

CONTROLLING VERTEBRATE PESTS IN ALFALFA

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ABSTRACT

Rodents, particularly meadow voles, pocket gophers and ground squirrels, cause significant damage in California's alfalfa fields. Left uncontrolled, these pests can be a serious threat to farming operations. Fortunately, there are tools that are effective. Meadow voles have been especially troublesome in California alfalfa fields because there were no rodenticides registered for in-crop use. In late 2003, zinc phosphide was registered for use in alfalfa crops. Other methods such as traps and fumigation can also be useful under certain situations. Development and implementation of Best Management Practices and Integrated Pest Management (IPM) for vertebrate pests will provide growers with an effective means to control vertebrate pests.

Key Words: meadow vole, pocket gopher, ground squirrel, rodent control, baits, traps

INTRODUCTION

Some wildlife species are welcomed and even encouraged in areas around alfalfa production. However, many rodent species, especially squirrels, voles and pocket gophers can cause problems that must be addressed. Rodents and rabbits are pests of alfalfa when they eat the above- and below-ground parts of plants. Their burrowing and mounding disrupts irrigation and maintenance operations, and can cause damage to harvesting equipment. Mounds cover and kill nearby plants and open the stand for weed invasion. Burrowing can damage structures, roads, and pathways. This damage is expensive to repair, and may result in domestic animal or human injury.

POPULATION CONTROL

When wildlife pest control is necessary, develop an integrated approach based on knowledge of the animal's ecology and behavior as well as information on all available control techniques. Using an IPM program will result in an environmentally and economically acceptable approach that will significantly reduce damage to alfalfa crops. Some people want to start control efforts whenever pests occur or even when they think they might cause a problem. While this is appropriate in certain situations, a good IPM program is based on monitoring the pest to determine when control is necessary. When the population density reaches the threshold level—the level at which control is economically justified—control should be undertaken. Threshold levels for rodents and other vertebrate pests in alfalfa are not generally established although the experiences of growers give us some ideas about when and if control measures should be taken.

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Because of the nature of rodent damage (killing plants and interfering with harvest) and the fact that they remain in the general area for life, the tolerable level is very low, in some cases, zero. The timing of a control program and the methods and materials to use depend on (1) the pest species, (2) how the area is managed, (3) the availability of equipment and labor and (4) other site and situation specific factors.

Legal restraints. In the U.S., wildlife are not the property of land owners or managers. The methods to deal with them are usually specified by state and local laws and regulations. In California, the Fish and Game Code classifies ground squirrels, meadow voles and pocket gophers as non-game mammals. If you find them injuring or threatening your crops or other property, you may control them at any time. Jackrabbits, cottontails and brush rabbits are game mammals but the code allows them to be taken to prevent damage. Any person other than the owner or tenant of the land must be carrying written authority from the owner or tenant at the time rabbits are transported from the property. The rabbit meat or fur cannot be sold. It's a good idea to know your local laws and regulations to be sure your control efforts are legal. While not the topic of this paper, waterfowl sometimes cause problems in alfalfa. They are migratory game birds and are protected by the Migratory Bird Treaty Act, and by Fish and Game hunting regulations. Check with the local wildlife agency if you are having problems with waterfowl such as coots or geese.

Endangered Species. In some areas, federally- and state- protected endangered species live in and around alfalfa fields. The species likely to be of concern in California are the San Joaquin kit fox, several species of kangaroo rats, and, where burrow fumigants are used, and the blunt-nosed leopard lizard. Special guidelines apply to the use of toxic baits and fumigants for vertebrate pest control in these areas. The latest detailed maps that show the ranges of endangered species and that give information on restrictions that apply to pest control activities in those areas are available from local agencies such as agricultural commissioners or cooperative extension offices. You can get additional information on California endangered species regulations from the DPR World Wide Web site (<http://www.cdpr.ca.gov/docs/es/index.htm>).

MEADOW VOLES

Meadow voles (*Microtus californicus*), also known as meadow or field mice, damage alfalfa by feeding on alfalfa roots and stems. They are small rodents with heavy bodies, short legs and tails, and small, rounded ears. Their coarse fur is blackish brown to grayish brown in color. When full grown, they are 4 to 5 inches long. Meadow voles are active all year and are normally found in areas with dense ground cover. They dig short, shallow burrows and make underground nests of grass, stems, and leaves. The peak breeding period is spring with a second, smaller breeding period in fall. Litters average four young. Meadow vole numbers fluctuate from year to year; under favorable conditions, their populations increase rapidly and become very dense. Preventing meadow vole damage usually requires a management program that keeps down the population in the area. If appropriate, the first step is to remove or reduce the vegetative cover surrounding the alfalfa field, making the area less suitable to voles. Removing cover also makes detecting voles and other rodents easier. Since this is not always practical or desirable, a program to control the vole population may be necessary. Because the damage voles do to alfalfa can be

quite severe, and because of their rapid reproductive rate, initiating a program of habitat modification and/or population reduction before their numbers explode is important.

Habitat Modification. When practical, habitat modification is particularly effective in deterring voles. Once they are established in the field however, habitat modification is not applicable since the alfalfa provides an excellent vole habitat. Weeds, heavy mulch, and dense vegetative cover encourage meadow voles by providing food and protection from predators and other environmental stresses. Clearing grassy and weedy areas adjacent to alfalfa fields can be helpful in preventing damage because it will reduce the base area from which voles invade. Weed-free strips can serve as buffers around areas to be protected. The wider the cleared strip, the less apt meadow voles will be to cross and become established in alfalfa. A minimum width of 15 feet is recommended, but even that might not be enough when vole numbers are high.

Trapping. Trapping is a common detection tool used to confirm that the burrows or runways observed are from voles. When vole numbers are low or when the population is concentrated in a small area, trapping may be an effective control method although this is rarely the case in alfalfa fields. The simple, wooden mousetrap is used. Peanut butter, oatmeal, or apple slices make excellent baits for meadow voles. Often, no bait is needed because voles will trigger the trap as they pass over it. Trap placement is crucial. Meadow voles seldom stray from their usual travel routes, so set traps along these routes. Look for nests, burrows, and runways in grass or mulch in or near the alfalfa. Place traps at right angles to and flush with the ground in these runways. Traps must be set in sufficient numbers to detect the presence and degree of vole infestation. A trap line of 50-100 traps should be used. Examine traps daily. Remove and bury dead voles or place them in plastic bags in the trash. Do not handle dead voles without gloves.

Toxic Bait. When meadow voles are numerous or when damage occurs over large areas you may need to use toxic bait to achieve adequate control. When you use toxic baits, take care to ensure the safety of children, pets, and non-target animals. Do this by following product label instructions carefully.

Single-feeding baits. Baits that require only one feeding to be lethal are called single-feeding baits. They are particularly useful where vole populations are spread over large areas. Zinc phosphide has a 24(c) registration for meadow vole control in alfalfa crops in California. This allows the bait to be used with the alfalfa crop; something that can only be done if it is allowed on the rodenticide label. Place bait in runways or next to burrows where voles will find it, or broadcast in the area where voles are found. Always follow label instructions. When using zinc phosphide, be aware that voles that feed on the bait but do not die may become bait shy. When this happens, they remember that the bait made them sick and will likely not eat it again. For this reason, zinc phosphide should not be used in the same field more than once in a 6 month period. Zinc phosphide bait is rapid acting. You may find dead voles within 12 hours of baiting. When practical (e.g. dead voles in the open such as along roads), dispose of dead voles by burying them or placing them in plastic bags and putting them in the trash. Do not handle them with your bare hands. Because zinc phosphide does not accumulate in the tissue of the voles, predators or scavengers such as dogs and cats are not likely to be affected by eating the poisoned rodents. However, children, as well as pets, birds, and other animals, can be affected by the bait, so store it out of reach and use it carefully in a way that will minimize their access to it. Zinc phosphide

is a Restricted Use Material. In California, you must obtain a permit from the local County Agricultural Commissioner to buy and use it. Check for local restrictions.

Multiple-feeding baits. Anticoagulant baits are registered for meadow vole control but not for use in alfalfa crops. Use in areas adjacent to the alfalfa field or during crop dormancy or where contact with the alfalfa plant will not occur. Anticoagulant baits are slow acting and must be consumed over a period of days to be effective. Whole grain baits are commonly recommended, but pelleted baits are also available. Moisture-resistant paraffin block baits are useful around ditches and other areas where high moisture may cause other types of baits to spoil. Because voles must feed on anticoagulant baits over a period of days, the bait must be available until the population is controlled. As with trapping, bait placement is very important. Place it in runways or next to burrows so voles will find it during their normal travel. If the rodenticides label allows it to be broadcast, be sure to spread it evenly over an infested area. Multiple broadcasts may be necessary. Read the label carefully. These baits are toxic to other animals so take care and keep non-target animals from eating the bait. No anticoagulants are registered for in-crop use at this time. Some anticoagulant paraffin bait blocks are registered for voles. Place them in runways or near burrow openings or both. Keep replacing them as they are eaten and remove those that remain when feeding stops. Bait blocks should not be used where children or pets might pick them up.

Natural Control. Predators, especially barn owls and hawks eat meadow voles. Unfortunately, predators are unable to keep vole populations below damaging levels in most cases. Barn owl nest boxes are being promoted by some to assist in the meadow vole control efforts. Unfortunately, there is no scientific evidence that these predators will control rodents, even when artificial nest boxes are in place.

Monitoring Guidelines. To detect the presence of voles, look for fresh trails in the grass, as well as burrows, droppings, and evidence of feeding. Routine monitoring of the alfalfa field and surrounding area is important. Pay particular attention to adjacent areas that have heavy vegetation because voles can build up in these areas and invade the alfalfa field.

POCKET GOPHERS

Pocket gophers (*Thomomys* spp.) are stout bodied, short-legged rodents, well adapted for burrowing. Their common name is derived from the fur-lined external cheek pouches, or pockets, used to carry food and nesting materials. The pocket gopher's lips close behind its four large incisor teeth, keeping dirt out of its mouth when it is using its teeth for digging. They live by themselves in an extensive underground burrow system that can cover an area of several hundred square feet. These burrows are about 2 inches in diameter, usually located from 6 to 12 inches below ground. They eat a wide variety of roots, bulbs, tubers, grasses, and seeds, and sometimes even the bark of trees. Their feeding and burrowing can damage alfalfa and surrounding areas. In addition, they may damage plastic irrigation lines and their tunnels can divert and carry off irrigation water, lead to soil erosion and cause some structures to fail. Pocket gophers seldom travel aboveground. They are sometimes seen above ground feeding, pushing dirt out of their burrow system, or moving to a new area. The mounds of fresh soil that are the

result of burrow excavation indicate their presence. Their mounds are usually crescent shaped and are located at the ends of short lateral tunnels branching from a main burrow system. One gopher may create several mounds in a day. Generally, a group of fresh mounds is evidence of 1 gopher. Because of the nature of pocket gopher damage, successful control programs depends on early detection and prompt measures to prevent damage. Most people control gophers in alfalfa by baiting using mechanical baiting probes, hand probes or a tractor-drawn baiting device. Trapping is sometimes used although it is usually too labor intensive to be effective over large areas. Recently, fumigation for pocket gopher control has gained popularity and is something to consider if the gopher problem is severe and other methods do not seem to be working. A program incorporating these methods should result in significant reduction in pocket gopher damage in the area.

Trapping. Traps can be effective in controlling pocket gophers if continuous effort is applied. Several types and brands of gopher trap are available. The most common is a two-pronged pincher trap that triggers when the gopher pushes against a flat vertical pan. Another popular version is the squeeze-type box trap. After you have located the gopher's main tunnel, open it with a shovel or garden trowel and set traps in pairs facing opposite directions. This placement will intercept a gopher coming from either direction. The burrow may need to be enlarged to accommodate wire traps. The box trap is somewhat easier to set but requires more excavation because of its size. Box traps are useful when the diameter of the gopher's main burrow is small (less than 3 inches). All traps should be wired to stakes so you won't lose track of them. After setting the traps, exclude light from the burrow by covering the opening with dirt, sod, cardboard, or some other material. Fine soil can be sifted around the edges to ensure a light-tight seal. If light enters, the gopher may plug the burrow with soil, filling the traps and making them ineffective. Check traps often and reset them when necessary. If no gopher is caught after 2-3 days, reset the traps in a different location.

Baiting. Strychnine-treated bait is the most common type used for pocket gopher control. Zinc phosphide is another single-feeding bait that is registered in some areas. When used in alfalfa, these are Restricted Use Materials. They are usually effective with one application. Baits containing anticoagulants are available in some areas although their usefulness in large scale agricultural areas such as alfalfa fields is unknown. They require multiple treatments or one larger treatment to be effective. All gopher bait is poisonous and should be used with caution. Because gopher bait is placed underground, it is considered safe to use because it is not exposed to most other animals, or to children. However, dogs and other animals can dig up gophers and might be exposed to bait in this way. Always read and follow product label instructions carefully.

Hand baiting. Simple hand probes or hand probe dispensers are used for baiting pocket gophers (see trapping section for probe description). To be effective, baits must be placed in the underground tunnel. After locating the main gopher burrow with a probe, enlarge the opening by rotating the probe or inserting a larger rod or stick. Then place the bait carefully in the opening, taking care not to spill any on the ground. A funnel is useful to prevent spillage. Close the probe hole with sod, rock, or some other material to exclude light and prevent dirt from falling on the bait. Tamp or rake down existing mounds so you can distinguish new activity. If gopher mounding activity continues for more than 2 days after strychnine or zinc phosphide bait, or 7 to 10 days after anticoagulant baits have been used, you will need to repeat your control efforts.

Mechanical baiting. The mechanical bait applicator offers a good way of controlling gophers over large areas with an once-over operation. This tractor-drawn device constructs an artificial underground burrow and deposits poison grain bait in it at regular intervals and quantities. The artificial burrow should be used only where gophers are active and should not be used as a prophylactic to prevent gophers from invading an area. The artificial burrow will intercept the natural gopher burrow systems in the treated area. Gophers readily explore these artificial tunnels and will consume the bait. In alfalfa, the machine will cut the plants and leave a slight ridge. Soil moisture is critical when you use the machine. If the soil is too wet, the tractor will bog down; too dry and the artificial burrows will collapse. The strychnine bait used in this machine is usually a higher strength than those used for hand baiting. Recently, the availability of strychnine bait, especially at the higher strengths has been very limited. Check with your agricultural chemical supplier.

Fumigation. Fumigation is not usually considered effective for pocket gopher control although aluminum phosphide (a Restricted Use Material) has been very effective if used properly. Aluminum phosphide tablets react with the moisture in the air to evolve phosphine gas. Start by probing for a main tunnel. Once found, enlarge the probe hole by using a bigger rod (some growers use a 3/4" PVC pipe) and place the tablets down into the burrow system. Cover the probe hole with soil or close it by healing the ground. Knock down all mounds in the area. Reinspect after 48 hours. If new mounds are being formed, re-treat the active burrows. While phosphine gas is toxic to all animals, it does not build up in the tissues of the gopher so there is minimal hazard if another animal eats a poisoned gopher. If using a fumigant, be sure not to use it under or near buildings. Read and follow the label carefully. Fumigation with smoke or gas cartridges is usually not effective because gophers quickly seal off their burrow when they detect smoke or gas.

Natural Control. Predators, especially barn owls, hawks, dogs and cats, eat pocket gophers. In most cases they are unable to keep pocket gopher populations below the levels that cause problems in alfalfa and landscaped areas. There is considerable interest in providing artificial nest boxes to encourage barn owls to live near alfalfa fields. Because barn owls often bring prey back to their nest (and regurgitate bones of those eaten elsewhere), growers notice evidence of feeding on gophers. There is no information on where these gophers were taken, however. We do know that owls forage some distance from their nests, often in open grasslands and other nonagricultural areas.

Other Control Methods. Pocket gophers can easily withstand normal irrigation but flooding can sometimes force them out of their burrows. When this happens, they are vulnerable to capture. A new device on the market is an exploding gun that pumps propane and oxygen into the tunnel system and ignites the mixture with a spark. While some growers are using this device, little information is available on its effectiveness for pocket gopher control. Repellents are not effective in protecting alfalfa from pocket gophers. Frightening gophers with sound, vibration, electromagnetic radiation, or other means has not proven effective in driving them from an area or preventing their damage.

Monitoring Guidelines. Once pocket gopher damage has been controlled, a system should be established to monitor the area for gopher re-infestation. Level or stamp down all existing mounds after the control program and clean away weeds and debris so fresh mounds can be seen easily. A monitoring program is important because pocket gophers may move in from other areas and a recurrence of damage can occur within a short time. They probably do this by using the tunnel systems left by other gophers. Experience has shown that it is easier, less expensive and less time consuming to control gophers before they build up to the point where they do excessive damage.

GROUND SQUIRRELS

Ground squirrels are common in most alfalfa growing areas. Each species is controlled differently and the availability of baits and other control materials varies throughout the county. While information on one species might not apply to all others, you can often get some good ideas from seeing how other people deal with their squirrel problems. The California ground squirrel (*Spermophilus beecheyi*) inhabits most agricultural and rural areas of California. Ground squirrels live in colonies of 2 to 20+ animals in a wide variety of habitats. Populations may be particularly dense in areas disturbed by humans, such as road or ditch banks, fencerows, near buildings, and in or near many crops. They usually avoid thick chaparral, dense woods, and wet or moist areas. Ground squirrels are active during the day and are easy to spot, especially in warm weather, from spring to fall. During winter, ground squirrels hibernate but some young squirrels remain active year round. Most adults go into summer "hibernation" (aestivation) during the hottest times of the year. At night and in bad weather squirrels will remain in their burrows. Ground squirrels reproduce once a year in early spring. Litter sizes vary, but seven to eight young are average. The young remain in the burrow for about 6 weeks before they emerge. Ground squirrels are primarily vegetarians. During early spring, they consume green grasses and other small plants. When the vegetation begins to dry, squirrels switch their diet to seeds, grains, and nuts. When ground squirrels cause or threaten damage, you should institute a control program suitable for the situation and time of year. The activity cycle of ground squirrels determines when various control measures are appropriate.

Fumigation. You can kill ground squirrels in their burrows with several types of fumigants, some of which require special use permits. Fumigation should not be used near or beneath buildings, or when a fire hazard exists (e.g. dry grass). It is most effective in the spring or at other times when soil moisture is high. The soil moisture helps hold the gas in the burrow system by limiting its diffusion into the small cracks often present in dry soil. Ground squirrels have fairly large burrows that can have several entrances. Treat all entrances and then seal them. Check treated burrows in 24-48 hours and re-treat any newly opened burrows. Fumigation is not effective during periods of hibernation and aestivation because at those times squirrels plug their burrows with soil. The plug usually can't be seen. Since fumigants will generally kill any animal in the burrow, take care to ensure other animals are not present. For example, Burrowing owls live in abandoned ground squirrel burrows. If you observe these owls sitting on the burrow mound, or see bird droppings or feathers in and around a burrow opening, do not fumigate the burrow. Gases emitted from some fumigants are dangerous to people so apply them carefully. They occasionally ignite, creating a fire danger. Do not use such fumigants where a significant

fire hazard exists such as near buildings, dry grass, or other flammable materials. Always read and follow the fumigant label instructions and restrictions.

Toxic baits (rodenticides). Some toxic baits are available over the counter, and others require a permit from your County Agricultural Commissioner. When you use toxic baits or any other rodent control materials, read and follow label instructions carefully. Anticoagulant baits are recommended for control of ground squirrels because they are effective and relatively safe to humans, pets, and most other wildlife. Anticoagulants interfere with an animal's blood-clotting mechanism, eventually leading to death. They are effective when consumed in several feedings over a period of 5 days. These features, as well as an effective antidote (vitamin K₁), make anticoagulant baits relatively safe to use. For ground squirrels, anticoagulant baits can be applied in three ways: bait stations, spot baiting, or repeated broadcast application. Bait stations are small structures that the squirrel must enter to eat the bait. A station contains sufficient bait for repeated feedings, minimizes bait exposure to weather, and helps keep children and pets from reaching the bait. The bait station is the preferred baiting method around homes and in other areas where children, pets, and poultry are present. Follow the product label regarding use, construction and placement of these stations. There are several things you should consider when you are designing a bait station for ground squirrels. The entrance hole(s) should be about 3-4 inches across to allow access to squirrels but keep out larger animals. A self-feeding arrangement will ensure that the pest gets a continuous supply of bait. Construct a lip or other arrangement to prevent bait from spilling out when squirrels exit. In areas accessible to children, provide a lock or devise some other method that will make it difficult for children to find or open the station. The bait station should be secured so that it cannot be turned over or easily removed. Place bait stations in areas frequented by ground squirrels such as near runways or burrows. If ground squirrels are noticeable throughout the area, space the stations at intervals of 100 to 200 feet. Initially, inspect bait stations daily and add bait if all is eaten overnight. Fresh bait is important. It may take several days or longer before squirrels become accustomed to and enter the bait station. Anticoagulant baiting with bait stations generally takes 3 to 4 weeks or more to be effective. Once feeding begins the squirrel usually dies in 5-6 days. Continue baiting until all feeding ceases and you observe no squirrels. Upon completion of the Control program, pick up unused bait and store or dispose of according to label instructions. Ground squirrels are excellent foragers for seeds. Spot and broadcast baiting uses this behavior to apply bait over the area where squirrels live and feed. With spot baiting, spread the bait by hand using a spoon or cup around the squirrel burrows or in the runways. Do not pile the bait. Mechanical seed broadcasters are also used to spread bait evenly over the area around the squirrel burrows or runways. With both of these methods the bait is spread very sparsely (approx. 3-4 grain kernels per square foot). This is sufficient for the squirrel to find it but too sparse for some other wildlife. It is necessary to repeat the bait application 4-5 days after the first treatment. Spot and broadcasting baiting can only be used if it is specified on the rodenticide label. Always read and follow label instructions carefully. Anticoagulant baits have the same effects on nearly all warm-blooded animals, including birds. Cereal based baits are attractive to dogs as well as to other non-target animals, so take care to prevent access to the bait. The hazards to children and pets can be reduced by placing bait out of their reach in a bait station and by keeping them out of areas where baiting is underway. Dead ground squirrels can contain small amounts of the anticoagulant in their tissues. Carcasses should be buried or put in plastic bags in the trash. Do not handle them with bare hands. Single-feeding type baits are also available for controlling ground squirrels, but there are

more restrictions on their use. Apply single-feeding baits such as zinc phosphide by hand or with a mechanical broadcaster according to the label instructions. Spread the bait near the ground squirrel burrow or at places where the squirrels are feeding. Ground squirrels are good foragers and can easily find the broadcast grain. Do not pile bait, as this will increase the hazards to non-target animals. Dead squirrels should be buried or put in plastic bags in the trash. Follow label instructions carefully.

Natural Control. Predators, especially hawks, coyotes and dogs eat ground squirrels. In most cases they are unable to keep the squirrel population below the level that causes problems in alfalfa and adjacent areas. There is considerable interest in providing artificial perches to encourage raptors to hunt near alfalfa fields. While raptors are reported using these perches, there is no evidence this resulted in less rodent damage to the alfalfa.

Other Control Methods. Ground squirrels like open areas where there is good visibility. Dense plantings might be a deterrent to ground squirrels living near alfalfa although this is not likely to be. A new device on the market is an exploding gun that pumps propane and oxygen into the tunnel system and ignites the mixture with a spark. While some growers are using this device, little information is available on its effectiveness for ground squirrel control, at least in California. Repellents are not effective in protecting plants from ground squirrels feeding. Frightening squirrels with sound, vibration, electromagnetic radiation, or other means has not proven effective in driving them from an area or preventing their damage.

Monitoring Guidelines. Once ground squirrels damage has been controlled, a system should be established to monitor the area for re-infestation. Squirrels will invade old burrows, even when covered with a layer of soil. Monitor these areas and other places when the squirrels have been a problem. Experience has shown that it is easier, less expensive and less time consuming to control squirrels before they build up to the point where they do excessive damage.