions for pocket gopher control and prairie dog control. Using $\leq \frac{1}{4}$ cup per burrow hole, we applied the bait directly at the ground squirrel hole.

Both pesticides were applied on the same day or within 24 hours. 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 in the pre-treatment survey conducted just prior to the baiting, applying the bait to the study area as well as the buffer zones.

Ditrac vs. Rozol in Bait Stations

To conduct our next trial, we used the same study plots used in the spot treatment studies. To apply the Ditrac, we used label instructions as approved for California ground squirrels in Utah to determine the amount of pesticide to use. This was similar to methods used in California from which we derived our study methods. We used a standard $\frac{1}{4}$ cup measuring cup to calculate the appropriate amount of pesticide to distribute, and spread the pesticide near each active squirrel burrow hole.

Bait stations were used to deploy Rozol once juveniles had left the burrows, in late April – early May. Bait stations were distributed at 50ft intervals across the plot and the buffer zone. Bait stations were checked every 2-3 days to ensure that bait was consistently available to ground squirrels. Bait stations were active for 7 days. At the end of 7 days, we conduct post-treatment ground squirrel surveys and burrow surveys, similar to those conducted in the efficacy trials.

Zinc Phosphide

We used 2 of the same plots used in the first two trials, and 2 new plots for this portion of the study. The first of these 2 plots had been used as a control in the first trial, and had seen little effect in the second trial. The second of these 2 plots had been the control in the second trial, and therefore there were many squirrels left on this plot. Once we had conducted ground squirrel surveys, and two days before the trials began, we pre-baited the study fields with cabbage that had no pesticide. We followed the process of preparing cabbage for zinc phosphide bait, cutting the cabbage and placing 1-2 oz. at each active burrow. After the pre-bait period, we applied zinc phosphide using the label instructions for use in California, at a rate of $\frac{1}{4}$ cup (2 oz) of zinc phosphide and 24 oz of cooking oil per 20 lbs of cabbage. We distributed 1-2 oz. of baited cabbage at each active burrow.

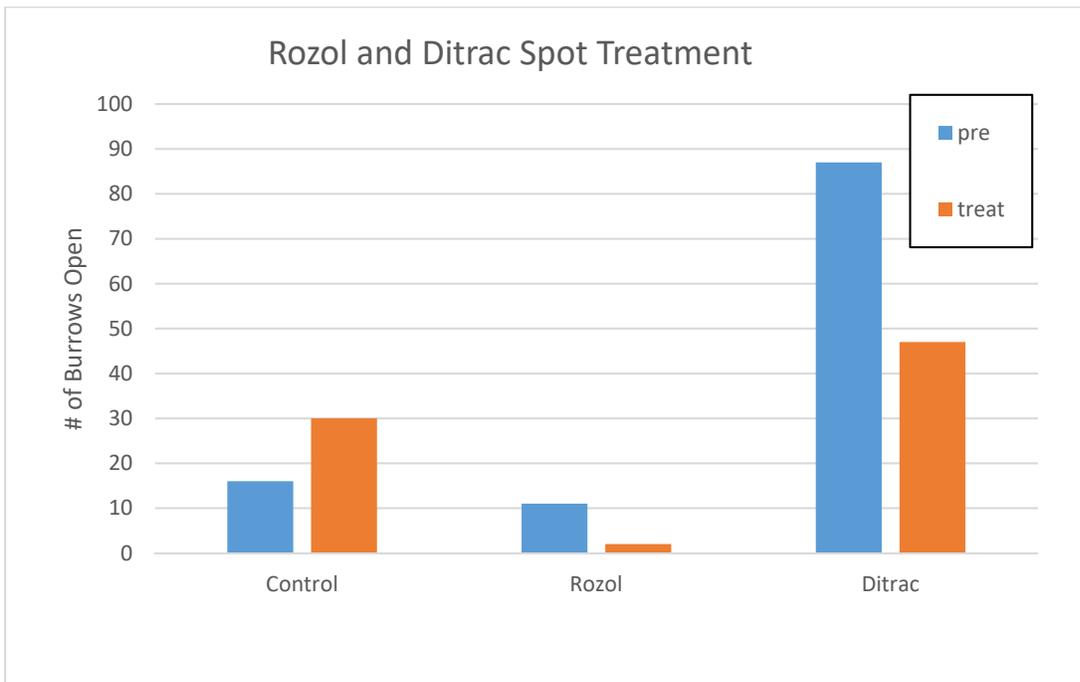
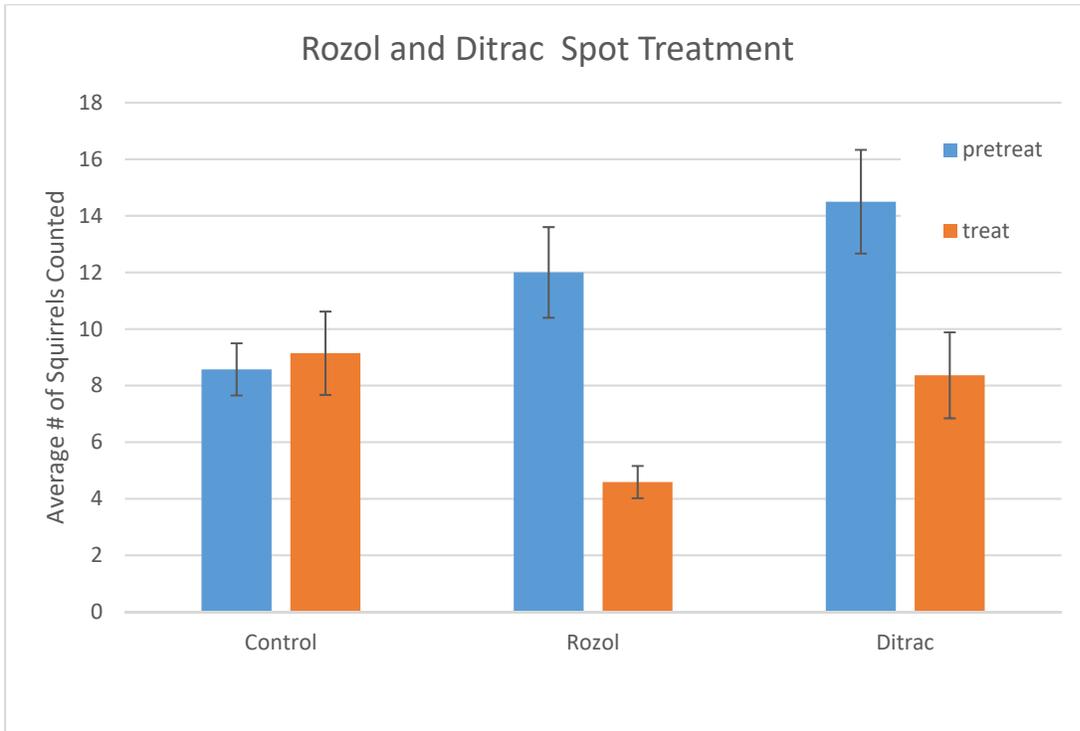
Zinc Phosphide is a fast-acting chemical; animals can and do die above ground, becoming accessible to hawks and eagles. Once the chemical is ingested it can remain active for several hours until the gasses dissipate. While the probability is low, there may be an indirect hazard to predators when using this method. In addition to the ground squirrel surveys conducted for the previous 2 trials, we also conducted carcasses searches for ground squirrels 48 hours after the application of Zinc Phosphide.

Statistical Analyses

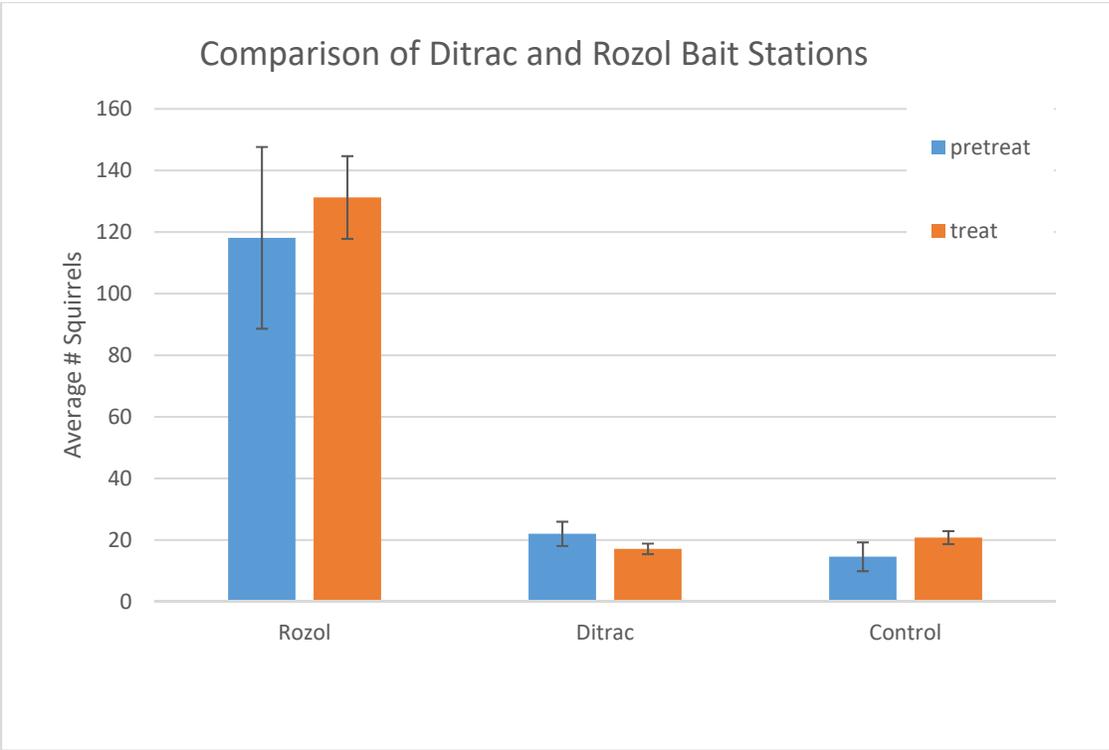
For each trial of the study, we will use the average number of ground squirrels observed during the visual scans and active burrow counts as indexes of the population density in each plot for the day counted. We will calculate the average number of squirrels recorded for the pre-treatment and post-treatment count period for each plot. We will also record the number of active burrows per study area in the pre- and post-treatment periods. We will use Kolmogorov-Smirnov nonparametric test to compare the number of ground squirrels recorded in pre- and post-treatment periods. We also will use a one-way ANOVA and Duncan's multiple range test to compare results from pre- and post-treatment counts. The measure of the success will ultimately be a reduction in the numbers squirrels counted.

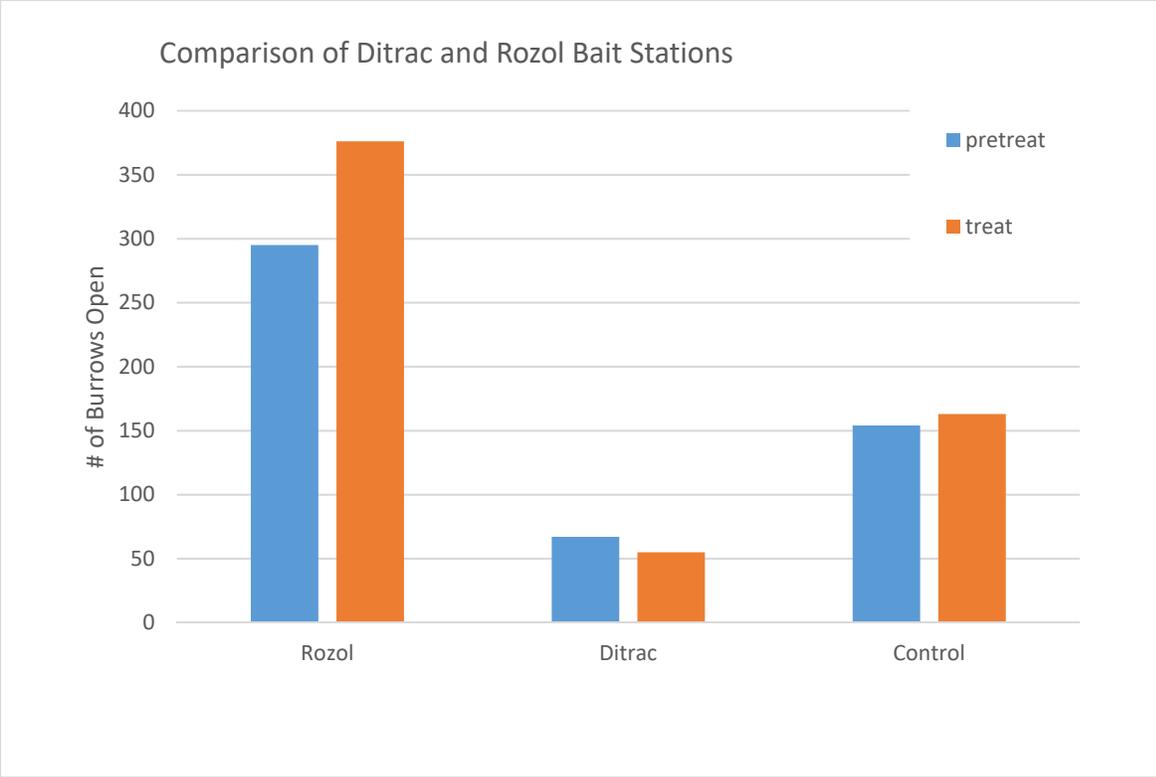
Results

A. Spot Treatment of Ditrac and Rozol to control adult ground squirrels

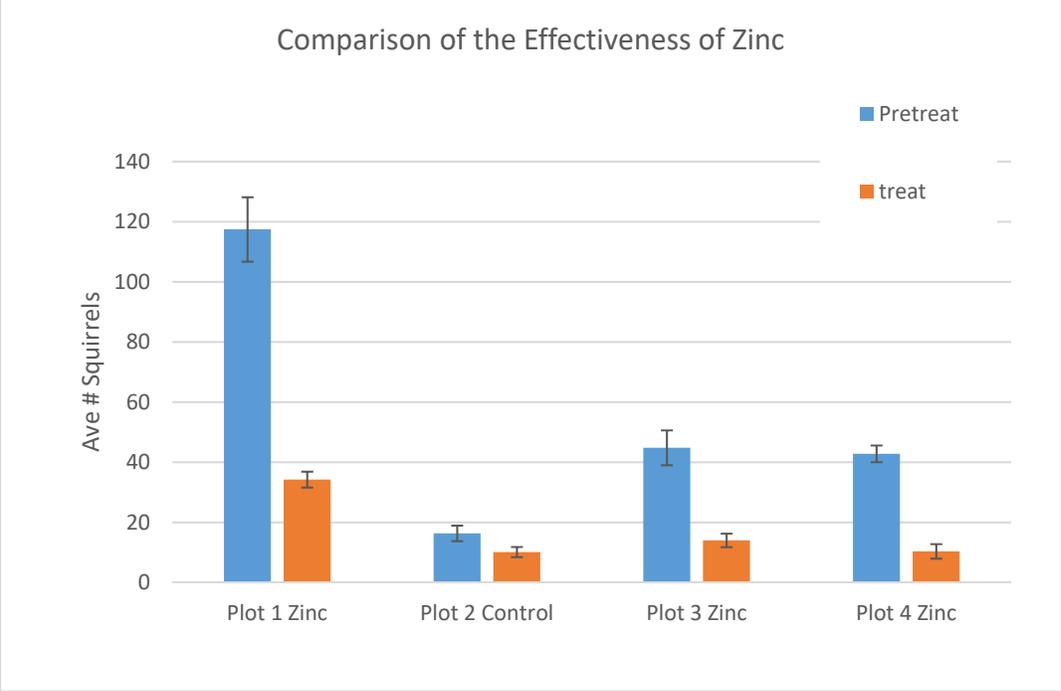


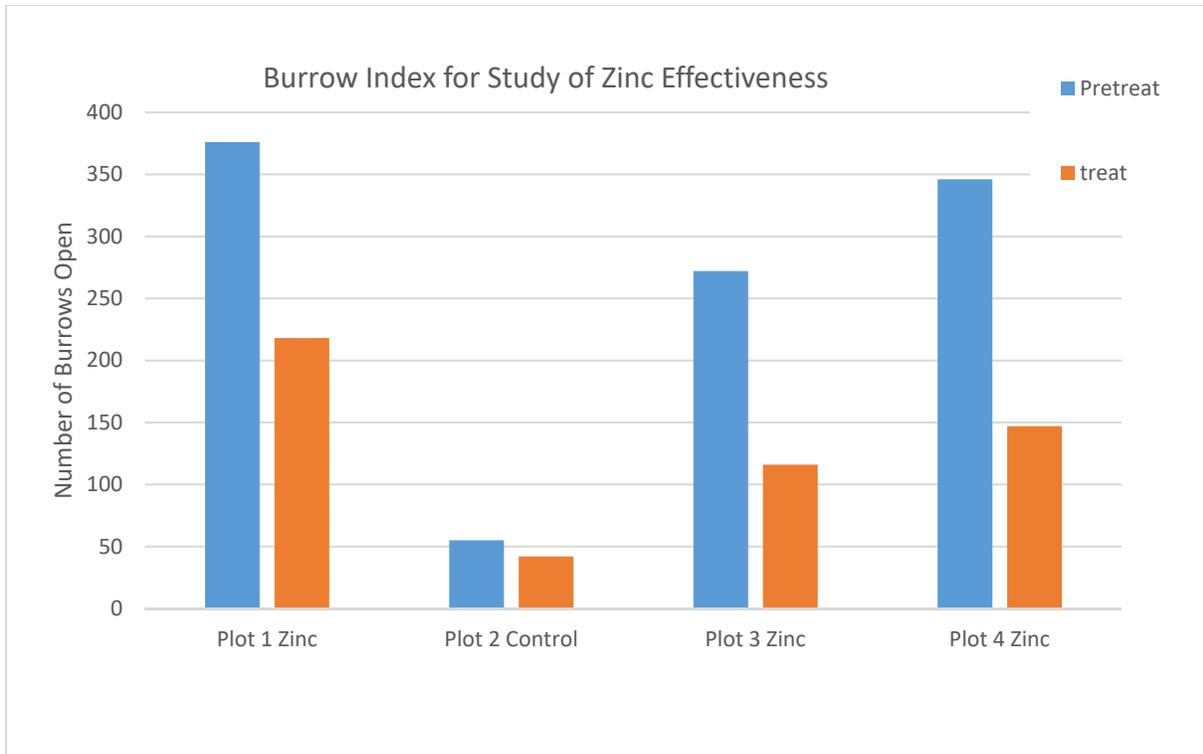
B. Ditrac compared to Rozol Bait Stations for adult and juvenile ground squirrel control.





C. Study to Determine the Effectiveness of Zinc to Control Ground Squirrels





Educational Outreach and Educational Products Produced:

We shared the results of the trials at the 2017 crop school held at the Beaver County Fairgrounds. We also presented this information at the 2016 Pesticide Training in Richfield, Utah. I was invited to present this information at the 2017 IFA Crop School in Cedar City February 2017. We plan on presenting our results at the 2018 Vertebrate Pest Conference in Northern California. We have created several power point presentations that I will attach to this document.