A REVIEW OF CURRENT TOOLS FOR MANAGING POCKET GOPHERS IN ALFALFA

Roger A. Baldwin[1]

ABSTRACT

Pocket gophers (*Thomomys* 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. In this paper, I highlight some of the tools that are used to manage pocket gophers in alfalfa. Primary tools continue to include rodenticides, burrow fumigants, and trapping, although other tools such as cultivation, burrow flooding, biocontrol, and repellents may have a role in effective management programs as well.

Key Words: alfalfa, fumigation, pocket gopher, rodenticide, *Thomomys* spp., trapping

INTRODUCTION

Although many vertebrate pests cause problems in alfalfa, the most frequent offender is the pocket gopher (*Thomomys* 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. 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. Therefore, continuous monitoring and control of pocket gopher populations is needed to keep their numbers low. Although pocket gophers can 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 given fewer pocket gophers to control at that time.

If left unchecked, pocket gophers will cause extensive damage to alfalfa (8.8% loss in revenue when present, 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 seedbeds, 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 rodenticides, fumigants, and trapping. Other control options are available as well, although their efficacy is less clear. I will briefly detail each of these approaches in the following section.

---

[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, 2021 Western Alfalfa and Forage Symposium, Reno, NV, November 16–18. UC Cooperative Extension, Plant Sciences Department, University of California, Davis, CA 95616. (See http://alfalfa.ucdavis.edu for this and other alfalfa conference Proceedings.)

CONTROL METHODS

Toxic baits

There are three primary rodenticides 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 generally been the more effective of the two and comes in a 0.5% concentration. 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. This can limit the efficacy of zinc phosphide baits.

Anticoagulants such as chlorophacinone and diphacinone are multiple feed toxicants. With these rodenticides, pocket gophers generally need to consume the bait multiple times over the course of 3 to 5 days to receive a lethal dose. This means larger amounts of bait are required to maintain a ready supply over this time period. Because of this, acute toxicants have often yielded better results 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. 2017b). 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 most tunnels are found within

that field. The artificial burrows must also be checked regularly to make sure that bait is being applied; the application equipment 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 in determining the applicability of this approach for each grower.

Fumigation

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 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 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 tunnel 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. As their name implies, these devices generate carbon monoxide and inject it into the burrow systems which then asphyxiates the inhabitants. Trials have indicated that this approach is moderately effective (56–68%; Orloff 2012, Baldwin et al. 2016, 2017a), 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.

A carbon dioxide injection device is now registered for use against pocket gophers as well. Data on efficacy of this tool is limited at this point, although the expectation is that efficacy should be relatively equivalent to that observed for pressurized exhaust machines. In contrast to pressurized exhaust machines, the carbon dioxide injection device requires a tank of carbon dioxide. This could make it more challenging to use over large acreage given the potential need for multiple tanks per day.

Trapping

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

(Baldwin et al. 2016). 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 trap. Historically, these have been box traps that require extra excavation to place, and may be a bit bulky to be practical in a large field setting. More recently, we've seen increased use of a cylinder-type trap called the GopherHawk, which is a choker style trap that takes little excavation and is quick and easy to set. 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 influence capture success, so there is 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 and larger pocket gophers (e.g., adult males).

Other control approaches.

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

Biocontrol. This approach relies on natural predation to control pocket gopher populations. From a management perspective, this typically involves the use of barn owl boxes to encourage owl predation of pocket gophers over alfalfa fields. Barn owls consume a large number of rodents annually. However, no replicated scientific study has yet shown how effective barn owls are at reducing pocket gopher populations in alfalfa fields, although recent investigations have shown a reduction of small rodent numbers in areas occupied by barn owls. Additional research is underway to better quantify the impact that barn owls have on rodent populations. At a minimum, erecting barn owl boxes on the perimeter of alfalfa fields cannot hurt management efforts, and may potentially help to keep pocket gopher numbers lower than they would be with barn owl assistance.

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.

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 burrow systems and will kill some pocket gophers in the process. Destroying the burrow systems helps slow down potential reinvasion into fields, and when combined with an aggressive pocket gopher 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 populations. When a field is flooded, the pocket gophers come to the surface to avoid drowning. 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 at this time to further reduce populations of these damaging pests.

Gas explosive device. This instrument 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. These devices are also quite loud; as such, they are not practical for use in or around residential areas. That said, this device does kill some pocket gophers and may be useful in some specialized settings, particularly where destruction of pocket gopher burrow systems is required.

Repellents. No substantive studies have shown that chemical repellents effectively keep pocket gophers from inhabiting fields. However, a recently registered repellent called Protec-T (active ingredient is methyl mercaptan) has shown some repellency in a minimally replicated study in alfalfa (R. Baldwin, unpublished data). The product is added to irrigation water and fed through subsurface drip irrigation (SDI) tubing. If effective, it could be a good tool to use to supplement

other management strategies in SDI alfalfa fields, but additional research is required to provide a more robust assessment.

LITERATURE CITED

Baldwin, R. A., A. Chapman, C. P. Kofron, R. Meinerz, S. B. Orloff, and N. Quinn. 2015a. Refinement of a trapping method increases utility for pocket gopher management. Crop Protection 77:176–180.

Baldwin, R. A., M. Kavermann, R. Meinerz, and S. B. Orloff. 2017a. Is pressurized exhaust an effective tool against burrowing rodents? Wildlife Society Bulletin 41:780–784.

Baldwin, R. A., D. B. Marcum, S. B. Orloff, S. J. Vasquez, C. A. Wilen, and R. M. Engeman. 2013. The influence of trap type and cover status on capture rates of pocket gophers in California. Crop Protection 46:7–12.

Baldwin, R. A., R. Meinerz, and S. B. Orloff. 2016. Burrow fumigation versus trapping for pocket gopher (*Thomomys* spp.) management: a comparison of efficacy and cost effectiveness. Wildlife Research 43:389–397.

Baldwin, R. A., R. Meinerz, and S. B. Orloff. 2014a. The impact of attractants on pocket gopher trapping. Current Zoology 60:472–478.

Baldwin, R. A., R. Meinerz, and G. W. Witmer. 2017b. Novel and current rodenticides for pocket gopher *Thomomys* spp. management in vineyards: what works? Pest Management Science 73:118–122.

Baldwin, R. A., T. P. Salmon, R. H. Schmidt, and R. M. Timm. 2014b. Perceived damage and areas of needed research for wildlife pests of California agriculture. Integrative Zoology 9:265–279.

Lee, L. L., W. E. Howard, and R. E. Marsh. 1990. Acquired strychnine tolerance by pocket gophers. Proceedings of the Vertebrate Pest Conference 14:87–90.

Lee, L. L., W. E. Howard, and R. E. Marsh. 1992. Laboratory studies of more durable baits for controlling pocket gophers. Proceedings of the Vertebrate Pest Conference 15:303–307.

Marsh, R. E. 1992. Reflections on current (1992) pocket gopher control in California. Proceedings of the Vertebrate Pest Conference 15:289–295.

Orloff, S. B. 2012. Evaluation of a pressurized exhaust device to control pocket gophers and Belding's ground squirrels in alfalfa. Proceedings of the Vertebrate Pest Conference 25:329–332.

Witmer, G., and R. A. Baldwin. 2014. Identifying possible alternative rodenticide baits to replace strychnine baits for pocket gophers in California. Draft Final Report QA-2146. USDA/APHIS/WS National Wildlife Research Center, Fort Collins, CO. 12 pp.