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BAIT PREFERENCE FIELD STUDY OF THE CALIFORNIA GROUND SQUIRREL

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ABSTRACT: A bait preference field study of the California ground squirrel (Spermophilus beecheyi beecheyi) was performed involving the comparison of the following untreated bait formulations fed ad lib.: oat groats, Ramik Green, and ZP Rodent Ag Bait. The study was performed on rangeland at California Polytechnic State University, San Luis Obispo, California, from March 11, 1984, to September 15, 1984.

Poor bait quality problems occurred in the early period of the study (March 11 to May 17), resulting in poor acceptance of both Ramik and Ag Bait. A descriptive analysis of this period is discussed. The statistical analysis of relative bait consumption (June 3 to September 15) determined a significant difference between the consumption of oat groats versus Ramik and Ag Bait; no significant difference between Ramik and Ag Bait; the acceptance of all three baits was good; and the use of any of the three would result in control of the ground squirrels. There was a strong correlation between overall bait consumption and the ground squirrels observed.

INTRODUCTION

Palatability and acceptance of bait are important aspects of an effective ground squirrel control program when using rodenticide baits. Since the rodenticide bait is in competition with the ground squirrel's natural food source, it is essential that the bait selected be palatable. Equally important is the timing of the application, as the rodenticide should be presented during the period of the ground squirrel's life cycle that maximizes optimum control.

Both palatability and acceptance of bait are affected by bait composition, bait modification, and shelf life. The bait chosen must be attractive to the target species. Grains commonly used in bait formulations include barley, oats, and wheat, and can be used whole or mechanically modified (Clark 1975). Mechanical modification includes crimping and rolling of grains or combining grains in a pelleted formulation.

It is necessary that the quality of the bait be maintained. Rodents do not like grain that is dirty, old, stale, or moldy (Smythe 1976). Qualities that make a manufactured bait palatable at the time of formulation should be maintained for a prolonged shelf life. The manufacturing process should guard against rancidity, molding, and general quality loss (Miller 1974).

METHODS AND MATERIALS

The purpose of the study was to determine the bait preference of the California ground squirrel (Spermophilus beecheyi beecheyi) in a rangeland situation. Ground squirrels were offered ad lib. choice of the following untreated, nontoxic bait formulations: oat groats, a lightly rolled oat with the hull removed; Ramik Green, manufactured by Velsicol Chemical Corporation at the time of the study; and ZP Rodent Ag Bait, manufactured by Bell Laboratories, Inc.

The study length was from March 11, 1984 to September 15, 1984, and was conducted at California Polytechnic State University, San Luis Obispo, California. The habitat was rangeland, with ground squirrel colonies located in the scattered rock outcrops. The study was composed of five test blocks, each block being located at a separate ground squirrel colony (Figure 1). Within each block were three separate bait stations, containing the oat groats, Ramik, and Ag Bait, that were spaced in a line at 2-foot intervals. The bait stations were surrounded by a barbed wire fence designed to keep rangeland cattle from disturbing the bait stations.

All of the bait stations were identical in design. The material used was ADS agricultural pipe, 4 inches in diameter. Two separate pipe sections, 2 feet and 3 feet in length, were joined at a 90-degree angle by a plastic elbow forming and "L" shape design. The upright 3-foot pipe section was fastened to a metal stake for support. A removable plastic cap covered the top of the bait station, and a plastic cap cut in half was attached to the feeding end. The bait stations were designed to allow ample supply of bait for continuous feeding by the ground squirrels; keep nontarget animals out while allowing ground squirrels easy access to the bait; and provide protection of the bait from weather conditions.

Consumption of the oat groats, Ramik and Ag Bait within each block was determined at weekly intervals. Frequent monitoring and addition of bait ensured a continuous bait supply. The three bait stations were rotated within each block at weekly intervals to prevent inaccurate consumption due to the ground squirrels feeding at a common location.

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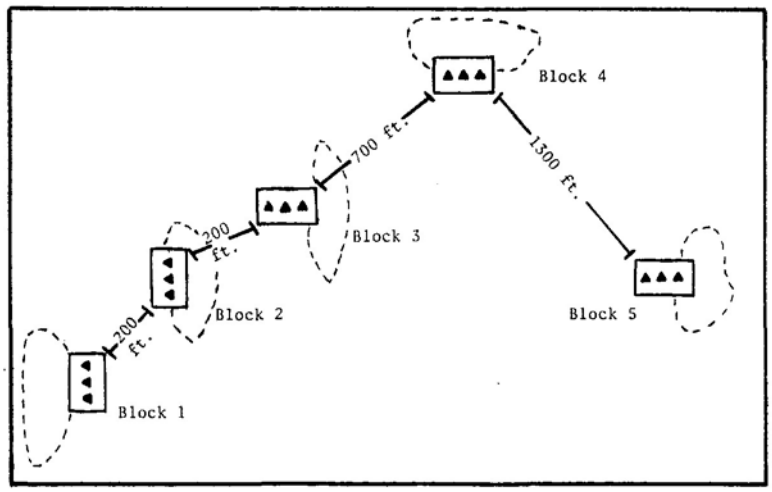

Figure 1. The study area. The bait stations and surrounding barbed wire fence at each block are represented by rectangles with solid triangles inside. The dotted lines indicate the area of burrow entrances within each colony.

Relative ground squirrel activity for each block was determined monthly. Counts were made during the middle of each month (March to September), and consisted of a visual squirrel count of approximately 30 minutes at each block. The counts were performed between 9:00 am and 12:30 pm, during the period of optimum aboveground activity for the given month.

RESULTS

Statistical analysis of relative bait consumption was performed using a randomized complete block design. Due to problems with bait quality during the early stages of the study, the data were analyzed separately for two time periods: Period I (March 11 to June 2), and Period II (June 3 to September 15). Consumption data includes the comparison of oat groats, Ramik, and Ag Bait within the five test blocks, along with overall consumption data (Table 1).

Table 1. Relative bait consumption tables of Period I and Period II, listed separately and combined.

PERIOD I (March 11 - June 2)

Block	Oat groats	Ag bait	Ramik
1	69.32	7.20	9.21
2	52.39	5.78	7.43
3	74.48	6.72	9.30
4	50.69	4.59	5.53
5	70.05	11.40	11.62
Total	316.93 kg	35.69 kg	43.09 kg

PERIOD II (June 3 - September 15)

Block	Oat groats	Ag bait	Ramik
1	52.19	37.20	37.71
2	39.61	32.55	30.90
3	51.17	35.80	37.03
4	43.60	28.97	30.39
5	77.76	39.92	36.43
Total	264.33 kg	174.44 kg	172.46 kg

PERIOD I & II (March 11 - September 15)

Block	Oat groats	Ag. bait	Ramik
1	121.51	44.40	46.92
2	92.00	38.33	38.33
3	125.65	42.52	46.33
4	94.29	33.56	35.92
5	147.81	51.32	48.05
Total	581.26 kg	210.13 kg	215.55 kg

The correlation between overall bait consumption and the index of relative ground squirrel activity was analyzed using simple linear regression. Overall bait consumption was based on a daily average of bait consumed each month, and relative ground squirrel activity was determined by the monthly squirrel counts. A graph is included which depicts the correlation (Figure 2).

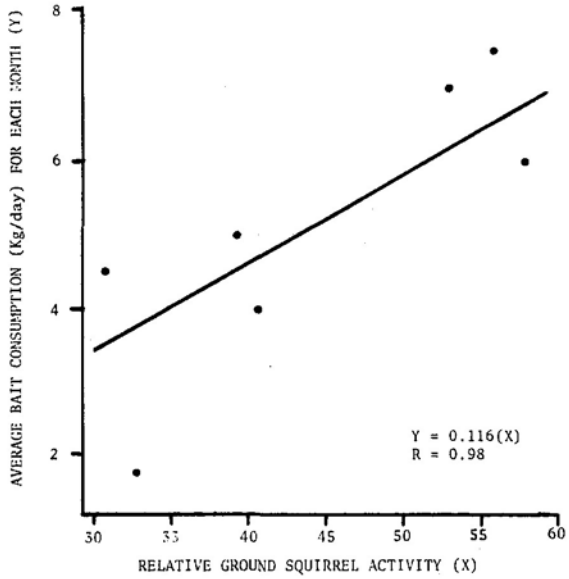

Figure 2. Linear correlation between overall bait consumption and relative ground squirrel activity.

DISCUSSION

Relative Bait Consumption

Bait quality problems were evident during Period I. The pelleted formulations of both Ramik and Ag Bait were initially poorly accepted by the ground squirrels. The baits had been stored for more than 1 year and apparently lacked freshness and quality. The Ramik pellets were replaced by new pellets (April 8), which later molded, due to a high-water content. These pellets were replaced by a fresh bait formulation (May 17). The original poor quality Ag Bait was replaced by a fresh bait formulation (May 5). The oat groats were fresh and of good quality from the beginning of the study, and initially were the bait most readily accepted by the ground squirrels. By May 17, all three bait formulations were of good quality. Consumption of the Ramik and Ag Bait immediately began to increase (May 12 to June 16), indicating greater acceptance of the fresh pellets.

Analysis of Period I clearly shows the ground squirrels consumed a greater amount of oat groats, resulting in a significant difference between the consumption of oat groats versus Ramik and Ag Bait (Figure 3). There was no significant difference in consumption between Ramik and Ag Bait. Period I results are indicative of the poor pellet acceptance due to poor bait quality that was present from March 11 to May 17. Because of this problem, Period I was analyzed separately from Period II in order to give an accurate analysis of comparison between oat groats, Ramik, and Ag Bait.

Period II results are important because all of the baits were fresh and of good quality. It is important to note that even after the exposure to the poor quality pelleted formulations, the ground squirrels readily began to feed on fresh, good quality pellets with little or no aversion.

The analysis of Period II indicates a greater amount of oat groats consumed, resulting in a significant difference between the consumption of oat groats versus Ramik and Ag Bait (Figure 3). There was no significant difference in consumption between Ramik and Ag Bait. Even though there was a significant difference in consumption of oat groats in comparison with Ramik and Ag Bait, there was good acceptance of all three bait formulations. In a ground squirrel control program, assuming no aversion due to the toxicant, there would be no functional difference between oat groats, Ramik and Ag Bait. The use of any of the three bait formulations should result in control of the ground squirrels.

Overall Bait Consumption

Overall bait consumption steadily increased from March 11 to June 2. The initial increase would be associated with the newly acquired feeding pattern of the ground squirrels in conjunction with placement of the baits. However, it is unlikely this would cause the total increase in consumption. In reference to the biological cycle of the California ground squirrel, the seasonal foraging tendencies shift the diet from green vegetation to a seed-eating diet. Additionally, there was an increase in the population due to natality. During April and May the majority of the young squirrels left their burrows and were observed feeding aboveground.

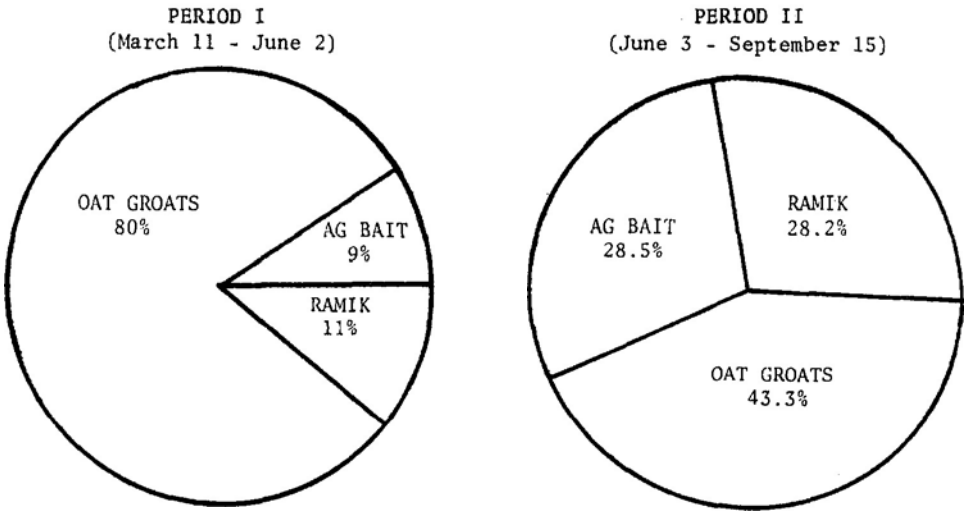

Figure 3. Relative bait consumption percentages of Periods I and II.

Overall bait consumption reached a peak (June 2), and then began to decline over the remainder of the study. This gradual decline corresponds with the gradual reduction of ground squirrels observed during the late summer and early fall. During this time period, the reduction of the feeding population was due to estivation, emigration, and mortality.

Statistical analysis results indicate a strong correlation between the number of ground squirrels observed, based on the monthly counts, and the total amount of bait consumed over the entire study.

CONCLUSIONS

With the various baits available for ground squirrel control, it is often asked which bait is the most readily accepted. For the three baits tested in this study it appears that bait quality and freshness are the most important considerations to assure ample bait acceptance.

In this study ground squirrels did not readily accept old or deteriorating baits when alternate fresh baits were available. Of equal importance, even after exposure to and rejection of poor quality baits, ground squirrels readily accepted those same baits when presented fresh.

When all baits presented to the ground squirrel were fresh, significantly more oat groats were consumed than either of the pelleted baits. This difference would probably not be important in a ground squirrel control program. Assuming no toxicant aversion, all three baits tested were consumed in sufficient quantities that control of the ground squirrels feeding at the bait stations would likely occur.

Suggestions for continued research include bait quality comparisons within each type of bait formulation. Characteristics that affect quality and should be tested include protein percentage, molding, rancidity, and contamination. While mechanical modification of grains, such as crimping, rolling, or pelletizing, may enhance acceptability to ground squirrels, bait modification processes may reduce the shelf life of the bait. Efforts should be made to quantify the effects of bait modification on bait shelf life. Further research in methods of enhancing shelf life and prevention of palatability loss is warranted.

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