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University of California
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Sacramento Valley Walnut News

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In This Issue

Submitted by:

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2014 Sacramento Valley UC Cooperative Extension Walnut Meetings Planned

Save the Dates!

Tehama Walnut Day	Friday, February 7	Red Bluff
Butte-Glenn Almond Institute & Walnut Day	Wednesday, February 12	Chico
Sutter/Yuba/Colusa Walnut Day	Wednesday, February 26	Yuba City
Walnut Pruning/No Pruning Field Meeting	Tuesday, March 4 (Wednesday, March 5, in case of rain)	Arbuckle
Botryosphaeria and *Phomopsis* canker and blight and their management in walnut Field Meeting	Wednesday, April 2, 2014 (Thursday, April 3, in case of rain)	TBA Sutter, Yuba or Colusa cos.

Managing Ground Squirrels and Pocket Gophers in Orchards

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Dept. of Wildlife, Fish, & Conservation Biology, UC Davis

Introduction

Although many vertebrate pests cause problems in orchards, perhaps the most frequent offenders in California are California ground squirrels (*Otospermophilus beecheyi*) and pocket gophers (*Thomomys* spp.). Ground squirrels are 9 to 11 inches in length (excluding tail), mottled grayish-brown in color, and have a semi bushy tail. They dig extensive burrows that may be 5 to 30 feet long, 2.5 to 4 feet below the surface, and about 4 to 6 inches wide. 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.

Ground squirrels reproduce only once per year, but average 8 young per litter. Pocket gophers will breed anywhere from 1 to 2 times per year. Therefore, continuous monitoring and control of all these burrowing rodent populations is needed to keep their numbers low. Ground squirrel young are born in early to mid-spring. Pocket gophers can breed at different times throughout the year; however, there is typically a pulse in reproduction toward the middle of spring. As such, control measures implemented before reproductive pulses of all burrowing rodents will often be more effective as there will be fewer individuals to control at that time.

If left unchecked, burrowing rodents will cause extensive damage including consumption of nuts, fruits, and other vegetative plant parts that result in direct loss of crop production; consumption of tap roots and girdling of stems and trunks that results in a loss in vigor of the plant; loss of irrigation water down burrow systems; and chewing on irrigation lines. Mounds and burrow openings can also result in additional problems including serving as weed seed beds, causing damage to farm equipment, and serving as a hazard to farm laborers.

A number of options are currently available for controlling burrowing rodents although most management programs center on toxic baits, burrow fumigants, and trapping. Given space limitations, I will focus on these three options. For additional information on managing ground squirrels and pocket gophers, I suggest checking out the UC IPM Pest Notes (http://www.ipm.ucdavis.edu/PMG/menu.vertebrate.html), as well as the training modules found at the UCCE Vertebrate Pest Control Education website (http://ucanr.edu/sites/vpce/).

Toxic baits

Ground squirrels.—Toxic baits are usually the most cost-effective way for controlling ground squirrels, especially large populations and over large areas. Bait consists of grain or pellets treated with a toxin registered for ground squirrel control. To be effective, the bait must be used at a time of year when ground squirrels are active and feeding on seeds (usually late spring through early summer and again in autumn; Fig. 1). Toxic baits registered for ground squirrel control include the acute toxin, zinc phosphide, and anticoagulant baits (diphacinone and chlorophacinone). Zinc phosphide can be applied through spot-treatments or broadcast applications. Spot treatments are used when a small number of burrow systems are treated. This approach involves lightly scattering bait around each active burrow opening. Alternatively, the bait may be broadcast over a larger area using a mechanical seed spreader. Bait shyness can occur with zinc phosphide baits when squirrels ingest a sublethal dose, thereby becoming sick and learning to avoid the bait during future applications. This can result in low efficacy of zinc phosphide baiting programs. Pre-baiting the area with untreated grain 2 to 3 days prior to the application of zinc phosphide may reduce the chance of bait shyness and improve the effectiveness of baiting programs. Control with zinc phosphide is usually achieved within 48 hours of bait application.

With anticoagulant rodenticides, ground squirrels must ingest several doses of bait over a period of several days. Control is slower but there is less chance of squirrels becoming 'bait-shy'. Another advantage is the availability of an antidote (Vitamin K1) in the event of accidental poisoning of non-target animals (e.g., pets, children, etc.). Anticoagulants can be applied in bait stations, as spot treatments near burrows, or broadcast over larger areas. Be sure to follow the label directions carefully to determine what application method is appropriate.

Bait stations are commonly used to provide bait for squirrels. Various kinds of bait stations can be used, though all are designed to let squirrels in while excluding larger animals. Bait stations should be placed near runways or burrows and should be secured so that they cannot be tipped over. If squirrels are moving into fields from adjacent areas, bait stations should be placed along the perimeter where squirrels are invading, with one station placed approximately every 100 feet, although closer intervals may be used when the number of squirrels is high. Bait stations should be checked daily at first, then as often as needed to keep the bait replenished. A continuous bait supply is important because if bait feeding is interrupted, the bait's effectiveness is greatly reduced. Any bait that is spilled should be collected, and wet or moldy bait should be replaced. Successful baiting via bait stations usually requires 2 to 4 weeks. Therefore, bait should continue to be supplied until feeding ceases and no more squirrels are observed.

Spot treatments and broadcast applications of anticoagulants follow the general procedure described for zinc phosphide. However, with anticoagulants, bait must be reapplied 3 to 5 days after the initial treatment to ensure that squirrels are exposed to a continual bait supply. Usually, ground squirrels retreat back to burrows when sick and will die there, although up to 20 to 30% of squirrels may die aboveground. As such, be sure to dispose of any visible carcasses to prevent poisoning of any scavengers. Burying within existent burrow systems is a good method as long as carcasses are buried deep enough to discourage scavengers. All rodenticides for aboveground field application are now restricted-use materials, so be sure you are fully versed on all current restrictions for their use before applying for ground squirrel control. Your County Agricultural Commissioner's office is your best source for this information.

Pocket gophers.—There are three 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 that they kill after a single feeding. Strychnine has historically been available in two concentrations in California: 0.5% and 1.8%. However, due to supply issues, strychnine importation into the U.S. is currently very low. As such, the 1.8% strychnine bait is no longer available for purchase. This is an important consideration, as the 1.8% strychnine has long been considered the most efficacious of all the pocket gopher baits. Going forward, growers will need to identify an alternative rodenticide if they wish to continue to use baiting as a pocket gopher management option.

Zinc phosphide is also available for pocket gopher control; it comes in a 2.0% concentration. Bait acceptance can be low 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, individuals 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 bait supply over this time period. Because of this, acute toxicants are typically preferred over anticoagulants for pocket gopher control. However, there are several new products on the market that contain these same toxicants but utilize a different delivery mechanism for providing the toxicant to the pocket gopher. As such, some of the newer products may be more effective and are in need of testing.

There are two primary methods for baiting in 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.

Once the tunnel is located, bait is directly deposited via a hand-crank or lever. Typically, it is recommended that burrow systems be treated at least twice to maximize efficacy.

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. Although convenient, the efficacy of this method has varied extensively among growers. Experimentation is key to determining the applicability of this approach for each grower.

Fumigation

Burrow fumigants can be very effective at controlling ground squirrels and pocket gophers. Primary burrow fumigants are aluminum phosphide and gas cartridges. However, as of January 1, 2012, carbon monoxide producing machines can now be used to apply carbon monoxide to burrow systems. Given the fact that they just became legal in California, researchers are still in the process of collecting data on their efficacy.

Ground squirrels.—Late winter and early spring are the best times to fumigate for ground squirrels as moist soil is needed to hold toxic gases inside the burrow system (Fig. 1). Conducting ground squirrel control prior to the birth of young will also dramatically decrease their detrimental effect on the population. However, you must wait to fumigate until after ground squirrels have emerged from hibernation; ground squirrels wall themselves off in their burrows when hibernating so fumigation is not effective at this time. Fumigation is also possible later in the year as long as sufficient soil moisture is present, although it is ineffective when ground squirrels are estivating during the hottest times of the year as ground squirrels again wall themselves off in their burrows. For safety reasons, do not use fumigants in burrows that may extend beneath buildings.

Two primary fumigants are used: gas cartridges and aluminum phosphide. Gas cartridges provide an easy and relatively safe way to fumigate ground squirrel burrows. Typically, one cartridge is used for each burrow that shows signs of activity, although larger burrow systems may require two or more cartridges. For application, the cartridges are ignited and shoved into the burrow fuse first using a shovel handle or stick. The burrow entrance is then sealed with soil to hold the toxic gases within.

Aluminum phosphide is a very effective fumigant, often outperforming gas cartridges. When aluminum phosphide tablets come into contact with moist soil in the burrow, they produce phosphine gas, which is highly toxic to any animal. Aluminum phosphide is a restricted-use material for which a permit is required for purchase or use. Application personnel should be trained in the material's proper use and on its potential hazards.

Pocket gophers.—Aluminum phosphide is the primary fumigant used for pocket gopher control; it is quite effective and has a very low material cost. The primary method for applying aluminum phosphide is similar to that of hand baiting. You use a probe to find a pocket gopher tunnel, and drop the label designated number of tablets into the probe hole. The opening is then sealed to eliminate light from entering and the toxic gases from exiting the tunnel. Typically, you treat each burrow

system twice to maximize efficacy. The key with aluminum phosphide treatments is to only apply when soil moisture is relatively high. Because of this, fumigation is typically most effective in late winter and early spring. However, fumigation after irrigation can also be a good strategy. Please note that aluminum phosphide is a restricted-use material. Applicators must be licensed and trained on its proper use.

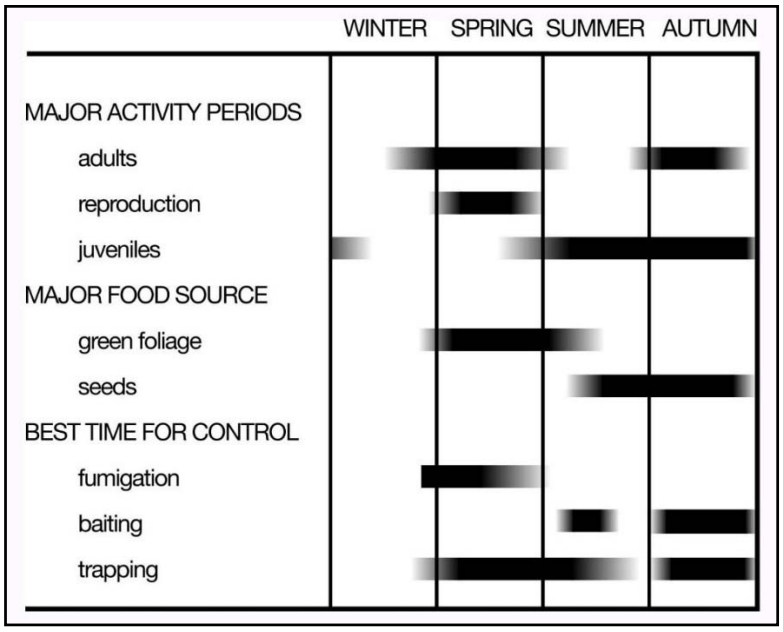
Trapping

Ground squirrels.—Because trapping is time-consuming, it is most practical for small infestations of ground squirrels. Additionally, trapping is effective at certain times of the year when other control options are ineffective (Fig. 1). Several types of kill traps, including modified pocket gopher box traps, tube traps, and Conibear traps, are effective. Because these are kill traps, be sure to take precautions to eliminate capture of non-target wildlife and pets.

Live-traps, such as wire-cage and multiple-capture traps, can also be used to capture ground squirrels. Because these traps keep animals alive after capture, they are useful in areas where non-target captures are a concern (e.g., areas with pets, children, etc.). However, ground squirrels must be euthanized by the trapper upon capture as translocation is illegal.

Pocket gophers.—Trapping is safe and one of the most effective although labor intensive methods for controlling pocket gophers. Nonetheless, the time for application may be offset by effectiveness. Several types and brands of traps are available. The most common type is a two-pronged, pincher trap such as the Macabee, Easy Set, 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. All pocket gopher traps can be effective, although the Gophinator has proven to be highly effective.

Figure 1. Activity periods and preferred food sources for the **California ground squirrel**. Activity periods vary somewhat from one growing area to another depending on local climate. To choose the most effective control action for ground squirrels and the proper timing, you need to know when they are active and what their preferred food sources are.



Winter Cold and Irrigation During Drought

Joseph H. Connell, UC Farm Advisor, Butte Co.

We know that during the winter months walnuts can be hurt by either too much or too little water. It's been a very dry fall so far and the deep soil profile in most walnut orchards takes significant rainfall to be recharged. Cutting back on water earlier in the fall slows down the trees growth and helps harden them off.

So far we've had a mild warm autumn. If temperatures drop rapidly below freezing there could still be the potential for cold damage to young vigorous non-dormant walnut trees. Winter kill, which can affect both young and mature walnut trees, happens when extremely low temperatures occur during the winter months even if trees are fully dormant. Water stressed trees or trees planted in sandy soil are most susceptible to this injury. Drought conditions during winter can make winter kill worse if we get sudden severely cold temperatures.

Are we in a drought? Or, is it going to start raining enough to refill our soil profiles and remove the risk of water stressed trees? Will it get cold enough to cause winter kill? Nobody really knows. We do know that dry trees are more susceptible to cold damage so make sure trees are not stressed as they go into winter.

If we don't know if it's going to rain significantly, how do we best apply water during the winter to alleviate drought? If you have water available, I'd suggest a light 1½ to 2 inch irrigation that simulates typical rainfall patterns. If we're still dry in December, then begin to gradually refill the soil profile with occasional 2 inch irrigations. Keep an eye on rainfall forecasts and amounts of rain received in your neighborhood so your irrigation timing doesn't end up creating a condition where the orchard is too wet. Although unlikely if current conditions persist, saturated soils can kill roots from water logging or can increase the chance of crown or root rots developing.

Most of our walnut soils generally hold around one and a half inches of available water per foot of depth. Trying to re-wet a 5 foot root zone in late February to early March if it hasn't rained much by then isn't a desirable situation. We still have some time for Mother Nature to resolve this problem but it bears watching.

Check soil moisture as the winter progresses to see how deep the soil profile has been re-wetted so you can make sure you don't have dry soil in the root zone come spring. The ultimate goal is to make sure the soil reservoir is completely refilled either by rain or winter irrigations by the time your walnut trees begin to wake up next March.

Training Young Walnut Trees: Minimum Pruning vs. No Pruning Compared

Janine Hasey, Farm Advisor Sutter/ Yuba/Colusa Counties
Bruce Lampinen, Extension Specialist, UC Davis

Training young walnut trees occurs in the first 1-6 years in the life of an orchard. Traditionally it has been done using a modified central leader with a minimum pruning style; the basics behind this pruning style are similar for standard spaced or hedgerow orchards. We believed for decades that if lateral bearing walnuts (most of our varieties) were not pruned, their growth would stall out from early cropping. Research conducted since 2004 investigating pruning versus non-pruning on young

walnut tree growth and productivity however, has challenged that paradigm. Results from trials on Howard and Chandler have shown that young walnuts do not need to be pruned in order to keep them growing or to produce adequate yields. In general, unpruned trees have produced higher early yields and equivalent yields in year 5 and on compared to minimally pruned trees.

With more knowledge, comes more complexity. Growers now need to decide when trees are one year old (first dormant pruning), whether to stick with the modified central leader and train using minimum pruning or to not prune which saves on labor and brush disposal. Growers interested in trying the unpruned method may want to start small and compare to the minimal pruning method to make sure it fits their management system. If you start with minimum pruning, we recommend that you continue with the same method until the trees are mature. Changing midstream from pruning to no pruning may lead to limb breakage especially if trees were heavily pruned which we do not recommend. Heavily pruned walnut trees also have lower early yields.

Below are the main steps comparing training walnuts for years 1-3 using the modified central leader with minimum pruning method to the unpruned training method. The assumption is a standard-spaced orchard and differences for hedgerow systems will be noted. Young walnut trees are sensitive to freezing temperatures which can kill or damage wood so it is best to delay pruning until March or late February at the earliest.

Modified central leader with minimum pruning method:

Pruning one-year old walnut trees

- The leader, or shoot selected to be the trunk, should have reached a height of at least 7 to 8 feet. Ten feet or more of growth is better (7-8 feet sufficient for hedgerow orchards).
- Heading the leader at 8 feet will give more area for the scaffolds. The leader should not be headed any less than 6 ½ feet since the first primary scaffold should be at least 5 ½ -6 feet above the ground so as not to interfere with equipment operation (hedgerow - head at 6 feet, first primary should be about 4 feet above ground). Make the heading cut into mature round wood.
- Any lateral shoots on the leader should be removed. 1 or 2 nonvigorous shoots arising below the leader can be stubbed to 2 to 3 buds to provide shade on the south and west sides and to aid caliper growth. They will be removed in the next dormant season.
- Primary buds above 5 feet from the ground that are necked should be rubbed off to the side so as not to damage the secondary bud. If left, necked buds form weak limb attachments that are subject to breakage. The secondary bud which is forced to grow will form a wide angle and develop a strong crotch.
- If the shoot selected to be the trunk has not reached sufficient height, cut it 3 to 6 buds above the point of origin and remove competing shoots. A stronger shoot can then be trained as the trunk over the summer.

Pruning two-year old standard-spaced walnut trees:

- The general goal is to select four to six primary scaffolds arising from the trunk in years two and three. Select the central leader which is typically the topmost branch.
- See above section for height of the first primary scaffold above ground.
- Select other primary scaffolds to form a spiral pattern around the trunk. Try to space them at least eight inches apart. Primary scaffolds should never originate directly opposite each other; this will ensure the leader does not get 'choked out'.
- Selected scaffolds should be angled about 45 degrees from the vertical. Limbs with narrower angles or bark inclusions are usually poorly attached and cannot support heavy crops and branches with wider angles of attachment may fail to grow vigorously.
- For most lateral bearing varieties, head all primary scaffolds ¼ to ⅓ of current growth depending on vigor and variety. Tulare and the new Forde variety are very vigorous and need only tipping or no heading of the scaffolds. The leader should be left the longest.
- Remove forked branches on chosen scaffolds to a single branch. Leave remaining unselected branches and small caliper wood unheaded to create early fruiting wood.

Pruning two-year old hedgerow walnut trees:

- Select a central leader and two to four side limbs that are oriented in opposite directions in the tree row.
- Remove branches below three feet that will interfere with shaking and flat limbs that grow out into the middles.
- Depending on variety and vigor, selected framework limbs should be headed or tipped as in above section and cut to an outside bud facing into the tree row. Other branches can be left unheaded to fruit early.

Pruning three-year old standard-spaced or hedgerow walnut trees (Photo 2):

- Choose the strongest, tallest scaffold for the leader and head ¼ to ⅓ of the current growth. Strong secondary scaffolds in a vertical position can be tipped or left unheaded. Head or tip one strong secondary scaffold on the sides of the canopy in each cardinal direction ¼ to ⅓ of the current growth.
- Forked branches can be left but twisted, rubbing or overlapping branches should be removed.

Unpruned training method:

One-year old walnut trees

- Leave the leader selected as the trunk **unheaded**.
- Remove lower limbs below 4 to 5 feet (3 to 4 feet for hedgerows).
- Place a long stake extension on existing stake to support the unpruned leader.

Two and three-year old walnut trees:

- No pruning or heading unless lower branches need to be removed for reasons of safety or ease of maintenance and harvest.
- Note that unpruned walnuts tend to put on extension growth in alternate years. Individual shoots follow a pattern of extension growth, followed by cross branching (side branching occurring on shoot with 5-8 inches growth on the end (Photos 1 and 3), followed by another year of extension growth).
- Unpruned trees tend to grow as a central leader with the primary branches naturally well-spaced along the trunk and at wide angles.

Whether trees are pruned or left unpruned, always remove suckers from the rootstock. To read about these studies, go to Walnut Research Reports at http://walnutresearch.ucdavis.edu/

You can compare the tree growth and productivity on 6 year old pruned and unpruned Chandlers at our annual field meeting at Nickels Soil Lab next March 4, 2014 (see meeting article).

Photo 1. An unpruned tree at the end of the third growing season. Note short shoot growth on primary branches. Photos by Bruce Lampinen.

Photo 2. A minimum pruned tree at the end of the third growing season. Note secondary scaffold extension growth from heading cuts.

Photo 3. An unpruned tree (left) and a minimum pruned tree (right) at the end of the third growing season.

Nitrogen Management Planning

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Fertilizer nitrogen use efficiency is maximized when trees recover the greatest possible percentage of applied fertilizer nitrogen. Nitrogen use efficiency is improved by using the right material, applied at the right time at the right rate and right placement. These 4 variables are important because reducing or eliminating nitrate leaching into groundwater is an increasing issue. Unfortunately, nitrogen management decisions are challenging because tree physiology and how root systems interact with the soil environment are complex and not well understood. Soil monitoring is one way to follow nitrogen, however variation within the orchard and time and expense to properly sample a soil profile is a problem. Leaf tissue sampling integrates the entire root zone but critical values don't directly indicate how much nitrogen to apply. The third possibility is to use a nitrogen budget approach and monitor under or over application with soil or leaf tissue analysis. A complete "Guide to Efficient Nitrogen Fertilizer Use in Walnut Orchards" is available at cooperative extension offices or on line (University of California Agriculture and Natural Resources Publication 21623).

Publication 21623 covers:

- Amount of nitrogen removed by the crop. 40 pounds of actual nitrogen per dry in shell ton is a good starting point. This estimate is being re-evaluated as it is based upon walnut research from the 1990's.

- Nitrogen contribution from irrigation water. Conversion factors are listed to calculate the amount of nitrogen per acre foot of applied water when reported in different units (NO_3-N or NO_3).
- Nitrogen contribution from manure or compost. This would involve the amount of material applied per acre, percent nitrogen plus an estimate of the release and recovery percentages.
- Nitrogen contribution from cover crops. This is often not a consideration in most walnut orchards but for orchards with a legume cover crop values are available to estimate cover crop nitrogen contribution.
- If you know the total amount of nitrogen required minus all nitrogen sources, the difference is the amount of nitrogen to apply. An estimated recovery factor (50 percent) is used to account for uptake efficiency. This efficiency factor is also being re-evaluated with ongoing walnut field research.
- Choosing nitrogen sources. Several nitrogen fertilizer formulations are available and publication 21623 lists the comparisons. Nitrogen percentage in the formulation is used to calculate the actual material rate.
- Estimates of fertilizer needs based upon a nitrogen budget can be confirmed by monitoring leaf tissue nitrogen to verify if applications are deficient or excessive and adjusting nitrogen application accordingly.