

Meadow Mouse (Vole) Control in Tree Fruit Orchards

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MEADOW MOUSE (VOLE) CONTROL IN TREE FRUIT ORCHARDS

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Short-tailed meadow mice or voles can cause extensive damage in all tree fruit orchards. They girdle the bark at the base of the tree, around the root collar, and along the major feeder roots. These girdled areas can weaken trees and serve as points of infection for various rots. When trees are severely damaged, they can die unless bridge-grafted the following spring.

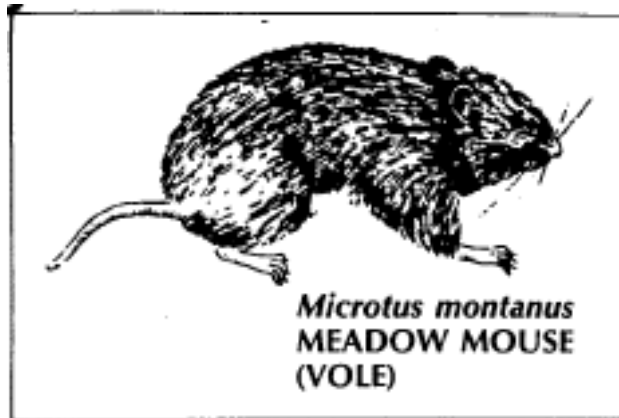
Growers should inspect their trees and the area surrounding the orchard frequently and thoroughly for evidence of voles. Under favorable conditions, one vole runway per tree, especially with young trees, is sufficient to cause a large amount of damage.

If evidence is found only around a few isolated trees, the grower will have to decide whether to use control measures in that one area or risk, in time, possible damage to the entire orchard.

MOUSE SPECIES

Three principal species of mice are found in Pacific Northwest orchards: the deer mouse, house mouse, and short-tailed meadow mouse or vole. Before making any chemical treatments, determine the species present. To do so, place several small wooden, spring-type mousetraps in tree rows near mouse runways. Bait with a 50-50 mixture of peanut butter and oatmeal. Adult house and field mice are approximately twice the length of voles and have tails equal to body length.

It's the short-tailed meadow mouse or vole (*Microtus* spp.), which causes damage to fruit trees throughout the Pacific Northwest. Other species may feed on grass and weed seeds in orchards, but are not destructive to fruit trees.



SUSCEPTIBILITY OF TREES

There is a significant difference in the susceptibility of trees to serious injury and economic loss, depending on tree age, type of fruit tree, and rootstock.

Tree Age

The volume of bark and the trunk size are important. In contrast to a large, mature tree, a young tree has a limited amount of bark; a few voles can readily girdle it. Voles prefer the relatively soft and succulent young or inner bark. Thus, older trees with heavy, thick bark are less susceptible, but not immune, to serious injury or total loss.

Type of Fruit Tree

Voles prefer the bark of apple trees to all other species. Pear is much less susceptible, but preferred over stone fruits. Peach and, sometimes, cherry trees can be attacked; apricot, plum, and prune are rarely bothered.

Rootstock

Dwarfing rootstocks are most susceptible, due apparently to differences in palatability. Dwarfing rootstocks also provide a smaller, more fibrous root system than standard seedlings. Thus, repairing wounds usually requires in-arching with new rootstocks rather than bridging from large roots to the trunk. As a result, tree loss is usually much higher.

ORCHARD FLOOR MANAGEMENT

Orchards that are clean-cultivated throughout the growing season provide little food source or protection for mice. As a result they are least likely to come under heavy mouse attack.

Trees in permanent sod are most susceptible. The dense cover and overhang of branches protect mice from their enemies. Control weeds and permanent sod, particularly legumes, around the base of the tree to eliminate much of this natural protection.

Eliminate all vegetation next to the tree base. A 3-foot strip or circle is recommended. Cultivate or spray with an approved herbicide. Remove all dead material.

Growth retardant sprays may be used between rows after the first mowing. Growth retardants are effective up to 6 weeks. Additional applications may have to be made during the summer, particularly just before propping.

Managing the sod to provide ample food sources, while at the same time balancing the vole population to this food supply is one of the most effective means of reducing injury. Sod must be well-fertilized and irrigated throughout the year. Grass cover that stops growing and becomes mature in late summer and fall can force mice to turn to trees as a source of food.

TREE PROTECTION

A physical barrier may be made to protect trees by encircling the trunk with a vole guard. Guards may be made by the grower or may be purchased commercially in a variety of designs. Materials include metal, plastic, fiberboard, and other products. One common material is wire screen cut 18 inches square and secured loosely around trees with short strands of wire. Regardless of material used, it is important that the guard be of sufficient height and length to protect not only the trunk, but also the surface feeder roots. It is helpful to bury the bottom of the guard 1 or 2 inches below ground to prevent voles from crawling under it.

POPULATION FLUCTUATION

Vole populations fluctuate over the years. One cause is snow cover. Seasons with extended snow cover allow greater survival; snow provides cover for the voles and greater access to the food supply. This is especially true in late fall and early winter. Populations may also differ from area to area depending upon local habitat, population pressures, and other mechanisms.

MONITORING ACTIVITY

The most critical factor in preventing injury is detection of the problem. Monitor vole populations and activity carefully from late summer through early winter when populations peak.

Evidence of Voles

Growers can tell if voles are present by examining the ground surface and vegetation in and around their orchards. Evidence of voles is easy to detect once the observer learns to recognize it.

Orchard voles will make runways on the surface of the ground and through vegetation by repeatedly using the same routes, gnawing and tramping vegetation along these runways. Where vegetation is not extremely dense, runways are obvious. In dense vegetation, grass and weed cover often hide runways. Parting the vegetation by hand, by foot, or with an appropriate tool will often reveal active runways.

Voies will burrow into the ground, and hole entrances of about 1 inch in diameter will be apparent. Runways are very shallow and may range from only a few inches to several feet in length. Voies make globe-shaped nests of grass and shredded vegetation on the surface of the ground or in a small depression. Nests are often in a clump of grass or other thick vegetation.

In orchards, runways are concentrated more heavily under the tree drip line. In hedgerow plantings, they extend up and down the row. Nests are often located near or close to the trunk of the tree. The various colonies are seldom

evenly distributed. They are more common or frequent where the soil is deep, fertile, well covered with grass and weeds, and well drained.

Signs of Activity

Once you locate the runway network, observe it frequently. Small piles of brownish droppings and short grass clippings scattered along the path are evidence of activity. Fresh droppings and clippings indicate recent activity. How closely the vegetation along the sides of these paths is clipped, as well as the width of the path, is a fair indication of use or population numbers.

Failure to find evidence of much activity in these runways requires some interpretation. This may be the result of a heavy kill, or an indication that voles have abandoned the area or path. Regardless, once established, this network may be readily reinvaded and inhabited.

Population Intensity

Some signs of vole activity may be found in the spring. Populations are usually small since voles prefer food other than trees. Treatment of a sizeable area when only a few isolated trees show evidence of voles is often questionable. In such a situation, using wooden-based mousetraps would seem more economical.

Hazards increase toward late summer and fall. By this time, vole populations can be high and increasing at tremendous rates. At the same time, cooler weather (and shortage of water in nonirrigated areas) results in less food to support the increased number of voles.

Areas of heavy vole activity may justify early preharvest spot treatment with zinc phosphide baits or trapping to reduce populations. Treatment at this time can reduce serious tree injury but will not completely eliminate the problem. Thorough treatment should be made soon after harvest.

Since voles burrow in the snow, monitoring population levels during the winter can be more difficult. Voles will damage tree trunks as high as snow accumulates. Root feeding is also common during this time of year. Damage cannot be easily seen or fully evaluated until snow recedes. Tracks are often common on top of snow when high populations exist. Such signs justify digging around trees (especially young trees) for indications of possible feeding.

The Meadow Mouse (Vole)

The distinguishing characteristic of the adult meadow mouse or vole is its short tail, which is approximately one-third its head and body length and is well covered with hair. The vole is medium size, stout (1.5 to 2.0 ounces), and has small, black eyes and fur-covered ears. It is black, gray, or yellowish brown. Its fur is loose, rather long or rough, and interspersed with black guard hairs, all of which give the vole a grizzled appearance. The feet do not have black guard hairs. The overall color is darkest on the back, and shades into gray, ash, or buff color on the underside.

The meadow mouse lives in an environment just above or slightly below the soil surface. In dense grass cover, meadow mice make a complex network of easily recognized surface runways. When the cover crop is light, and open, these runways may be less distinct or even absent. Grass cuttings and small piles of droppings litter frequently used runways. Burrows may be dug especially in loose soils, and nests may be built underground. Usually, however, nests are built slightly below the ground surface in a clump of grass; they are well formed balls of interwoven dry grass, which provide voles with good shelter in most weather conditions. There is also little disturbance from natural predators, which include hawks, owls, shrikes, snakes, badgers, and skunks.

The usual foods are the succulent stems and roots of grasses, legumes, and weeds along the runways. Tree suckers provide a favorite food supply. Each vole can eat its weight in forage daily.

Meadow mice breed at a very high rate. They can produce from 5 to 10 litters per year, with an average of six young per litter. Gestation is about 21 days, and females may mate again the day the young are born. Young voles grow quickly, are weaned at two or three weeks, and are sexually mature in a month. Even though there are low numbers in the spring, populations may increase rapidly by the fall months. The vole's enormous appetite, combined with prolific breeding, causes much of the problem.

When the food supply is good, an individual meadow mouse lives in a very small area-less than 1/2 acre. Several hundred voles per acre may be present in some years, and they may be extremely destructive unless orchard practices reduce this danger.

Vole populations are cyclic both within and between years. Numbers are lowest in the spring and highest in the fall. Peaks in population occur approximately every four or five years. These peaks and the ability to multiply so rapidly have often been misinterpreted as a migration into the orchard. While such migrations do occur, they are usually of only limited distance from around or within the orchard.

CHEMICAL CONTROL

Each of the rodenticides listed is highly effective in controlling voles in orchards when used under specific conditions and when applied in a precise manner. The choice of a chemical and method of control will depend upon state registration, the size of the orchard, relative costs, amount of time available, and weather conditions.

Weather can affect success or failure of any outdoor control program. Light rains can wash zinc phosphide coats off of grain baits. Heavy rains can turn pelletized baits into mush, and wash Rozol sprays from grass cover. Weather conditions should be anticipated. In bad weather, voles are less active, so fewer may come in contact with the poison.

All recommended chemicals are toxic and the user must possess a state certified pesticide applicators license. Rodenticides must be handled and used with extreme caution. Misuse or misapplication can seriously injure domestic pets and other animals as well as birds and wildlife.

Hand Baiting

The principal advantage of hand baiting is the ability to treat local areas where high vole activity exists at any time during the year.

Hand baiting is the most flexible method of control. Poison bait is placed directly in active runways or holes made by voles in the ground around trees. This method is especially well suited to areas where soils or soil moisture conditions prevent mechanical treatment. Hand baiting can be used for supplemental treatment during winter when ground is frozen.

Locate well-defined runways and place two to four baits per tree. After placing the bait, push vegetation over the area to prevent vole shyness. Make bait placements also around grassy orchard borders or in fencerows where activity is observed. Retreatment may be required to clean up high vole populations.

Zinc phosphide is the only fast-acting rodenticide registered for hand baiting in Washington. Oregon and Idaho permit hand baiting with Rozol pellets.

Zinc phosphide is a highly toxic stomach poison that kills rapidly. Bait shyness can develop if only a small amount of bait is eaten. Rozol is a slow-acting poison, which must be fed on for several days. Bait shyness does not develop with this rodenticide. Both baits are valuable tools in controlling vole populations, since they can be used in various ways. The primary limitations are registration restrictions, acceptability of the bait, weather, and care in application.

Different baits are more effective at different seasons of the year. Zinc phosphide treated oats, oat groats, or soft, white wheat are the most common baits. Voles prefer Apple or carrot cubes during the winter and early spring. Treat 1 quart of fresh-cut cubes with 1 level teaspoon of zinc phosphide concentrate (63%). Place one or two cubes at frequent intervals in active trails under cover crop or in holes. Do not place bait on bare ground.

Mechanical Baiting

Zinc phosphide treated oats, oat groats, or soft white wheat may be applied mechanically, using a specifically designated mouse trail builder. This method is fast, safe, and more economical per acre than other treatments. Mechanical baiting is especially well suited for large orchards.

With the use of the trail builder machine, apply 6 to 7 pounds of poisoned grain per acre. (Bait is dropped into the machine-made tunnel at the rate of 3 pounds per 1,000 linear feet.)

A single trail should be made at a depth of 2 to 4 inches on each side of the trees as close in the row as possible and around the orchard borders. The soil should be moist enough so that the artificial runways will remain intact until the voles contact the poison bait through the intersecting natural runways. The ground should not be disturbed for several days following treatment applications.

Forming tunnels too close to the soil surface or too far below will likely miss natural burrows. Tunnels should be constructed in the fall, as soon after harvest as possible and before the ground freezes. Low limbs and props usually interfere with earlier tunnel construction; harvest crews also are likely to collapse the tunnels.

Mechanical Broadcast Baiting

Two anticoagulant treated baits (chlorophacinone and diphacinone) are commonly used for broadcast applications in the Pacific Northwest. Both cause death by internal bleeding after 3 to 5 days continuous feeding. Application of bait must be delayed until harvest is completed and all fruit drops have been removed or destroyed. Place adequate warning signs around all treated areas.

Both baits are pelletized and should be broadcast in the orchard and along borders. Use aircraft or a cyclone ground spreader. Apply before mowing or beating. The weight of the bait allows the pellets to fall through the trees, sod, and weeds to the ground and vole runways. Mechanical application will assure a uniform dispersal pattern. Avoid treating bare ground and roadways because of potential hazard to pets and wildlife.

One effective way to broadcast bait is to use a tractor mounted whirling disc-type cyclone spreader. One trip between tree rows is sufficient for good coverage. This method can be calibrated to apply 10 pounds of bait per acre. Results have been excellent in recent years in many orchards.

Aircraft can be used to spread the bait more quickly in larger orchards. Aircraft with large hoppers can bait 200 to 300 acres in less than a day, by making one pass over each tree row. This method makes best use of brief periods of fair weather.

Rozol Pellets. Use Parapel (for Washington only) and Rozol (both chlorophacinones) during the dormant season on apple, pear, and stone fruits. Apply 10 pounds of the paraffinized pellets per acre. Do not apply to bare soil. Where vole populations are high, a second application may be made later. Do not apply more than 20 pounds of bait per acre in any one season.

Commonly used mechanical broadcast spreaders may cause break-up or powdering of Rozol pellets; therefore, the rodenticide manufacturer recommends the Lely one-row precision type spreader for a more uniform application.

Ramik Brown Pellets. Ramik Brown (diphacinone) is most effective when applied in two separate treatments at 10 pounds of pellets per acre but not exceeding 20 pounds total per acre per year. Delay the second application until 20 to 40 days after first treatment. If snow falls before a second application is made, delay until after the snow recedes from around the trees. If one application gives adequate control, omit the second treatment.

Safety Precautions. Anticoagulants can kill nontarget birds, wildlife, and domestic pets. To avoid injury, observe the following precautions:

1. Use bait pellets only during the dormant season.
2. Use the rate specified on the product label. Scatter the bait; do not pile.
3. Broadcast mechanically or by aircraft. Help prevent nontarget animals from coming into contact with bait.
4. Scatter or pick up any piles. Avoid applying to bare areas. Pets or wildlife may consume exposed bait in runways or driveways. Store the bait in a closed area. An open bag left unattended invites curious animals.
5. Unused portions of bags should be stored in a safe place.
6. Never leave empty containers where they are accessible to children, pets, or wildlife.

Ground Sprays

Ground sprays can be used very effectively to control voles. Successful results depend on thorough coverage to penetrate the grass and weed cover crop. The ground cover should be free of moisture at time of application and short enough for maximum spray penetration. The orchardist should delay application in the fall until fruit has been harvested and all dropped fruit has been removed or destroyed. For best results, make treatment before ground freezes.

Use a handgun nozzle to spray thoroughly around the base of trees, in a strip down the tree rows, and around the orchard borders.

Ground sprays are especially useful when other treatments cannot be used. As a supplement to baiting, ground sprays will provide protection against voles migrating into the orchard. As the voles travel across treated ground, they ingest the poison by licking their feet and bodies. This makes ground sprays useful in and around orchards that are subject to an invasion of voles during late fall and winter when ground is covered with snow for extended periods of time.

Rozol Ground Spray (Chlorophacinone). This rodenticide is registered for use in controlling voles in and around pome and stone fruit orchards. It may be used in Washington and Oregon BUT NOT IDAHO. In limited orchard tests, one fall application has given almost 100% vole kill. In orchards, apply after harvest, and before frost, by spraying grass cover crops in tree rows. Do not make more than one application per year. During the growing season, orchard borders and ditchbanks may be treated to control voles migrating into the orchard.

Rozol ground spray is an anticoagulant, which kills voles by internal bleeding after 3 to 5 days continuous feeding.

*Severe restrictions exist in Washington. Contact the Washington State Department of Agriculture for current information.

Apply with handgun sprayer at the rate of 1-pint liquid concentrate per 100 gallons, using 600 gallons of dilute spray per actual treated acre. Do not spray bare soil or treat roadways between tree rows. Apply at least 12 hours before expected rain and repeat treatment if rain occurs within 12 hours after application,

Caution: Rozol is highly toxic to fish. Do not apply where runoff will occur. Do not contaminate waterways, streams, or ponds when cleaning equipment.

EVALUATING RESULTS

Traps can be useful in evaluating vole kill percentage following a rodenticide application. Before and after treatment, check the population by placing four wooden snap traps in grass cover under each of ten adjacent trees in a row. Set the traps in runways at right angles with the trigger in the trail. Use peanut butter or a pinch of oat flakes over the trigger. Check the traps on the following day. If voles are caught after treatment at more than a tree or two, retreatment may be necessary.

Apple slices can also be used effectively to monitor vole populations. Place slices of apple under felt, paper, or wood at 20 or more locations in an active run. Count the number of slices that have been eaten or chewed. Example: Before baiting, place 20 slices of apple. The next morning, 15 slices have been partially or completely eaten. $15/20 = 75\%$ base number.

One week after baiting, again place 20 apple slices in the orchard. The next day, 5 are found partially eaten. $Y_{20} = 25\%$ ending number. $75\% - 25\% = 66.6\%$ population reduction.

Surviving voles sometimes continue to breed in late fall and early winter, if the weather is mild. A few survivors may increase to a moderate number by mid-winter. Voles also may migrate into an orchard from adjacent fields. Inspect the orchard several times during the winter for signs of activity, such as trails and burrows underneath snow cover as well as evidence of trunk or root feeding. If signs are found, use grain or vegetable baits and spot-bait by hand. Place baits in vole burrows or under vegetation in runways to increase effectiveness and reduce hazards to other wildlife.

SAFETY

Rodenticides are highly toxic and hazardous. Their use has been subject to severe criticism because of injury to pets, birds, fish, and other wildlife. Care should be exercised in their storage, handling, and application as well as in warning the public. Orchard vole baits and sprays are poisonous to warm-blooded animals or they would not be effective against voles. Before using any of these materials, read the container label instructions carefully and observe all cautionary statements. Follow these safety precautions:

1. Post-all treated areas. Even if signs are not required, they serve as a courtesy as well as a warning to workers, neighbors, children, and others who may cross or otherwise use the orchard.
2. Store all rodenticides in closed storage areas that can be made inaccessible to children or pets.
3. Never drop or leave empty containers where they are accessible to children, pets, or wildlife.
4. Remove or destroy all fruit that has fallen on the ground before applying any rodenticide.
5. If poison baits have been applied to orchards before harvest, caution employees and prohibit harvest crews from camping or allowing their children and pets to play in the treated area.
6. Always carefully read and follow rodenticide label instructions.

Meadow mouse illustration courtesy Public Health Service Communicable Disease Center, Atlanta, Georgia.

Use pesticides with care. Apply them only to plants, animals, or sites listed on the label. When mixing and applying pesticides, follow all label precautions and preharvest intervals to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

Only materials registered for use in respective states have been included.

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