

WEST COAST

Nut Grower Guide

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In This Issue:

- **WALNUT HUSK FLY**
- **REGIONAL CONSIDERATIONS FOR NITROGEN TIMING**
- **A MENACE TO NUT CROPS?**

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WEST COAST *Nut Grower Guide*
THIS MONTH'S ISSUE

3 WALNUT HUSK FLY: *An Emerging Pest in the Southern San Joaquin Valley*

6 REDUCING NITRATE LEACHING FROM MUNICIPAL WASTEWATER TREATMENT AND FOOD PROCESSING PLANTS

12 REGIONAL CONSIDERATIONS FOR NITROGEN TIMING

14 A MENACE TO NUT CROPS? *Understanding the Potential Impact and Control Options For Managing Squirrels in California*



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BEST PRACTICES

A MENACE TO NUT CROPS? UNDERSTANDING THE POTENTIAL IMPACT AND CONTROL OPTIONS FOR MANAGING SQUIRRELS IN CALIFORNIA.

By: Roger A. Baldwin, Wildlife Pest Management Advisor for the University of California's Statewide IPM Program

The California ground squirrel (*Spermophilus beecheyi*) is considered to be the most damaging vertebrate pest in California agriculture. This species is native throughout much of California and is often seen foraging and creating extensive burrow systems in a variety of nut crops. The California ground squirrel is a medium-sized rodent that is grayish-brown in color and has a semi bushy tail. Ground squirrels reside in underground burrow systems but will climb trees to girdle stems and consume nuts. They are most easily distinguished from tree squirrels by chasing them. Because ground squirrels live in burrow systems, they will retreat to these burrows to avoid danger. In contrast, tree squirrel species such as the native western gray squirrel (*Sciurus griseus*) and non-native eastern fox squirrel (*Sciurus niger*) will escape to trees to avoid such danger. Fox squirrels typically have brownish red-orange fur, while western gray squirrels are gray on the back and white on their underside. Tree squirrel species are not typically as large of a pest of nut crops, but can be localized problems when present.

Both ground squirrel and tree squirrel species are active throughout the day, so it is usually not difficult to tell when these species are present in an orchard. Squirrels can cause extensive damage including direct consump-

tion of nuts, girdling of tree limbs and trunks, and will chew holes into irrigation tubing and emitters. Ground squirrels also cause extensive damage through their burrowing activities which results in decreased stability of trees, leads to a loss of irrigation water which can cause increased soil erosion, and can serve as a hazard to farm laborers and equipment. Plus, in some crops such as almonds and walnuts, nuts can be lost down these burrow openings during harvest. These forms of damage have resulted in estimated losses in profits of around 9% annually in nut crops. Estimates of damage are not available for tree squirrels.

The California ground squirrel is classified as a nongame species by the California Department of Fish and Game (CDFG). As such, they may be controlled by the tenant or landowner by any legal means anytime they are causing damage to crops or property. In contrast, tree squirrels are considered game species. As such, their harvest is typically limited to hunting regulations. However, there are exceptions for situations where they are damaging crops. For the fox squirrel, they may be taken by any legal means anytime they are causing damage to crops or property. For gray squirrels, you can apply to CDFG for a depredation permit if they are damaging crops or property.

Fortunately, we have many control options for the California ground squirrel. These include habitat modification, bait application, burrow fumi-

gation, and trapping. The first step to consider when developing a program to control ground squirrels is to determine if habitat modifications can be made to reduce the attractiveness of the area to ground squirrels. For example, removal of brush and pruning piles from fields will reduce preferred burrow locations for ground squirrels, thereby reducing the habitat potential for a particular field. This will reduce costs of more direct control measures such as baiting..

The application of rodenticide baits is often the quickest and most cost-effective method for ground squirrel control. Anticoagulant baiting (e.g., diphacinone and chlorophacinone) has been perhaps the most frequently studied and widely used approach for controlling ground squirrels. Anticoagulant baits are grain based (e.g., oats, wheat, or milo) and are distributed through spot and broadcast treatments or through the use of bait stations. An acute toxicant, zinc phosphide, is also available for use, but is only available for spot and broadcast baiting. All field use rodenticides are now restricted-use materials, so proper certification is required to use these materials. Zinc phosphide baits are typically cheaper than anticoagulant baits because they require only a single application. However, zinc phosphide can only be applied once per year, often has lower bait acceptance than anticoagulants, and lacks

Story Continued on Page 16

BEST PRACTICES

A MENACE TO NUT CROPS? Continued from Page 14

an effective antidote, so preference of baits varies depending on the applicator. Baits are most effective during early summer and autumn months when ground squirrels are actively feeding on seeds. Treatments during extreme heat of mid-summer are often less effective because some of the squirrels are in summer hibernation. Burrow fumigation with aluminum phosphide and gas cartridges is also effective for controlling ground squirrels. Fumigation is generally more expensive and time consuming than baiting, but less so than trapping. As opposed to baiting, there is little risk of secondary poisoning with fumigants, as fumigation relies on the use of toxic gases to euthanize ground squirrels in their burrow system. Aluminum phosphide is the most effective and least expensive burrow fumigant, but is a restricted-use material. Gas cartridges are more expensive and less effective, but are not restricted-use materials. Burrow fumigation is generally only effective when soil is moist. Therefore, fumigation is restricted to late winter and spring or following irrigation. Nonetheless, fumigation can be an important part of an Integrated Pest Management (IPM) approach for controlling ground squirrels, as it is effective at times of the year when baiting is ineffective.

A variety of traps are available for controlling ground squirrels although they typically fall into two categories: body-gripping traps and live traps. Live traps have the advantage of not killing captured individuals. Therefore, if a non-target animal is captured, it can be released unharmed.

However, ground squirrels must be humanely euthanized after capture, thereby limiting its appeal for many growers and PCAs. Body-gripping traps are kill traps, thereby eliminating the need for euthanizing captured ground squirrels. However, because they are kill traps, extra care must be exercised to not capture non-target animals. This makes their use in residential areas, and in areas occupied by the endangered San Joaquin kit fox (*Vulpes macrotis mutica*), less appealing. Trapping is generally the most time-consuming and costly of the above-listed methods. However, it is one of the only methods effective at controlling ground squirrels anytime they are active, it is a good follow-up method to further reduce population size (e.g., target individuals not removed through a baiting program), and it can be used in organic crops. Although many techniques are effective at reducing ground squirrel numbers, few vertebrate pests can be fully controlled by using a single management strategy. This holds true for ground squirrels as well, as the use of multiple control options (i.e., IPM) will likely yield the greatest control. The first step to consider

when developing an IPM plan is to determine if habitat modifications can be made to reduce the attractiveness of the area to ground squirrels. Once these modifications have been made, the next step is to consider the time of year for application as this greatly influences the effectiveness of control measures. Baiting works best in early summer and autumn when ground squirrels are consuming seeds; fumigation works best in late winter and spring when soil is moist; trapping will work anytime ground squirrels are active (Fig. 1). One potential strategy for controlling ground squirrels would be to use fumigants approximately 7–10 days after ground squirrels become active. This represents the time of year when populations are smallest. Additionally, if you fumigate in late winter and early spring, you can remove reproductive females and their young from the population before they leave the burrow system, thereby greatly reducing the amount of effort needed to treat the entire population. Then you can follow up with trapping, anticoagulant bait, or zinc phosphide bait later in the year to remove the remaining ground squirrels in your

Story Continued on Page 18



BEST PRACTICES

WALNUT HUSK FLY:

Continued from Page 4

do®) and bait will kill walnut husk fly for around 10 days. When adding the period needed for egg development to this time, each spray application offers around 3 weeks of protection. Consequently, multiple applications may be required in a season as determined by trap catches, presence of egg-laying females, and persistence of insecticide residues.

Recent studies demonstrate the efficacy of several reduced risk products for management of walnut husk fly, including GF-120®, Entrust®, or Success® (all spinosad products; IRAC Group 5). The GF-120® formulation already contains a bait, but Entrust® and Success® both require incorporation of a bait (such as NuLure®). Both Entrust® and GF-120® are labeled for organic use. If using Entrust® for organic production, it is important to utilize an organically-acceptable bait material. Applications of GF-120® should commence at the onset of adult walnut husk fly emergence (detection of egg-laying is not necessary with this compound), then continue at 7 to 14 day intervals until populations begin to decline in traps. GF-120 is recommended only for

low populations of walnut husk fly. For more information on management of walnut husk fly, visit UC IPM Online (www.ipm.ucdavis.edu). YAcknowledgements. We are grateful to Jim Stewart, AG IPM CONSULTANTS, Inc for providing information on timing of adult walnut husk fly emergence in Tulare County orchards. Additionally, we thank Bill Coates, San Benito Co. Farm Advisor, and Robert Van Steenwyk, Extension Specialist, UC Berkeley for their input and suggestions, and for their extensive research on walnut husk fly management.

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A MENACE TO NUT CROPS?

Continued from Page 16

fields.

Alternatively, if you have a large population of ground squirrels, you may decide to first treat the infested area with zinc phosphide during early summer or autumn. This should substantially reduce the population before hibernation. Then, shortly after ground squirrels become active, you could fumigate all active burrow systems. By first treating the infested areas with zinc phosphide the previous year, you should be able to dramatically decrease labor costs associated with fumigation the following year. If any ground squirrels remained, you could try anticoagulant baiting or trapping to remove those individuals. These are just two of many potential options. The treatment strategy you employ will depend upon your needs and qualifications.

Unfortunately, there are far fewer control options for tree squirrels, with trapping and shooting typically the only available options. Common traps for tree squirrels include tube or tunnel traps placed in trees, or wire cage traps placed on the ground. Nuts and fruits are usually good baits to use. For shooting, high-powered air rifles and .22 caliber rifles are your best bets. Much trapping and shooting effort is required to control large tree squirrel populations, so it is best to employ both techniques when needed. **Additional management information can be found for both species at <http://www.vprac.org/about/handbook.php>**