DEVELOPING AN IPM PROGRAM FOR CONTROLLING POCKET GOPHERS AND VOLES IN ALFALFA

Roger A. Baldwin[1]

ABSTRACT

Pocket gophers (*Thomomys* spp.) and voles (also known as meadow mice; *Microtus* spp.) are often the most damaging vertebrate pests in alfalfa. The amount and form of damage they cause can be quite varied but includes a loss in vigor and/or mortality of plants, damage to subsurface drip lines, and loss of irrigation water down burrow systems. Many control options are available including the use of toxic baits, burrow fumigation, and trapping. An Integrated Pest Management (IPM) program that incorporates several of these approaches, and potentially other techniques, can have many positive attributes for controlling pocket gophers and voles, not the least of which is greater control than is typically observed by focusing on any single method. The best IPM plan for alfalfa growers will vary depending on numerous aspects including the time of year when control is needed or implemented; the cost of control measures; the presence of non-target, threatened, or endangered species; and existent laws and regulations for potential control methods. Nonetheless, an effective IPM program can be developed by adhering to the following four-step process: 1) identify the species that is causing the damage, 2) assess your control options, 3) develop and implement the management plan, and 4) monitor to determine the effectiveness of the management plan. Adhering to these four steps should allow alfalfa growers to effectively control pocket gophers and voles, while reducing control costs.

Key Words: alfalfa, baiting, Integrated Pest Management, fumigation, *Microtus* spp., pocket gopher, *Thomomys* spp., trapping, vole

INTRODUCTION

Although many vertebrate pests cause problems in alfalfa, the most frequent offenders are pocket gophers (*Thomomys* spp.) and meadow voles (also known as meadow mice; *Microtus* spp.). Pocket gophers are short, stout burrowing rodents, usually 6–8 inches in length. They spend most of their time below ground where they use their front legs and large incisors to create extensive burrow systems. Meadow voles are small, blunt nosed stocky rodents with small eyes and short ears and legs. They are typically dark grayish brown in color with size intermediate to that of a house mouse and a rat.

Pocket gophers will breed anywhere from 1 to 2 times per year, although in more southern irrigated alfalfa fields, they may reproduce up to 3 times per year. Female voles may produce from 5 to 10 litters per year. Therefore, continuous monitoring and control of pocket gopher and vole populations is needed to keep their numbers low. Although pocket gophers and voles can

[1] R. A. Baldwin (rabaldwin@ucdavis.edu), UCCE Wildlife Specialist, Department of Wildlife, Fish, & Conservation Biology, One Shields Ave., University of California, Davis, CA 95616; **In:** Proceedings, 2015 Western States Alfalfa and Forage Symposium, Reno, NV, 2-4 December, 2015. UC Cooperative Extension, Plant Sciences Department, University of California, Davis, CA 95616. (See http://alfalfa.ucdavis.edu for this and other alfalfa conference Proceedings.)

breed at different times throughout the year, there is typically a pulse in reproduction in late winter and early spring depending on location and weather patterns. As such, control measures implemented before this reproductive pulse will often be more effective as there will be fewer pocket gophers and voles to control at that time. Additionally, because voles mature rapidly and can bear many litters annually, vole populations can increase rapidly. Typically, their numbers peak every 6 to 8 years when population numbers can be as high as hundreds of voles per acre.

If left unchecked, pocket gophers (8.8% loss in revenue when present) and voles (11.3% loss) will cause extensive damage to alfalfa (Baldwin et al. 2014b). This damage includes consumption of tap roots and above-ground vegetation that can result in reduced vigor and/or mortality of alfalfa plants, loss of irrigation water down burrow systems, and chewing on subsurface drip lines. Pocket gopher mounds can result in additional problems including serving as weed seed beds, burying of plants, and causing damage to farm equipment.

A number of options are currently available for controlling pocket gophers but most control centers on toxic baits, fumigants, and trapping. Other control options are available as well, although their efficacy is less clear. For voles, control in alfalfa centers on toxic baits and cultural practices. I will briefly detail each of these approaches in the following section.

CONTROL METHODS

Toxic baits

Pocket gophers. There are three primary toxic baits for pocket gopher control: 1) strychnine, 2) zinc phosphide, and 3) anticoagulants (e.g., chlorophacinone and diphacinone). Both strychnine and zinc phosphide are considered acute toxicants. This means they kill after a single feeding. Strychnine has typically been promoted as the more effective of the two. Up until a few years ago, strychnine came in two concentrations in California: 0.5% and 1.8%. However, the 1.8% strychnine is no longer available, and the 0.5% product can be difficult to find due to supply shortages. Zinc phosphide is also available for pocket gopher control; it comes in a 2.0% concentration. Bait acceptance can be an issue with zinc phosphide, as it has a distinctive odor and taste that pocket gophers are often averse to. Anticoagulants such as chlorophacinone and diphacinone are multiple feeding toxicants. With these rodenticides, pocket gophers must consume the bait multiple times over the course of 3 to 5 days to receive a toxic dose. This means larger amounts of bait are required to maintain a ready supply over this time period. Because of this, acute toxicants are typically preferred over anticoagulants for pocket gopher control. Extensive laboratory trials have shown that strychnine products are far more efficacious than other rodenticides currently registered for pocket gopher control (Witmer and Baldwin 2014). Subsequent field trials indicated 100% removal of pocket gopher populations across three vineyards, so strychnine does still appear to be highly efficacious (Baldwin et al. 2015b). However, pocket gophers do develop a behavioral or physiological resistance to strychnine if repeatedly used over time (Lee et al. 1990, 1992, Marsh 1992). Therefore, strychnine baiting should be used only as one part of an Integrated Pest Management (IPM) program.

There are two primary methods for baiting in alfalfa fields: 1) hand baiting with an all-in-one probe and bait dispenser, and 2) a burrow builder. Hand baiting can be effective if you have relatively few pocket gophers in a field. For this approach, an all-in-one probe and bait dispenser is used to locate a tunnel. The bait is then directly deposited into the tunnel. The opening left by

the probe is covered up with a dirt clod or rock to prevent light from entering the burrow. When using this method, care must be taken not to bury the bait with loose dirt as this will limit access to the bait. Typically, it is recommended that burrow systems be treated at least twice to maximize efficacy. Recent research has shown that the experience of the individual who applies the bait is very important; those applicators who have been properly trained on how to use the equipment, and who can detect the difference between extant versus back-filled tunnels, are more than twice as efficacious as those individuals who have not received the proper training (Baldwin 2014).

Although hand baiting can be effective for smaller pocket gopher populations, the burrow builder can be a more practical method for treating larger areas. The burrow builder is a device that is pulled behind a tractor on a 3-point hitch and creates an artificial burrow at a set depth. Bait is then deposited at set intervals along the artificial burrow. While engaging in normal burrowing activity, pocket gophers will come across these artificial burrows and consume the bait within. This device must be used when soil moisture is just right. If the soil is too dry, the artificial burrow will cave in, but if it is too wet, the burrow will not seal properly and will allow light to filter in; pocket gophers will not travel down burrows if they are not sealed. The depth of the burrow builder must also be adjusted for each field (and occasionally within the same field) to ensure that the artificial burrows are created at the depth where must tunnels are found within that field. The artificial burrows must also be checked regularly to make sure that bait is being applied; the applicator often plugs, and if no bait is deposited, the process will obviously not work. Although convenient to treat large areas, the efficacy of this method has varied quite extensively from grower to grower. Experimentation is key to determining the applicability of this approach for each grower.

Voles. The use of toxic baits is the primary method for controlling voles in alfalfa. Within alfalfa fields, only zinc phosphide can be applied. Zinc phosphide is a restricted-use rodenticide; it can only be used by or under the direct supervision of a Certified Applicator. Zinc phosphide is applied directly to vole burrows and runways through spot treatments or broadcast applications. Spot treatments are used when only a few burrows are to be treated. Otherwise, broadcast applications are more efficient. If overused, problems with bait shyness can occur. As such, zinc phosphide should not be applied more than twice per year. Additionally, zinc phosphide must be applied when new growth is less than 2-inches tall. Zinc phosphide can off-gas when it comes into contact with water. As such, it should not be applied during heavy fog or when dew or precipitation are expected within the following 24–48 hours. Carefully read the label for more information on restrictions for zinc phosphide application in alfalfa.

Both zinc phosphide and anticoagulant baits (e.g., chlorophacinone and diphacinone) can be applied in non-crop areas adjacent to alfalfa fields. If adjacent fields or non-crop areas harbor large vole populations, these areas should be treated as well to reduce immigration into alfalfa fields after bait application.

Fumigation

Pocket gophers. Primary fumigants for burrowing rodent control have historically included gas cartridges and aluminum phosphide. Studies have shown that gas cartridges are not effective for pocket gophers. Aluminum phosphide, however, is quite effective. Aluminum phosphide is a

restricted-use material; it can only be used by or under the direct supervision of a Certified Applicator. That being said, it is quite effective and has a low material cost if used over small areas. The primary method for applying aluminum phosphide is similar to that of hand baiting. You use a probe to find a pocket gopher tunnel, then wiggle the probe to enlarge the opening (if the probe hole is not already large enough to allow passage of the aluminum phosphide tablets into the tunnel), and drop the label specified number of tablets or pellets into the tunnel. You then seal up the opening with a rock or dirt clod to eliminate light from entering and the toxic gases from exiting the tunnel. Once again, care must be taken not to bury the tablets with loose soil as this will render them ineffective. Typically, each burrow system is treated twice to maximize efficacy. The key with aluminum phosphide treatments is to only apply when soil moisture is relatively high. If you can ball up a clump of soil at the burrow depth and it maintains that ball in your hand, then soil moisture is high enough to fumigate; if the clump falls apart in your hand, it is too dry. Because of this, fumigation is typically most effective in late winter and early spring. However, fumigation after irrigation can also be a good strategy.

In addition to aluminum phosphide, carbon monoxide generating machines can now be used to control pocket gophers in California. As their name implies, these devices generate carbon monoxide and inject it into the burrow systems which then asphyxiates the inhabitants. Initial trials have indicated that this approach is moderately effective (56–68%; Orloff 2012, R. Baldwin and S. Orloff, unpublished data), although efficacy is less than typically observed with trapping, aluminum phosphide, and strychnine. Additionally, equipment can be expensive to purchase. However, many more burrow systems can be treated during a day of application with this approach, so these machines likely have utility moving forward, particularly for growers and pest control professionals who have large acreage to treat.

Voles. Fumigants are not typically used for vole control in alfalfa given the large amount of labor required to treat every burrow opening.

Trapping

Pocket gophers. Trapping is safe and one of the most effective although labor intensive methods for controlling pocket gophers. Nonetheless, the cost and time for application is often offset by effectiveness (R. Baldwin and S. Orloff, unpublished data). Several types and brands of pocket gopher traps are available. The most common type is a two-pronged, pincher trap such as the Macabee, Cinch, or Gophinator, which the pocket gopher triggers when it pushes against a flat, vertical pan. Another popular type is the choker-style box trap, although these traps require extra excavation to place and may be a bit bulky to be practical in a large field setting. Of trap types tested, the Gophinator trap (Trapline Products, Menlo Park, CA) appears to be one of the most effective. In particular, it has proven more effective than the Macabee trap (The Macabee Gopher Trap Co., Los Gatos, CA), which is likely the most commonly used pocket gopher trap in the western U.S (Baldwin et al. 2013). The increased effectiveness of the Gophinator is due to its ability to capture larger individuals at a greater rate. If an individual has old stock piles of Macabee traps, their effectiveness can be increased by placing a cable restraint (0.06 inch in diameter, 9 inch in length) to the front of the Macabee trap to help keep larger individuals from escaping. However, the Gophinator trap is still more effective (Baldwin et al. 2015a).

For trap placement, the first step is to probe near a fresh mound to find the main tunnel, which often is on the side closest to the plug of the mound. The main tunnel usually is 6 to 8 inches deep; the probe will drop quickly about 2 inches when the tunnel is encountered. Traps will then need to be placed in as many tunnels as are present as you will not know which side the pocket gopher currently is using. After placing the traps, you can cover the hole to keep light out of the tunnel. However, covering trap sets only marginally increases capture efficiency when temperatures are high (perhaps >85°, although the exact impact of temperature is not known) and provides no increase in capture success at other times (Baldwin et al. 2013). Therefore, if setting a large number of traps, a substantial amount of time in setting and checking traps can be saved if the trap-holes are left uncovered. Various attractants have been tested to see if they will increase capture success. They do not appear to increase capture success, although if using covered trap sets, there could be a slight increase in capture success when using an attractant such as peanut butter (Baldwin et al. 2014a). Human scent also does not appear to influence capture success, so there appears to be little reason to worry about handling traps with bare hands (Baldwin et al. 2015a). Trap sets are typically only operated for 24 hours. If no activity is present in that timeframe, they should be moved to a new location to maximize capture probabilities.

Pincer-type traps can also be placed in lateral tunnels, which are tunnels that lead directly to the surface. To trap in laterals, the plug is removed from a fresh mound and a trap placed into the lateral tunnel so that the entire trap is inside the tunnel. Pocket gophers will come to the surface to investigate the tunnel opening and will be caught. This approach is quicker and easier to implement than trapping in the main tunnel. However, trapping in lateral tunnels may be less effective at certain times of the year (e.g., summer) and for more experienced pocket gophers (e.g., adult males).

Voles. Trapping is not typically used to control vole populations. Voles can easily be captured with standard mouse snap-traps, but the amount of labor, time, and resources required to remove voles from an alfalfa field is counter-productive.

Other control approaches.

A variety of other control options are sometimes used to control pocket gophers and voles in alfalfa. They are briefly discussed in the following paragraphs.

Biocontrol. This approach relies on natural predation to control pocket gopher and vole populations. From a management perspective, this typically involves the use of owl boxes to encourage owl predation of pocket gophers and voles over alfalfa fields. Unfortunately, no replicated scientific study has ever been able to show that owls substantially reduce pocket gopher or vole populations in a field. Owls do eat a large number of rodents per year, but do so over a wide enough area that they may not be able to reduce pocket gopher or vole populations to low enough levels to constitute effective control.

Cultural practices. Habitat modification is an example of a cultural practice. This approach involves altering rodent habitat to reduce its desirability for that site. This can be a good approach for reducing pocket gopher populations in many other commodities, but unfortunately

is not as practical in alfalfa given the pocket gopher's strong affinity for this crop. Likewise, cover removal can be very effective at controlling vole populations but is not practical in alfalfa.

Cultivation is a more practical example of a cultural practice in alfalfa. If you have an alfalfa field that you are going to replant, deep ripping will eliminate many of the pocket gopher and vole burrow systems and will kill some pocket gophers and voles in the process. Destroying the burrow systems helps slow down potential reinvasion into fields, and when combined with an aggressive pocket gopher and vole management program post-cultivation, can provide a "clean slate" for a newly planted alfalfa field.

Flood irrigation. Where still feasible, flood irrigation can help control pocket gopher and vole populations. When a field is flooded, the pocket gophers and voles must come to the surface or drown. When at the surface, they can be picked off by a number of predators; growers and their dogs can also actively seek out pocket gophers and voles at this time to further reduce populations of these damaging pests.

Gas explosive device. This is an instrument that injects a mixture of propane and oxygen into the burrow system and then ignites this mixture thereby potentially killing the burrowing rodent through a concussive force. This approach has the added benefit of destroying the burrow systems which should slow down reinvasion rates by burrowing rodents. However, studies have not shown it to be overly effective for many burrowing rodent species. Additionally, there are potential hazards associated with this device including damage to buried pipes and cables, injury to the user, and the potential to catch things on fire. Additionally, these devices are quite loud; as such, they are not practical for use in or around residential areas. That being said, this device does kill some pocket gophers and voles and may be useful in some specialized settings, particularly where destruction of burrow systems for pocket gophers is required.

Repellents. No scientific data has been reported to show that chemical repellents effectively keep pocket gophers or voles from inhabiting fields. Frightening pocket gophers and voles with sound or vibrations also does not appear effective.

DEVELOPING AN EFFECTIVE MANAGEMENT PLAN

Often, growers will rely on a single method to control many vertebrate pest species including pocket gophers and voles. However, relying on a single control method has a number of potential problems including: 1) lower efficacy than when incorporating multiple control strategies, 2) greater potential hazard to non-target organisms and the environment if relying solely on pesticides, 3) limits the time of year when control actions can be implemented, and 4) increases the probability of behavioral or biological resistance or adaptation to a control mechanism. Therefore, I recommend incorporating an IPM approach for controlling pocket gophers and voles. The following paragraphs outline a four-step process to help you develop an effective IPM program for controlling pocket gophers and voles in alfalfa.

Step 1: Identify the species that is causing the damage. This is an intuitive step and one that often is easy to discern. However, in some cases it is difficult to identify if damage, mounds, or burrows are caused by pocket gophers, moles, voles, or some other species. For pocket gophers,

look for horseshoe-shaped mounds with a plug located on the open side of the horseshoe. The plug is circular in appearance and is around 2 to 3 inches in diameter. Mole mounds are occasionally mistaken for pocket gopher mounds. However, mole mounds are typically more volcano-shaped in appearance with the plug either found in the middle of the mound or is not visible. Pocket gophers will also create feeder holes. Feeder holes are shallow burrows that open at the surface. They do not have a mound associated with them, but are usually plugged. Feeder holes can further be identified by a circle of vegetation removed for an inch or two around the circumference of the hole. When plugged, feeder holes are easy to identify, as voles never plug burrow systems. However, these plugs are quite shallow and will often cave-in. When this occurs, they can resemble vole burrows. The easiest way to differentiate between pocket gopher feeder holes and vole burrows is to look for runways (1–2 inch wide linear runways that have been cleared of vegetation that voles use for travel) that extend back and forth between other burrow openings. If these runways are present, the open holes belong to voles. If not, they are likely pocket gopher feeder holes whose plug has collapsed. It is important that you correctly identify the source of these burrows and mounds, as the control methods that you can effectively use vary depending on the species. For example, bait application for pocket gophers occurs below ground, while bait is typically applied above ground for voles. Additionally, while pocket gophers and voles are major pests of alfalfa, moles are not. Therefore, if you only have moles, control may not be needed. Without proper pest identification, a control program is likely to be ineffective at best, and may potentially be illegal.

Step 2: Consider your control options. There are many different aspects to consider when developing an IPM program for controlling pocket gophers and voles. These include: 1) what time of year is it, and how does this influence the efficacy of various control methods, 2) how bad is the infestation, and how will this influence the cost of various control methods, 3) are there non-target, threatened, or endangered species that are likely to be affected by control actions, and 4) are there laws or regulations that will limit the ability to use any of the various control methods? Examples of items to consider for each of these are as follows:

Timing. This is a key component to consider, as it influences many different aspects of an effective control program. Examples of the influence of timing are:

- Pocket gopher and vole populations are often at their lowest levels in mid to late winter. A control program focused on this time of year would require the least amount of effort and should provide the greatest control.
- Almost all forms of control become too difficult to justify attempting once alfalfa gets more than a few inches tall. Therefore, control actions for alfalfa should be focused on periods of dormancy or immediately after cuttings.
- Fumigation with aluminum phosphide requires relatively high soil moisture. Therefore, you must time these control strategies for when sufficient soil moisture is present.

Cost. Some control options are more costly than others, while others are more effective than alternative options. This will vary depending on the density of rodent populations, soil type, soil moisture, etc. For example, use of a burrow builder may be an effective way to treat a large field with abundant pocket gophers. However, if this field has only a few pocket gophers present, an alternative method such as trapping or fumigation may be less expensive and more efficient.

Non-target, threatened, or endangered species. This is an important aspect to consider. If threatened or endangered species are present, certain control options may not be available for use, or at a minimum, may require some alteration in application procedure (e.g., may only be able to treat burrow systems that are "verified" as currently occupied by pocket gophers rather than all "potentially" occupied burrow systems). If you are unsure if you have any threatened or endangered species in areas that you plan to control, contact your local County Agricultural Commissioner's office. They can help you make that determination. Also, some rodenticides (e.g., anticoagulants) pose potential secondary hazards to predators and scavengers who may consume rodents that are dead or dying. This potential non-target poisoning may limit your use of these rodenticides if you are in an area where you are concerned about such issues (e.g., close to residential area where pets may find and consume poisoned pocket gophers or voles).

Laws and regulations. Some rodenticides are allowable for use in controlling pocket gophers but not voles. It is imperative that rodenticide users understand the restrictions involved with using a control strategy before developing a management plan to control all vertebrate pests.

Step 3: Develop and implement the proposed management plan. After considering all of your options, it is time to develop and implement your management plan. Ideally, you will incorporate multiple control methods into this plan for reasons listed at the beginning of this section. One example of an IPM plan to control a field heavily infested with pocket gophers if you are planning on replanting the next year would be to first deep-rip the field after the last cutting. You could then proceed with trapping to eliminate all pocket gophers that survived the ripping process. With trapping, as with most all control measures, there will always be a small segment of the population that is trap shy. For those individuals that you do not capture with traps (i.e., trap shy), you could fumigate with aluminum phosphide. This approach would minimize pesticide use, while providing efficient control. Obviously, this approach would only be useful if you were replanting the field. If you were not planning on replanting, you might decide to use strychnine bait applied via a burrow builder to reduce pocket gopher populations. This approach will allow you to treat a large area relatively quickly. However, it alone may not result in sufficiently lower numbers of pocket gophers. Therefore, after reducing pocket gopher populations with the burrow builder, you could then target remaining active burrow systems with trapping or aluminum phosphide to further reduce these populations. Keep in mind that with large pocket gopher populations, multiple applications of trapping, fumigation, and baiting may be needed to eliminate an acceptable percentage (at least 70%) of the population. These are only two of many potential combinations of control techniques that could be incorporated into an IPM plan. Each grower will have a unique set of circumstances that will influence what is best for them.

Step 4: Monitor fields. This is a very important step to consider but is one that is often overlooked. First off, you must monitor pocket gopher and vole activity to determine how effective you were at reducing these populations. If you did not achieve the desired level of control, then you will need to retreat. Additionally, if control levels were substantially lower than what you expected, you should take time to contemplate why so that you do not repeat the same results after the next round of treatments. For example, perhaps you treated a field with aluminum phosphide, but achieved only 25% control. This is much lower than would be expected. One explanation would be that soil moisture was too low. If you think this might be

the case, do not retreat pocket gopher tunnels with aluminum phosphide until you have higher soil moisture. The specific level of control that you are targeting is up to you, but it is typically recommended that you shoot for a minimum of 70% control, and closer to 90% is much better. As previously stated, pocket gophers and voles are rodents, and as such, can reproduce quite rapidly. If you only reduce rodent populations by 60% and do not treat the field again until the following year, they will have had time to repopulate the area to approximately the same level they achieved the prior year. Therefore, to obtain long-term reductions in rodent populations and subsequent lower control costs, higher levels of control are needed; given the pocket gopher and voles known propensity for causing damage in alfalfa, a zero-tolerance policy is typically warranted. Specific monitoring protocols that can be used for pocket gophers and voles are as follows.

Pocket gophers

To monitor pocket gopher populations to determine treatment efficacy, I recommend one of two methods: the mound count and the open-hole methods. Both of these methods work in much the same way in that they allow you to determine the presence or absence of a pocket gopher in a designated area. For implementation, I recommend establishing ten to twenty, 30 foot by 30 foot plots throughout a field following a grid structure; keep a minimum of 45 feet between each plot to minimize the potential of pocket gophers moving between plots during the sampling period. Be sure to establish these plots in areas where you know you have pocket gopher.

Once the plots have been established, you can begin the monitoring process. For the mound count method, clear away all pocket gopher sign within each plot using your boot, rake, or shovel. Be sure to clear away or cover up feeder holes as well. Two days after clearing all pocket gopher sign, come back and check for new activity. If you have activity (i.e., new mounds or feeder holes), you know that a pocket gopher is present. If not, then you assume no pocket gopher is present. After you have finished this monitoring activity, treat the area using whatever strategy you have decided to use. Approximately one week after treating the area, clear all old sign away from the previously established plots, and come back two days later to check for new activity. This will give you an idea of the level of control you have experienced. For example, let us assume that you established 20 plots prior to treatment and determined that all 20 plots had pocket gopher activity. This equates to 100% occupancy of your monitoring plots. After pre-treatment monitoring, you then treat all burrow systems with zinc phosphide bait via a hand probe. One week after application, you go back in and clear mounds from the previously monitored plots, and two days later you check for activity. This time, you find that 12 of the 20 plots no longer exhibit pocket gopher activity. This means you have experienced a 60% (12/20) decrease in pocket gopher populations after one treatment. In this case, one more treatment round would likely be warranted. Perhaps this time you may use trapping or aluminum phosphide.

The open-hole method is very similar except you are not clearing old activity within study plots; rather you dig a hole down to a pocket gopher tunnel and leave it open. You do this twice for each study plot. Because pocket gophers do not like open burrow systems, they will plug it up if they are using that tunnel. If you find a plugged hole, you know that a pocket gopher is in the plot. After opening the holes to the burrow system, you check them

two days later to verify presence. If no holes are plugged, you consider that plot "unoccupied". If any of the 2 holes in that plot are plugged, you consider the plot "occupied". You then repeat this monitoring procedure one week after the control treatment is applied and calculate the level of control in the same manner as described for the mound count method. Both of these methods work fairly well, although the open-hole method can be more precise given that pocket gopher sometimes do not mound for several days. For example, you could sample at a time when pocket gopher are not mounding much. If using the mound count method, you may overestimate your level of control. However, many individuals prefer to use the mound count method as it can be quicker to use; the choice is yours.

Voles

Monitoring for vole activity is a bit more challenging. The most practical approach would be to place a network of snap traps in vole runways with the trap placed perpendicular to the runway so that the trigger part of the trap overlaps the runway. This can be repeated for a representative sample of runways throughout the field (probably 50–100). Traps do not need to be baited if placed in the runway as mentioned above. The number of voles captured prior to treatment applications can then be compared to the number captured post-treatment (if using zinc phosphide bait, post-treatment monitoring can begin 72-hours after bait application) to determine removal rates. General observations of burrow activity and feeding sign can also be used to help assess vole activity in alfalfa fields.

Unfortunately, even after dramatically reducing pocket gopher and vole populations, your work is not done. Constant monitoring of fields is warranted given these rodents ability to rapidly repopulate. Once a field is under control, it takes relatively little work to keep it that way if a grower is vigilant. If you are not vigilant, odds are the pocket gopher and voles will repopulate and you will have to start over again.

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