

Managing Rodents in Pistachios

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Species Identification (Ground Squirrels)

- Gray-brown fur with semi-bushy tail; social and diurnal
- Damage includes girdling of trees, consumption of forbs and grasses, chewing of irrigation lines, and abundant burrow openings.



Species Identification (Pocket Gophers)

- Burrowing rodent about 6-8 in long; rarely seen above ground.
- Gopher mounds are plugged and often fan-shaped.



Species Identification (Meadow Voles)

- Have dark grayish brown fur and are 4-6 inches in length.
- Populations tend to cycle, exhibiting irruptive growth patterns.



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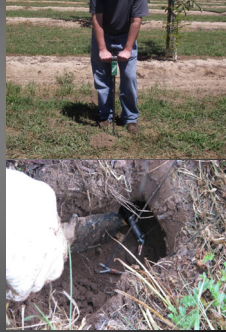


Species Identification (Rats and Mice)



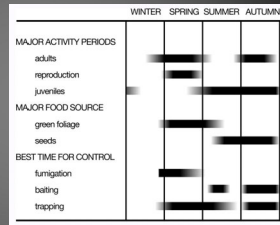
Current Control Strategies

- Currently, we focus on an integrated approach that utilizes a number of strategies and tools to control vertebrate pests.



Importance of Biology/Ecology

- Understanding the biology and ecology of vertebrate pests will guide management decisions.
- **Example:**
- CA ground squirrel



What Control Options Are Available?

	Habitat modification	Baiting	Burrow fumigation	Trapping	Exclusion	Repellent	Frightening	Shooting
Ground squirrel	X	X	X	X				X
Pocket gopher	X	X	X	X		?		
Vole	X	X	?		X	?		
Rats & mice	X	X	?	X				

Control Options—Habitat Modification

- Involves altering habitat to reduce the desirability for pests.
- **Example:**
 - destroy old burrows; remove brush piles



Control Options—Habitat Modification

- Involves altering habitat to reduce the desirability for pests.
- **Example:**
 - destroy old burrows; remove brush piles
 - remove or reduce cover for voles



Control Options—Exclusion

Voiles

- Tree protectors can eliminate damage caused by voles



Control Options—Trapping

Ground squirrels

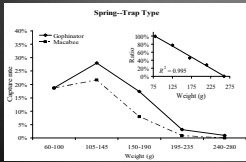
- Body-gripping traps, tube traps, and box-type squeeze traps are common kill traps.
- Wire cage traps are common live traps.
- Live traps require euthanizing target animals.



Control Options—Trapping

Pocket gophers

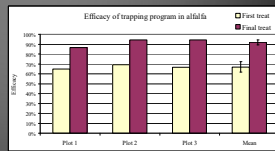
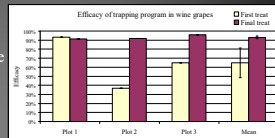
- Gophinator trap was more effective.
- Covered sets yielded slightly higher capture rates in spring-summer, but not autumn.
- Efficacy was offset by setting time.
- We did not observe a difference in the number of captures across attractants.
- Human scent had no effect.



Control Options—Trapping

Pocket gophers

- Exhibited high efficacy in wine grapes after two treatments.
- Exhibited high efficacy in alfalfa after two treatments.



Control Options—Baiting

- Involves use of poison baits to control vertebrate pests.
- There are restricted use and non-restricted use baits.
- Are also second-generation anticoagulants for indoor use.

	Anticoagulant	Zinc phosphide	Strychnine	Bromethalin	Cholecalciferol
Ground squirrel	X	X			
Pocket gopher	X	X	X		
Vole	X	X			
Rat and mouse	X			X	X

Control Options—Baiting

Anticoagulants

- used for spot treatments, broadcast, or in bait stations
- require multiple feedings



Control Options—Baiting

Zinc phosphide

- is an acute toxin
- potential bait shyness
- can be used for spot treatments and broadcast baiting
- not to be used in or around buildings



Control Options—Baiting

Pocket gophers

- Strychnine works best.
- Use probe to find tunnel.
- Dispense bait in tunnel.



Roof Rats and Deer Mice

- Study showed 0.005% diphacinone grain effective (90%) against roof rats in almonds.
- Must be used in elevated bait stations.
- Also highly effective on deer mice (99%).



Roof Rats and Deer Mice

University of California
Agriculture and Natural Resources

ANR Publication 8513 | December 2014
<http://anrcatalog.ucanr.edu>

Managing Roof Rats and Deer Mice in Nut and Fruit Orchards

Abstract

Effective rodent management is critical for the control of damage from these agricultural pests in nut and fruit trees in California and the rest of the United States. In our case, we have developed an effective management plan for roof rats (*Rattus norvegicus*) and deer mice (*Peromyscus spp.*) in California orchards. In this publication, we describe an effective management plan using 0.005% diphacinone-treated corn placed in elevated bait stations. In particular, we look at the specific types of damage that rodents cause in orchards—information you need to know in order to implement an effective baiting program—and we give a cost estimate for a baiting program. The elevated baiting program for roof rats and deer mice in nut and fruit orchards, which proved 90% effective in the natural environment.

Roof rats and deer mice are estimated to cause \$1.5 billion in damage in the United States each year (Pimental 2013). Roof rats (*Rattus norvegicus*) and deer mice (*Peromyscus spp.*) are extremely common invasive pests found throughout most of the United States in both urban and agricultural areas and are thought to be among the main causes of damage. This fact sheet reports on the control of damage caused by rats at \$19 million (Pimental, Zaring, and Marston 2005).

Many specifically, rats and mice are known to cause considerable damage to nut and fruit trees in the United States (Klein 2013; Pearson, Gormont, and Schroyer 2006; Yoda, Koshida, and Higuchi 1992). In nut crops, damage to developing macadamia nuts from invasive rats has been estimated to be between 3 and 10% (Cable, Koshida, and Higuchi 1992). Native rodent species can also cause a lot of damage, with estimates for damage from deer mice (*Peromyscus*) at \$200 per acre (USDA) in some almond orchards in Fresno County, California (Pearson, Gormont, and Schroyer 2006).

Clearly, effective rodent control is critical for the prevention of damage to agricultural crops. Worldwide, rodenticide baits are the most commonly preferred means for rat and mouse control, given their low cost and high efficiency (Pimental et al. 2005). In California, past and present control strategies have focused on baiting berries (species of *Rattus*) (Fresno County Agricultural Commissioner office, pers. comm.), and for baiting species are available for these species. Baiting berries, though, is an inefficient use of time and resources. The development, efficacy verification, and registration of a baiting material and strategy for rat and deer mouse control in California orchards would be of great use.

<https://anrcatalog.ucanr.edu/pdf/8513.pdf>

Control Options—Fumigation

Gas cartridges

- Effective for ground squirrels (75% control).
- Not effective for gophers.
- Caution must be used to prevent fires.



Aluminum phosphide

- Highly effective for both ground squirrels (97-100%) and gophers (90-100%).
- Is a restricted use pesticide.



Control Options—Fumigation



Control Options—Fumigation

Species	Device	Authors	# of fields	Efficacy
Pocket gopher	PERC	Orloff	3	56%
Pocket gopher	PERC	Baldwin & Orloff	3	62%
Pocket gopher	PERC	Baldwin & Orloff	2	68%
Belding's GS	PERC	Orloff	2	76%
California GS	PERC	Baldwin	2	66%
California GS	PERC	Baldwin	2	100%
California GS	Cheetah	Baldwin	3	-7%

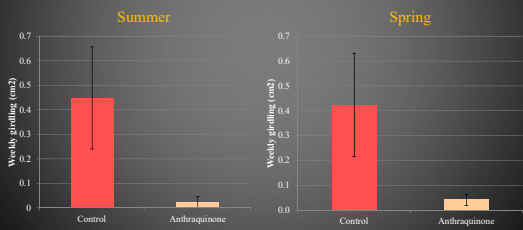
Repellents—Voles

- Rely on objectionable odors or unpleasant tastes/responses.
- Commonly available but none proven effective.
- Anthraquinone may show some promise for voles.



Repellents—Voles

- Anthraquinone reduced damage
 - summer: control: 0.45 cm², anthraquinone: 0.02 cm²; $P < 0.001$
 - spring: control: 0.42 cm², anthraquinone: 0.04 cm²; $P < 0.001$



Shooting

- Shooting can be effective for controlling ground squirrels although it is labor intensive.
- Lead bullets are banned statewide.



Ground Squirrel BMP website

