Poster Presentation

Efficacy of Rodenticides for Roof Rat and Deer Mouse Control in Orchards

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ABSTRACT: Roof rats and deer mice are occasional pests of orchard crops throughout the world. The application of rodenticides is an effective and practical method for controlling rodent pests and reducing damage. However, a paucity of information exists on the efficacy of rodenticides in orchards for these pest species. To address this gap in knowledge, we first developed an index to measure rodent activity in order to monitor efficacy of rodenticides. We then used this index to test the efficacy of 3 first-generation anticoagulant rodenticide baits to determine their utility for controlling roof rats and deer mice in agricultural orchards. Of the baits tested, the 0.005% diphacinone grain bait was the most effective option for controlling both roof rats and deer mice (average efficacy = 90% and 99%, respectively). The use of elevated bait stations proved effective at providing bait to target species and should substantially limit non-target access to rodenticides.

KEY WORDS: bait station, deer mouse, diphacinone, *Peromyscus maniculatus*, *Rattus rattus*, roof rat

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INTRODUCTION

Rats (*Rattus* spp.) are a common and very damaging invasive pest found throughout much of the world. Damages have been estimated to be between 5-10% in nut and tree crops (Tobin et al. 1997). Damage caused by deer mice (*Peromyscus maniculatus*) can be extensive, with estimates of $51 per ha reported in some almond orchards (Pearson et al. 2000). We aimed to develop an index of rodent activity to monitor efficacy of rodenticides, and to subsequently test the efficacy of 3 baits (0.005% chlorophacinone treated oats, 0.005% diphacinone treated oats, and 0.005% diphacinone wax block; California Department of Food and Agriculture, Sacramento, CA) to determine their applicability for controlling roof rats (*Rattus rattus*) and deer mice in agricultural orchards. This publication provides a quick overview of our findings. For a more complete review of this study, see Baldwin et al. (2014).

METHODS

Indexing Trials

Five 180 × 210-m sampling plots were established in almond orchards for the indexing trials (4 in Fresno County, CA and 1 in Yolo County, CA). Roof rat activity was measured using remote triggered cameras focused on two attractants (wax blocks and peanut butter and oats). Upon completion of 3-day indexing trials, we initiated live trapping using Tomahawk live traps (Tomahawk Live Trap LLC, Hazelhurst, WI) to determine a minimum number known estimate. Traps were checked for rat captures for 4 consecutive days. Once captured, roof rats were tagged with No. 3 Monel ear tags (National Band and Tag Co., Newport, KY) to allow for individual identification, and weight and gender were recorded. We considered 3 measures of activity at each camera for both attractants: 1) Total number of rat intrusions per 24-hr period, 2) Total number of rat intrusions separated by at least 5 mins, and 3) Binary (yes/no) visitation. These 6 combinations were used to evaluate how best to construct the index.

Baiting Trials

A randomized complete block design was used to test the efficacy of 0.005% diphacinone oats, 0.005% diphacinone wax blocks, and 0.005% chlorophacinone oats. Four 180 × 210-m treatment plots were established in each orchard with all 3 rodenticide baits and a control randomly assigned to each orchard.

Indexing Protocol

Prior to bait application, roof rats and deer mice were indexed in each treatment plot across 4 almond orchards using cameras focused on non-toxic wax blocks. Camera sites followed a 5 × 4 pattern with cameras spaced at 30-m intervals. Cameras were operated for approximately 72 hrs and set with a 5-min delay. This process was also repeated immediately following the completion of the baiting trials to determine the efficacy of the 3 rodenticides.

Rodenticide Baiting Trial

Thirty bait stations were attached to tree branches during the indexing period. Following completion of the index, the bait stations were loaded with their assigned baits and sustained for approximately 4 weeks.

RESULTS

All photographic measures using wax blocks as an attractant had a superior correlation ($r \geq 0.92$, $P \leq 0.029$) with the minimum number of known roof rats than all of

the measures using peanut butter and oats as an attractant ($r \leq 0.71$, $P \geq 0.180$). The use of a 5-min lag time between photos was most effective at indexing roof rat populations ($r = 0.96$, $P = 0.008$).

Of the baits tested, the 0.005% diphacinone treated oats was most effective for roof rat control (mean efficacy = 90%; $t_3 = 4.2$, $P = 0.012$; Table 1); 0.005% chlorophacinone grain was completely ineffective against roof rats. As with roof rats, we also observed a significant drop in deer mouse activity post-treatment for diphacinone grain (mean efficacy = 99%; $t_3 = 41.9$, $P < 0.001$; Table 1).

Table 1. Mean efficacy values across 4 sites for the 4 treatments.

Treatment	Roof Rat Mean Efficacy	House Mouse Mean Efficacy
Control	34%	16%
Chlorophacinone Grain	- 170%	67%
Diphacinone Block	83%*	63%
Diphacinone Grain	90%**	99%***

* Mean efficacy values were different than a 70% efficacy threshold ($P = 0.081$)

** Mean efficacy values were different than a 70% efficacy threshold ($P = 0.012$)

*** Mean efficacy values were different than a 70% efficacy threshold ($P < 0.001$)

DISCUSSION

Tests proved 0.005% diphacinone-treated oats to be an effective control option for both target species. The use of elevated bait stations was effective at providing bait to both roof rats and deer mice. Using elevated bait stations should considerably limit access to rodenticides by many non-target species which may have been previously susceptible during broadcast baiting regimes. This study provides an effective and safe baiting protocol, previously lacking, for controlling roof rats and deer mice in nut and tree-fruit crops. For a more complete description of this project, see Baldwin et al. (2014).

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LITERATURE CITED

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