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VERTEBRATE PEST MANAGEMENT IN ORCHARDS*

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Bird and mammal pests are found in and around orchards throughout the state. Some damage caused by birds results in loss of the current fruit or nut crop; other damage caused by rodents, rabbits, or deer may result in more lasting or permanent tree damage and can lower yields for years following the injury.

Rodents and rabbits eat roots, leaves, twigs, and bark and can outright kill young trees; rodent burrows like those of ground squirrels, and mounds interfere with orchard maintenance and sometimes harvesting operations, as with almonds; and structural damage such as gnawed drip irrigation lines can be costly. Deer strip young trees of foliage and can stunt or even kill saplings.

To avoid losses from vertebrate pests, orchards should be routinely and systemically monitored (i.e., inspected) to detect populations of birds and mammals. Clean, weed-free orchards generally have fewer rodent problems. Weedy ditch banks, fence lines, adjacent fields, and brush piles make excellent harborage for certain field rodents and contribute significantly to increased rodent and rabbit problems. Adjacent habitat that favors pests by providing breeding areas, suitable loafing and cover sites, and additional food make a pest problem more severe.

To better control vertebrate pests, there are several things a grower can do: (1) correctly identify the species causing the problem; (2) alter the habitat, when feasible, to make the area less favorable to the pest species; (3) use the control methods appropriate for the location, time of year, and other environmental conditions; and (4) establish a monitoring system to detect reinfestation so you can determine when additional corrective measures or controls are necessary. A program incorporating these points requires some planning but will result in fewer vertebrate pest problems.

Vertebrate control equipment and supplies (e.g., baits, fumigants, gas exploders, and traps) are generally available at local retail outlets such as farm supply and hardware stores. In addition, most County Agricultural Commissioners have available for growers certain rodent control pesticides. For further information or sources of special control materials, consult your local County Farm Advisor or Agricultural Commissioner.

This paper concentrates on the three most important rodent pests of orchardists in Northern California.

*This paper discusses the three most economically important rodent pests of orchards.

GROUND SQUIRRELS

California ground squirrels, Spermophilus beecheyi, medium-sized rodents about 14 to 20 inches long (including their long, slightly bushy tail), are responsible for major damage in orchards, especially almonds and walnuts. They live in underground burrows and form colonies of 2 to 20+ animals. Ground squirrels live in a variety of natural habitats and are found along road or ditch banks, fence rows, around buildings, and within or bordering many agricultural crops. They tend to avoid thick chaparral, dense woods, and very moist areas. Ground squirrels are active during the daytime and are easy to spot. During winter months, most will hibernate, but it is not uncommon for some younger squirrels to be active on warm sunny winter days. Many adults go into a summer sleep called estivation during the hottest parts of the year. Squirrels reproduce once yearly in the early spring and have an average litter of 7 to 8 young which are nursed in the burrow for about six weeks before they come above ground to forage.

Ground squirrels are primarily herbivorous. During early spring, they consume a variety of green grasses and forbs. When these begin to dry and form seeds, they then switch to seeds, grains, fruit, and nuts. With fruit, they are often more fond of the seed than the pulp.

Damage

(Timing is critical for control) hibernate during winter, some individuals don't.

Ground squirrels often infest orchards. They easily climb trees and feed on fruit or nuts from set to maturity and through harvest. Adult squirrels collect and often cache seeds and nuts in their burrows, especially in the late summer and early fall. During this period losses of nut crops greatly exceed those of consumption alone.

When digging burrows, squirrels bring soil and rock to the surface and deposit it in mounds near burrow openings. Burrow systems are enlarged by constructing more tunnels each year, so the longer the squirrels occupy the burrow system, the more extensive it becomes. The presence of large burrow openings and soil mounds is hard on orchard equipment and can make harvesting of almonds, walnuts, and prunes difficult. Ground squirrels frequently burrow around trees and damage the root systems; they can even kill the tree. Squirrels also gnaw surface-type drip irrigation pipes. Ground squirrels are not overly intimidated by man's presence, and squirrel burrows beneath buildings and other man-made structures are common.

Monitoring Guidelines

A system should be established to periodically inspect areas where ground squirrels are likely to invade, such as along ditch or road banks or in crops adjacent to the orchard. This can be done by routine observation in the morning when squirrels are most active. Where ground squirrels are a serious problem, records should be kept on the type(s) of controls used and their success, as well as on changes in numbers of squirrels. Such records can be used as the basis for future management decisions.

Management Guidelines

When ground squirrels are present in or immediately adjacent to an orchard that is susceptible to damage, they should be controlled. Poison baits, burrow fumigants, and traps are the primary methods used for their control. It is almost impossible to exclude ground squirrels by fencing, and no practical type of habitat modification within an orchard will expel them. Ground squirrels are not responsive to chemical or physical repellent methods.

Habitat modification. In natural habitat, ground squirrels generally feed in open areas where visibility is good, although they adapt to other situations. In orchards, ground squirrels often use long-standing piles of orchard prunings, wood, or rock piles to burrow beneath or as harborage. Removing such piles may make the area somewhat less desirable to them, but the root crowns of trees, fence lines, and ditch banks still offer good burrowing sites. Peripheral orchard cleanup makes detection of squirrels and their burrows easier, helps in monitoring their populations, and improves access to burrows for control operations.

Natural Controls. Predators such as coyotes, foxes, badgers, and other mammalian carnivores and several hawk species feed on ground squirrels; however, predation is not a significant factor in keeping ground squirrel populations below the damaging economic level.

Trapping. Trapping is time-consuming and considered most practical for small infestations involving relatively few squirrels. Several types of kill traps are effective. Box-type kill traps can be placed on the ground near squirrel burrows or runways and should be baited but not set for several days so the squirrels become accustomed to them. After the squirrels are taking the bait, rebait and set the trap. This makes trapping more decisive. Walnuts, almonds, oats, barley, and melon rinds make good trap baits. Conibear traps are set in the burrow openings so squirrels will pass through them and trip the trigger. No bait is used when conibear traps are set in this way. As with all traps, take precautions to minimize trapping nontarget wildlife, pets, and poultry.

Fumigation. Fumigation of ground squirrel burrows with toxic gases (including smoke-generating cartridges) is an effective control method when used according to directions. It is most effective and selective in the spring or when the soil contains enough moisture to retain the toxic gas in high concentrations within the burrow. Fumigants are ineffective when animals are hibernating or estivating because ground squirrels seal themselves in with a soil plug. For safety reasons, fumigants should never be used where burrows extend beneath buildings.

Poison baits. Poison grain baits have been developed for controlling ground squirrels. Ground squirrels that are extensively feeding on green vegetation, as they do after emergence from hibernation and into late spring, may not accept grain baits. The latter part of May and all of June represent the best periods for baiting, as ground squirrels begin eating seeds and grains to a greater extent. In orchards, once the squirrels begin to feed on immature fruit and nuts, it may be difficult to get them to accept grain

Strychnine - death in 3
24 to 48 hrs.

Zinc phosphide
has very little
potential for secondary kill.

ethanization w/ CO₂ drum Knocks
Rodent unconscious in 10 sec, dead in 20 min.

break
down
in 3 to 4
weeks
scattered
on
surface.

baits. As a percentage of the adult population goes into estivation during the hottest part of the summer, summer is not the best time to start a major control program. In the fall (September 15th through about the end of October), a high percentage of squirrels will again be active and feed on grain baits until they go into winter hibernation. Various grain baits with one of several poisons are available from commercial distributors or the County Agricultural Commissioner's Office.

Single-dose poison baits such as zinc phosphide are the most cost effective for controlling ground squirrels and generally produce results within 48 hours. Bait distribution may be done by spot baiting--scattering bait by hand on bare ground to cover 2 to 3 square feet at the side or behind each active burrow--or in noncrop areas by broadcasting--scattering bait relatively uniformly over the entire infested area. Broadcasting can be done by hand with a belly grinder type seeder or with a vehicle equipped with a tailgate type seeder. Consult product label for recommended application methods and rates.

100 to 200 feet apart is adequate (perimeter control)

Multiple-dose baits (anticoagulant rodenticides) will give effective control when ingested in multiple feedings for six or more days. Deaths generally occur from 6 to 14 days following the first feeding. Because eating anticoagulant bait does not immediately affect the squirrel's feeding or activity, apparently healthy squirrels will still feed; these animals, however, will soon be affected. It is vital that bait remains available because effectiveness is reduced if 48 hours or more lapses between feedings. The bait's slow action and the availability of an effective antidote (vitamin K₁), makes anticoagulant rodenticides relatively safe to livestock, pets, and children if they are accidentally consumed once.

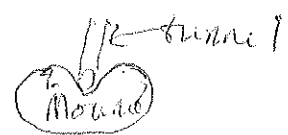
In noncrop areas, anticoagulant baits may be spread by repeated spot or broadcast baiting according to label directions. In orchards, anticoagulant baits are best used in bait boxes. Bait boxes are small structures that are designed to hold enough bait to provide multiple feedings and are designed for the squirrel to enter to feed but exclude larger nontarget species.

POCKET GOPHERS *can nest up to 6' in cold climates.*

Pocket gophers (Thomomys spp.) are stout-bodied, short-legged rodents. External fur-lined cheek pouches open outside the lips on each side of the mouth and are used extensively for carrying food. The head and body measure about 6 to 8 inches. They have a short scantily-haired tail.

Pocket gophers are most common where abundant plant growth exists. Pocket gophers feed primarily on succulent underground parts of herbaceous plants. They live almost entirely underground and are antisocial and solitary except during breeding and when the young are being raised. Burrows systems may be extensive and include main deeper burrows, more shallow feeding tunnels, and side tunnels to push out dirt. Characteristic soil mounds are pushed above ground and the mound is most evident in late fall following the first good rain and in the spring. Main tunnels are normally 10 to 12 inches under the surface but frequently may be deeper. Burrow openings are plugged

push soil out from in front of them



with soil so the system is completely enclosed, stabilizing the burrow's temperature and humidity at close to optimal conditions.

In orchards and other irrigated lands such as alfalfa, females may produce 2 litters in a single year, with litters averaging about 5 young.

Damage

Pocket gophers are frequently encountered in orchards. They are active throughout the year and, if uncontrolled and food is plentiful, their populations can increase to 30 to 40 gophers per acre if the habitat is suitable. They cause tree damage or death by girdling the roots or crown of trees at or below the soil level.

Monitoring Guidelines

Because pocket gopher damage is frequently not visible, it often goes undetected until a tree exhibits stress. By that time the tree may be beyond saving. Pocket gophers are relatively slow reproducers and population build-ups in orchards will be gradual year after year. Gophers are readily detected by the presence of fresh mounds, which are produced in greatest numbers in the spring and fall when the soil is amply moist. In mature orchards the need for pocket gopher control is a matter of individual grower experience based on previous damage, but with a newly planted orchard, it is essential.

Management Guidelines

Pocket gophers can be controlled effectively and even eliminated from orchards by continuous, persistent efforts. The preferred control methods are poison baits and, to a lesser extent, trapping. Most burrow fumigants with the exception of aluminum phosphide are not very effective, and there are no effective chemical or mechanical repellents for pocket gophers.

Poison baits. Single feeding poison baits such as strychnine placed in the burrow tunnels are widely used and effective for controlling large numbers of gophers. Follow bait label directions for application methods and amounts. There are two methods of bait applications: hand baiting and mechanical baiting.

Hand baiting. Hand baiting is usually done by using a metal probe to locate one of the gopher's tunnels. Use a pointed 1/4-inch steel rod to find the burrow by probing near the fresh mounds or between two recent mounds. Then enlarge the probe opening with the larger end of the probe and place a small amount of grain-type bait in the burrow.

Hand-operated mechanical bait dispensers with a bait reservoir and bait release mechanism permit probing and bait dispensing in one operation. These devices substantially speed hand baiting operations.

Mechanical baiting. Tractor-drawn mechanical bait applicators and burrow builders offer an excellent mechanized way of controlling gophers in large areas with a once-over operation. This tractor-drawn device constructs

an artificial burrow beneath the soil surface and deposits poison grain bait within the burrow at preset intervals and in preset quantities. The machine is ordinarily operated down each orchard row where pocket gophers are present. The artificial burrow will intercept some of the gopher's natural burrows or the gopher will soon discover the artificial one and consume the bait. Soil moisture must be right to produce a well-formed, smooth, artificial burrow, and this generally means the soil must be relatively moist.

Trapping. Traps, either pincher or box type, are effective, but, because trapping is labor intensive, they are most commonly used where only a few pocket gophers are present. To set traps, locate the main runway or tunnel by probing with a steel rod a short distance in front of the low side of a fresh mound or between two fresh mounds. When the main tunnel is located, dig a 10- to 12-inch hole down to intercept it. Then clean out the burrow and set two traps in the runway, one facing each direction. Macabee® or similar sized traps should be wired to a stake so they will not be lost.

Poisonous gases. Pocket gophers have relatively extensive burrow systems and portions of these are relatively near the ground surface; therefore, poisonous gases (burrow fumigants) are difficult to keep in lethal concentrations. Plus, pocket gophers may escape fumigation by quickly plugging off their burrows when they detect a toxic gas. These factors generally contribute to unsatisfactory results with burrow fumigants. In recent years, however, one registered fumigant, aluminum phosphide, has been shown to give acceptable results, but some repeat treatments may be needed.

Habitat modification. Certain orchard practices modify the habitat making it less conducive to pocket gophers. Permanent ground covers of herbaceous and certain grassy plant species favor gophers. The removal of the permanent ground cover will do much to reduce gophers. Deep disking destroys some burrows making the orchard less habitable, as does clean cultivation in general, and allows earlier detection of new mounds. Controlling gophers along fence rows and roadways adjacent to orchards is important because young gophers will disperse from there into the orchard.

When orchards are flood irrigated, very young pocket gophers may be drowned and adults sometimes forced to the surface where they are more easily killed by the irrigator, dogs, or other predators. By comparison, sprinklers or drip irrigation systems generally favor pocket gophers.

Biological control. There are a variety of predators that capture and feed on pocket gophers; however, their presence will generally not keep pocket gopher populations in orchards low enough to prevent economic injury.

MEADOW VOLES

Meadow voles, Microtus spp., also called meadow mice, can cause severe damage in orchards by feeding on the bark at the base of the trees. Vole populations often develop in orchards or on orchard borders, roadsides, and fencelines where grass or other permanent vegetative cover remains year-round. Orchards that have year-round cover crops are most susceptible; meadow voles

prefer to live in grassy habitats as opposed to broadleaf herbaceous cover but will eat many types of cover crops.

Meadow voles are small, blunt-nosed, stocky rodents with small ears and eyes, short legs, and rather short tails. They usually have dark gray or grayish-brown, relatively coarse fur. When full grown they are larger than a house mouse but smaller than a rat. Females may produce up to 6 or so litters a year. A few females will breed year-round, but the principal breeding time is during the spring. Voles have a great propensity for rapid population increases, with very high numbers (hundreds per acre) of voles reached periodically (every 6 to 8 years) in ideal habitat. It is during these mouse outbreaks that damage will be most severe and widespread. Meadow voles' home ranges are relatively small, usually less than 10-feet around their burrows.

Damage

Characteristic damage of meadow voles is complete or partial girdling of tree trunks from just below the soil line up as far as they can reach on the trunk, usually no more than 3-5 inches. However, there are exceptions where they climb higher to feed on young trees. Young trees are attacked more readily and sustain greater damage than older ones.

Monitoring Guidelines

Meadow voles are usually found first in localized spots marked by numerous 1-to-2-inch wide surface runways running through dense or matted grass, and silver-dollar-sized holes to their burrows. They are active all year irrespective of weather but do the most damage to trees in winter or early spring. They actively feed both night and day. Deposits of small, soft, brownish feces and short 1 to 2 inch pieces of grass stems along the runways are evidence of their presence. Burrows frequently have numerous openings to the surface--are short, relatively shallow, and contain food and nesting chambers.

Monthly inspections of orchards and surrounding fields starting about mid-winter is essential for spotting vole activity and population increases. Check especially heavily vegetated areas for new vole runways, burrow openings, and evidence of bark or grass feeding. Numerous well-used runways, extensive newly-cut vegetation, and many fresh droppings in runways are indicative of a dense population of voles.

Management Guidelines

Vegetative cover provides food and protection from predators, so management of cover is most important for meadow vole control. Adjacent fence rows or properties may be harboring a population of voles. Eliminating the vegetative cover in these areas or providing a 30-to 40-foot wide buffer area will reduce the number of voles invading the orchard. Once vole populations are detected in the orchard, either clean cultivation of the entire orchard, removal of all vegetation from immediately around the trees, and/or poison baits are generally the most effective ways to reduce or eliminate damage.

Habitat modification. Cultural practices can significantly affect meadow vole populations. Clean cultivation or band weed control are highly effective in preventing damage by making the habitat next to the tree unsuitable. Weed-free fence rows, roadsides, and ditch banks are also important preventive measures. Because voles do not travel more than a few feet from their burrows to obtain food, any significant destruction of their food and cover will cause them to abandon their burrows or die out in that location.

Biological control. Predators such as coyotes, foxes, badgers, weasels, owls, and hawks feed upon meadow voles; however, predation is rarely, if ever, a major factor in controlling a rapidly increasing vole population.

Chemical repellents have been tested, but no effective repellents have been found to protect orchard trees from voles.

Trunk guards. Young trees can be protected with cylindrical wire or plastic trunk guards. To prevent voles from burrowing under them, guards must extend at least 6 inches below the soil surface. Meadow voles rarely climb over these guards. However, trunk guards may give a false sense of security because voles may cause damage below them or work beneath them and consume the bark unnoticed behind the guards.

Poison baits. Poison grain baits are very effective in reducing meadow vole populations. For most effective control, bait should be applied in the voles' runways where most feeding occurs. Baiting may be done by spot baiting--placing bait by hand in runway--or by broadcasting--or by broadcasting--scattering bait over the entire area--as permitted by the label. Broadcasting may be done by hand, by seeder or by vehicle with a tailgate seeder. Baiting should be done depending upon estimated density of the voles and the toxicity of the toxicant. Both single-dose (e.g., zinc phosphide) and multiple-dose (diphacinone and chlorophacinone) baits are available. Consult product label for application.

OTHER

Rabbits, both jackrabbits (*Lepus*) and cottontails (*Sylvilagus*), cause damage in some areas by eating the trunk bark and clipping leaves. Deer can also be a problem in areas such as Lake and Mendocino Counties.

Orchards located near woodlands or near suburban residential areas are often damaged by fox (tree) squirrel (*Sciurus niger*) which especially almonds, walnuts, and acorns. Fox squirrels and nut trees may be a major food source for roof rats (*Rattus*) which inhabit some residential areas. Roof rats, however, are rarely associated in damage to commercial deciduous orchards.