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ORCHARD FACTS

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Sacramento Valley Almond/Prune/Walnut Newsletters

Pam Geisel
Interim County Director

Pocket Gopher and Ground Squirrel Management for Autumn

Carolyn DeBuse, UCCE Farm Advisor, Solano and Yolo Counties

Late autumn is a time to get the last of the 'to do list done' for the year and on almost everyone's orchard task list is gopher and squirrel control. Managing these vertebrate pests is a year-round task. Gophers can be controlled with most methods throughout the year, but squirrel control methods change with the seasons depending on the squirrel biology. This article will outline the control methods, but also inform you about some outstanding online resources that are useful to learn new information, understand seasonal cycles, and determine the best control methods to use.

Pocket Gophers: Gophers are active all year round and can be controlled with traps, poison baits, fumigation with aluminum phosphide, and a gas explosive device (Rodenator ®). Recent UC research showed that trapping plus additional fumigation had the highest efficacy. The reason that these two methods were combined was because some gophers can become trap shy, so additional fumigation killed the individuals that the traps were missing. Baiting with strychnine came in second for control and the use of the Rodenator® was the least effective. To prevent a re-infestation after reducing the gopher population, destroy the existing tunnels and level the mounds by disking. With non-tillage orchard floor management, disking isn't desirable so it's even more important to prevent gophers from becoming established in the first place. Keep vegetation away from the tree trunks, especially in young orchards.

The UCCE Vertebrate Pest Control Education website now has training modules online for gopher, vole and ground squirrel control. Go through the training online or download a podcast that you can listen to anywhere. Find it at: http://ucanr.edu/sites/vpce/.

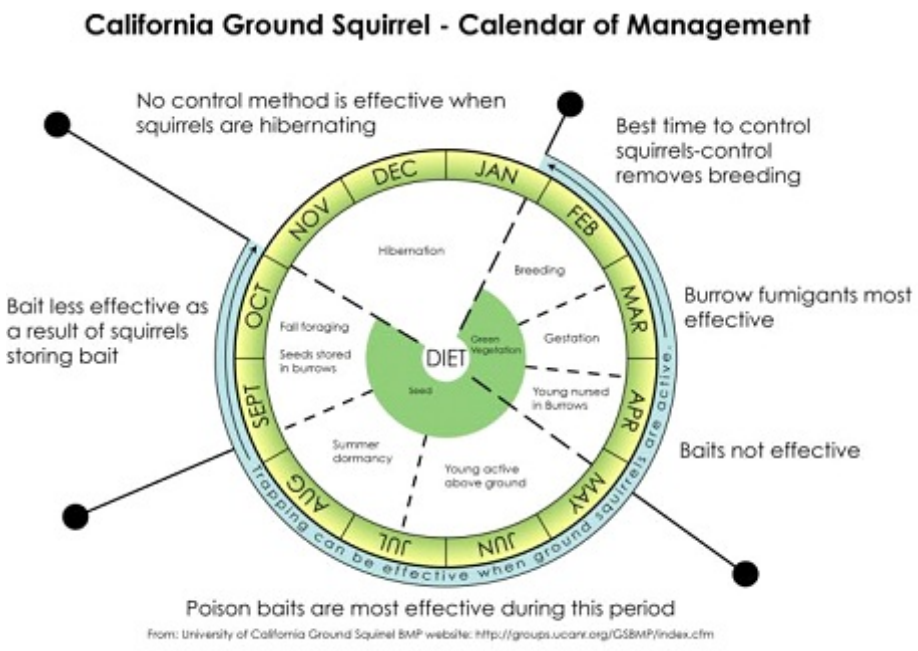
Ground Squirrels: The task of controlling ground squirrels is so difficult and never ending that UC Cooperative Extension has a dedicated webpage just for them. The site contains information on biology, monitoring, control methods and laws and regulations. It should be your first stop for new information and education.

"Ground Squirrels Best Management Practices" is at: http://ucanr.edu/sites/Ground_Squirrel_BMP/.

Ground squirrels are controlled in much the same manner as gophers. They can be controlled with traps, poison baits, and fumigation. Different methods work best at different times of the year. During the winter months the squirrels hibernate so there are no effective methods. In spring, fumigation is best because the squirrels are breeding; the burrows become nurseries, and the soil is usually moist holding the fumigant in the burrows.

Baiting does not work in spring because the squirrel's diet is almost solely fresh vegetation. During summer, baits are most effective because the squirrels have changed their diet over to seed and nut collection. Summer baiting is difficult near almond orchards because the squirrels may ignore the bait, preferring almonds instead. In the heat of the summer, squirrels can hibernate in blocked off tunnels and control is not possible. Blocked tunnels and crack soil that lets the fumigant dissipate from tunnels make fumigation a poor choice in summer and fall. So it is important for almond growers to use methods in the spring and fall so that populations don't get out of hand. During the fall the only method that is effective is trapping. Trapping can also be effective any time of year. Like gopher control, after reducing the population, take measures to destroy the burrows and dens to discourage re-infestations.

With any use of poison baits or fumigant, caution should be taken to use them safely. Follow labels carefully and obtain correct permits from your county agriculture commissioner for the use of restricted poisons. Always take care to protect workers and non-target wildlife.



40th Annual Almond Conference Moved to Sacramento

Franz Niederholzer, UCCE Farm Advisor, Sutter, Yuba, & Colusa Counties

The Annual Almond Conference will be held in 2012 in Sacramento, not Modesto. This year the conference will run from Tuesday, December 11 to Thursday, December 13 at the Sacramento Convention Center. Registration information, agenda, etc. are available on-line at: http://conference.almondboard.com/.

This is THE almond meeting of the year, combining a trade show (larger this year due to a larger site), continuing education opportunities, industry updates, and lots of time to network and talk with interested growers, PCAs, and manufacturer/industry representatives.

Presentations of interest to growers include:

- Honey Bee Colony Assessment
- Sprayer Coverage
- Designing and Developing a New Orchard
- What's New in Fertility Management

The meeting is an hour closer to Sacramento Valley residents this year. Admission is free.

Hull Rot

Joe Connell, UCCE Farm Advisor, Butte County

Almond hulls are susceptible to attack by hull rot fungi (*Monilinia spp*. and *Rhizopus* stolonifer) from the time nuts are mature and green at hull split initiation until the hulls begin to dry. Densely canopied, vigorous, well-watered and fertilized orchards usually have the most severe damage from hull rot. Observations suggest that more open canopies help reduce this disease. Nonpareil is very susceptible, but Sonora and Winters are also susceptible. Kochi can be severely affected by hull rot.

Hull rot fungi invade hulls and produce a toxin that kills the twig beyond where an infected nut is attached. When the shoot dies suddenly, nuts and leaves dry up and remain stuck on the trees well after harvest. This symptom is a good indication of hull rot infection and this loss of fruit wood can reduce productivity in future years. Early harvest can reduce loss of fruitwood from hull rot. The sooner nuts are removed, the less opportunity there is for hulls to become infected and toxins to be transported into the twigs.

Dr. Beth Teviotdale, UCCE Extension Pathologist, worked on hull rot in the early 1990s. She demonstrated hull rot could increase 10-fold with an increase in total water applied, particularly irrigations applied as nuts are maturing. Rainfall any time during nut maturation or high humidity also increased hull rot. Regulated deficit irrigation management at the onset of hull split was shown to greatly reduce the incidence of hull rot. This practice is the most important cultural control.

In Dr. Teviotdale's trials, hull rot also decreased as the amount of applied nitrogen (500, 250, 125, and 0 pounds of N per acre per year) decreased. In addition to this general decrease, there was a major difference in the amount of hull rot between the 125 and 250 pound N treatments. A sharp increase in hull rot occurs somewhere between applications of 125 and 250 pounds of N. This was true in both experimental orchards for two years. So, if you don't want to favor hull rot, avoid excess nitrogen fertilizer. July leaf nitrogen levels should be below 2.6% N. Dr. Teviotdale found that both *Monilinia spp*. and *Rhizopus* fungi responded similarly to irrigation and fertilization.

Figure 1. Black spores of *Rhizopus* hull rot are visible between the hull and shell.

Recent work by Dr. Jim Adaskaveg, Professor, Plant Pathology, UC Riverside, has shown that both *Monilinia spp*. and *Rhizopus* fungi can invade through the outside of green mature hulls. Some of his fungicide work has shown potential for reducing *Rhizopus* hull rot with summer fungicide applications. Several materials have helped reduce hull rot in trials compared to unsprayed controls, but there are no general recommendations for preventing hull rot with fungicides at this point.

Figure 2. A tan hull rot on the outside of a green hull is often caused by *Monilinia* hull rot, but recent work has shown that *Rhizopus* hull rot can also attack the outside of mature green hulls.

Leaf Blight

Joe Connell, UCCE Farm Advisor, Butte Co.

Leaf blight is caused by the fungus, *Seimatosporium lichenicola*. The fungus kills individual infected leaf petioles thus cutting off water to the leaf. Individual leaves on spurs or shoots wither and die usually in mid-summer. Leaves dry up suddenly and remain attached to the shoot or spur. The fungus can affect yield when it moves from the petiole into the axillary buds. When the axillary bud is killed, spurs fail to grow thus eliminating some future fruiting positions. If spur leaves are infected the fungus can kill the spur, once again eliminating a fruiting position.

Although dried up leaf blades disintegrate over the winter, diseased petioles continue to stick on tree during winter. The fungus survives on these dead petioles. Spores are spread by rain, and disease is favored by wet spring weather or early summer rain. Leaf blight is usually controlled incidentally by fungicide applications targeting other diseases in the spring. As a result, it is rarely widespread and seldom kills more than 20% of the leaves in one season. Repeated early death of leaves will weaken trees, but most significant is its contribution to future yield loss as a result of bud or spur death and the loss of fruiting positions.

Ziram®, Captan®, strobilurins (Abound®, Gem®), and myclobutanil (Laredo®) are effective fungicide controls for leaf blight. Fungicide treatments with effective materials from early leafing through the spring rainy period will usually provide protection from leaf blight. If you've experienced significant leaf blight, you'll also need to guard against late spring or early summer rains that occur after spring fungicide effectiveness has diminished.

Figure 1. Shoot with leaf blight showing current season blighted leaves and blighted petioles remaining from the previous season's infections. The fungus overwinter's on blighted petioles.

2012 Navel Orangeworm – Part 2

Richard P. Buchner – UCCE Farm Advisor, Tehama County

The July 2012 Sacramento Valley Regional Almond newsletter (Part 1) started the navel orangeworm (NOW) story discussing traps, generation timing and an initial third generation egg laying prediction of 8/14/12 for NOW feeding on new crop nuts. As the season progressed, we verified the second biofix on 7/23/12 and readjusted our third generation egg laying prediction to 8/25/12. The actual third biofix occurred on 8/31/12 (Figure 1) at 923 Degree Days following the second biofix. NOW eggs laid in the summer usually take about 4 days to hatch. So in this Tehama County orchard, almonds were exposed to NOW larvae about the first week in September. Every orchard is different so multiple egg traps in individual orchards are critical to verify the Degree Day models.

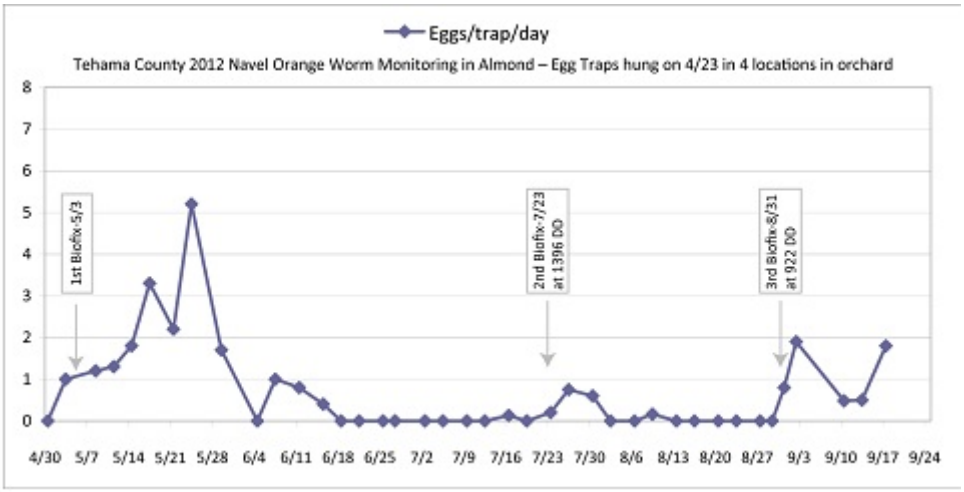


Figure 1. Egg laying activity for navel orangeworm in a single almond orchard in Tehama County. Larvae from the third generation could potentially damage almonds.

NOW overwinter in unharvested nuts remaining on the tree (mummies). First generation and many of the second generation eggs are laid on the surface of the mummy nuts. Second generation eggs can also be laid on new crop nuts depending upon spring temperature and hull split timing. The availability of mummy nuts influences initial populations and increases the potential for subsequent generations to increase and cause damage. Removal (sanitation) of mummy nuts in the fall or winter and rapid early harvest provide the most effective control of NOW.

Poor sanitation favors population buildup and makes chemical control more difficult.The first shot at NOW involves monitoring mummy nuts. Sample each orchard on or before January 15. Examine and count overwintering nuts on 20 trees per block. If an average of two or more mummies per tree are found, plan to remove mummies from tree canopies by February 1 and destroy nuts on the ground by flail mowing before March 15. Experience suggests best control is achieved when an average of less than two mummies per tree remain after February 1.

Trunk shaking is the preferred method to remove mummy nuts particularly on large trees with lots of mummy nuts. Machine sanitation must be done when orchard soils are dry enough to support shaker weight. Hand poling is an option particularly on smaller young trees.

Planning Your Weed Management Program

Andrew Johnson, UCCE, Almond Board of California Intern

Now is the time to begin planning your weed management program for the coming year, especially if you intend to utilize a residual preemergent herbicide. While it is tempting to look at the cost of residual herbicide and choose a less expensive burndown product, the incorporation of a preemergent herbicide can help control winter, spring and some summer emerging weeds and cut down on the number of herbicide applications. Rotating herbicide mechanisms of action coupled with preemergent herbicides can be a powerful tool in managing herbicide resistance.

Consider three tips that will help optimize your chemical inputs, saving you money in the long run. First: correctly identify the weeds in your orchard. Second: choose materials registered for use in almonds and proven to provide adequate control of your specific weeds. Third: ensure your application equipment is properly calibrated and in good working order and always follow the rates and application criteria found on the label.

The first thing to do before selecting materials, is to identify what weeds are present. While most growers and pest control advisors will have a good idea of what is growing in the orchard, weed populations change over time, and proper identification is important for selecting the most effective material. University of California (UCIPM) suggests monitoring weeds twice a year; in the fall to identify any summer species that were not effectively controlled by the summer program and newly emerging winter species, and again in the late spring to identify those weeds that were not controlled. There are several resources available to help with weed identification. One simple and free resource is the Weed Identification Tool available at the University of California Weed Research and Information Center (http://wric.ucdavis.edu). Weed species identification is critical for accurate selection of both post and preemergent herbicides.

While weed control programs vary, most include a preemergent herbicide tank mix with a burndown herbicide in late fall or early winter followed by burndown applications as needed. Some weed managers choose not to incorporate any preemergent products and rely on multiple applications of burndown herbicides. The cost of residual preemergent herbicide is generally more per acre per application, but some can provide adequate weed control for six months or more. When the price of adjuvants, fuel, labor, and herbicide are taken into account for multiple applications; an application of a preemergent herbicide may be more economical than it appears at first glance.

Repeated application of the same material, often the case when relying on burndown herbicides alone, (i.e. repeated applications of glyphosate), has led to the emergence of herbicide resistant weeds. Resistance management will help keep many of the tried and tested materials from losing their relevance. One way to manage resistance is through the addition of residual materials into your weed program.

Weed control success requires matching a material with your weed population. Failure to select materials known to control your specific weeds will result in unsatisfactory results, additional applications, and increased cost. Many residual preemergent products are registered for use in almonds in California. Information on registered pre and postemergent herbicides and how they perform against certain weeds is provided at http://ucanr.org/sites/Weed_Management/files/74880.pdf. Charts (chart 1 and 2) compiled by Fresno County Farm Advisor Kurt Hembree on herbicide selectivity are included in this newsletter.

While selecting the correct preemergent herbicide is important, selecting an effective burndown partner can be equally important. This is becoming especially important for hard to control species like glyphosate-resistant horseweed and fleabane. Again, is it important to choose a burndown material that will provide control of your specific weed populations. In a trial conducted in Merced County, treatments containing Rely 280® (glufosinate) provided the best control of cutleaf geranium when compared to Durango® (glyphosate) and Durango® (glyphosate) + Treevix® (saflufenacil) (Figures 1 and 2). Better residual activity is favored by good initial weed control provided by the burndown component of the herbicide tank mix.

While the identification of weed population and selection of a material may seem like the most important part of a successful orchard floor management program, proper application rates and timing of those materials is equally important. Many weeds become difficult or nearly impossible to control once they have reached a certain size or reproductive stage. Some materials are not easily translocated in the plant, while others are dependent on movement into the soil by either rain or irrigation. In either case, the materials need to be applied according to the manufacturer's recommendation if they are to perform as expected. If your tree rows are covered in leaves and debris, you will need to blow them clean before application of preemergent materials.

If your nozzles are old and worn, replace them. The cost of replacing your nozzles will be much less than the cost of repeated ineffective applications and other problems associated with poor weed control.

Knowing your weeds, choosing the most appropriate material, and properly applying that material will help you achieve the desired results.

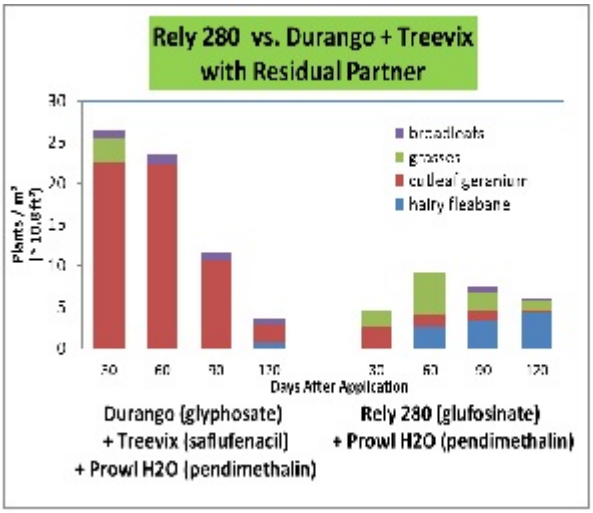


Figure 1. A comparison of the burndown herbicides Rely 280® (glufosinate) and Durango® (glyphosate) + Treevix® (saflufenacil) both tank mixed with residual herbicide Prowl H_2O® (pendimethalin). Treatments were applied in a mature almond orchard in Merced County on February 10, 2012.

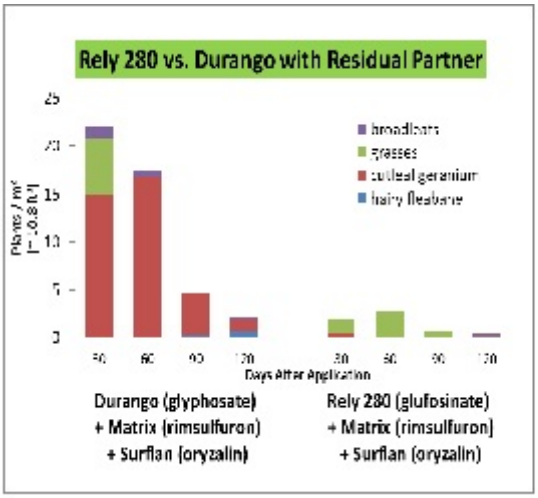


Figure 2. A comparison of the burndown herbicides Rely 280® (glufosinate) and Durango® (glyphosate) both tank mixed with residual herbicides Matrix® (rimsulfuron) and Surflan® (oryzalin). Treatments were applied in a mature almond orchard in Merced County on February 10, 2012.

Chart 1. Selectivity of Annual Broadleaf Weeds to Herbicides Registered in Almonds in California

	Preemergent herbicides													Postemergent herbicides										
	eptc (Eptam®)	flumioxazin (Chateau®)	indaziflam (Alion®)	isoxaben (Trellis®)	norflurazon (Solicam®)	oryzalin (Surflan®, etc.)	oxyfluorfen (Goal®, etc.)	pendimethalin (Prowl H_2O®)	penoxsulam + oxyfluorfen (Pindar GT®)	rimsulfuron (Matrix SG®)	simazine (Princep®)	thiazopyr (Visor®) - NB	trifluralin (Treflan 4E®, etc.)	carfentrazone (Shark®)	clethodim (Select Max®) - NB	fluazifop (Fusilade DX®) - NB	glufosinate (Rely 280®)	glyphosate (Roundup, etc.)	msma (MSMA®) - NB	paraquat (Gramoxone®, etc.)	pyraflufen (Venue®)	saflufenacil (Treevix®)	sehtoxydim (Poast®)	2,4-D amine (Orchard Master®, etc.)
Annual Broadleaves																								
Cheeseweed	N	C	C	C	P	P	C	P	C	C	P	P	N	C	N	N	C	P	N	P	P	C	N	P
Chickweed	C	C	C	C	P	C	P	C	C	C	C	P	C	C	N	N	C	C	C	C	C	--	N	N
Clovers	N	--	P	P	N	N	P	N	C	--	C	--	N	P	N	N	P	P	N	P	P	--	N	N
Cocklebur	N	--	--	--	C	N	P	N	--	P	C	N	N	C	N	N	P	C	P	C	C	C	N	C
Cudweed	P	--	C	C	C	N	N	N	C	--	C	C	N	P	N	N	P	C	N	N	C	--	N	P
Fiddleneck	C	--	C	C	P	C	C	C	C	C	C	C	C	C	N	N	P	C	N	P	P	--	N	P
Filaree	P	C	C	C	P	P	C	N	C	C	C	C	P	C	N	N	C	P	N	P	P	C	N	C
Goosefoot	C	C	C	C	P	C	C	C	C	P	C	C	C	C	N	N	P	C	N	C	C	C	N	C
Groundcherry	C	C	--	C	C	N	C	N	P	C	C	P	P	C	N	N	C	C	P	C	C	C	N	C
Groundsel, common	C	C	C	C	P	P	C	N	C	C	P	C	N	C	N	N	P	C	N	C	C	C	N	P
Hairy fleabane	C	P	C	C	P	N	P	N	C	C	P	P	N	P	N	N	C	P	N	P	P	C	N	C
Henbit	C	C	P	C	P	C	C	C	C	C	C	P	P	C	N	N	C	C	C	C	C	--	N	P
Horseweed	C	C	C	C	P	N	P	N	C	C	P	P	N	P	N	N	C	P	N	P	P	C	N	C
Knotweed, common	P	--	P	C	P	C	P	C	P	C	C	C	C	P	N	N	P	P	N	P	C	--	N	P
Lambsquarters	C	C	C	C	P	C	C	C	C	C	C	P	C	C	N	N	P	C	N	C	C	C	N	C
London rocket	C	C	C	C	P	P	C	P	C	C	C	P	N	C	N	N	C	C	N	C	C	--	N	C
Morningglory	P	C	P	C	C	P	C	N	--	N	C	--	C	C	N	N	C	C	P	P	C	C	N	P
Mullein, turkey	N	--	--	C	P	N	P	N	--	--	N	C	P	P	N	N	C	P	N	P	P	--	N	P
Mustard	N	C	C	C	P	N	C	P	C	C	C	P	N	C	N	N	C	C	N	C	C	C	N	P
Nettle	C	C	C	C	C	P	C	N	C	C	C	C	N	C	N	N	C	N	N	P	C	C	N	P
Nightshade	P	C	C	C	C	N	C	N	C	P	C	P	N	C	N	N	C	C	N	C	C	C	N	C
Pigweed	C	C	C	C	P	C	C	C	C	C	C	P	C	C	N	N	C	C	N	C	C	C	N	P
Prickly lettuce	C	P	P	C	P	N	C	N	C	P	C	C	N	C	N	N	C	C	N	P	C	C	N	C
Primrose, evening	--	--	P	C	N	P	P	P	C	--	C	C	P	P	N	N	C	C	N	C	C	--	N	--
Puncturevine	N	C	--	C	C	C	P	P	P	C	P	P	P	P	N	N	P	C	P	C	P	C	N	P
Purslane	C	C	C	C	C	C	C	C	C	C	C	C	C	N	N	N	C	C	N	C	C	C	N	P
Russian thistle	P	C	C	C	C	P	P	P	C	P	C	P	P	P	N	N	C	C	N	C	C	C	N	P
Shepherd's-purse	P	C	C	C	P	N	C	P	C	C	C	C	N	P	N	N	C	C	N	P	C	C	N	C
Sowthistle	C	P	C	C	P	P	C	N	C	P	C	C	N	N	N	N	C	C	N	P	C	C	N	P
Spotted spurge	N	C	C	C	C	P	P	P	P	C	P	P	P	P	N	N	C	C	N	C	C	C	N	P
Wild radish	N	C	--	C	P	P	C	N	C	C	C	C	N	P	N	N	C	C	N	C	C	C	N	C
Willowherb	--	C	C	P	P	P	C	--	C	--	N	--	--	P	N	N	C	P	--	N	P	C	N	P

NB = NB = non-bearing only
C = control, P = partial control, N = no control, -- = no information

This is not an endorsement for of any trade names listed, nor does the omission of specific trade names reflect the view of the author. Please refer to your local dealer or chemical representative for specific herbicide products available but not listed. Always read and follow the label directions carefully before using any pesticide. Ratings reflect appropriate timing and dose according to label recommendations. Kurt Hembree, UCCE, Fresno County. January 2012. http://cefresno.ucdavis.edu

Chart 2. Selectivity of Annual Grass and Perennial Weeds to Herbicides Registered in Almonds in California

	Preemergent herbicides													Postemergent herbicides										
	eptc (Eptam®)	flumioxazin (Chateau®)	indaziflam (Alion®)	isoxaben (Trellis®)	norflurazon (Solicam®)	oryzalin (Surflan®, etc.)	oxyfluorfen (Goal®, etc.)	pendimethalin (Prowl H_2O®)	penoxsulam + oxyfluorfen (Pindar GT®)	rimsulfuron (Matrix SG®)	simazine (Princep®)	thiazopyr (Visor®) - NB	trifluralin (Treflan 4E®, etc.)	carfentrazone (Shark®)	clethodim (Select Max®) - NB	fluazifop (Fusilade DX®) - NB	glufosinate (Rely 280®)	glyphosate (Roundup, etc.)	msma (MSMA®) - NB	paraquat (Gramoxone®, etc.)	pyraflufen (Venue®)	saflufenacil (Treevix®)	sehtoxydim (Poast®)	2,4-D amine (Orchard Master®, etc.)
Annual Grasses																								
Annual bluegrass	C	C	C	N	C	C	P	C	C	C	C	C	C	N	C	N	C	C	N	P	N	N	N	N
Barnyardgrass	C	C	C	N	P	C	P	C	P	C	P	C	C	N	C	C	C	C	P	P	N	N	C	N
Bromegrasses	C	P	C	N	C	C	N	C	--	C	--	C	C	N	P	P	C	C	--	P	N	N	P	N
Canarygrass	C	P	--	N	C	C	P	C	--	--	P	C	C	N	C	C	C	C	N	P	N	N	C	N
Crabgrass, large	C	C	C	N	P	C	N	C	P	C	N	C	C	N	C	C	C	C	C	C	N	N	C	N
Fescues	C	P	C	N	C	C	N	C	--	C	P	P	C	N	P	P	P	C	--	P	N	N	P	N
Foxtails	C	C	C	N	P	C	N	C	--	C	C	C	C	N	C	C	P	C	--	C	N	N	C	N
Junglerice	C	C	C	N	P	C	P	C	P	C	P	C	C	N	C	C	P	C	P	P	N	N	C	N
Lovegrass	C	C	C	N	P	C	P	C	--	P	P	P	C	N	C	C	C	C	--	P	N	N	C	N
Ryegrass, Italian	C	P	C	N	C	C	N	C	P	C	P	C	C	N	C	C	C	C	N	P	N	N	C	N
Sandbur	C	C	C	N	C	P	N	C	--	--	C	C	C	N	C	C	C	C	C	P	N	N	C	N
Sprangletop	C	P	C	N	P	C	N	C	--	--	N	C	C	N	C	C	P	C	N	N	N	N	C	N
Wild barley	C	P	C	N	C	C	P	C	--	P	P	C	C	N	C	C	C	C	N	P	N	N	C	N
Wild oat	C	C	C	N	C	C	P	P	C	P	C	--	P	N	C	C	C	C	N	P	N	N	C	N
Witchgrass	C	P	--	N	P	C	P	C	C	--	P	--	C	N	C	C	P	C	N	P	N	N	C	N
Perennials (seed)																								
Bermudagrass	C	N	--	N	C	C	N	C	N	N	P	C	C	N	C	C	C	C	N	P	N	N	C	N
Dallisgrass	C	--	--	N	C	C	N	C	N	N	C	C	C	N	C	C	C	C	C	N	N	N	C	N
Johnsongrass	C	C	--	N	C	C	N	C	N	P	C	C	C	N	C	C	C	C	C	C	N	N	C	N
Field bindweed	N	--	--	C	P	P	N	P	P	P	P	C	P	C	N	N	C	C	N	P	P	C	N	P
Perennials (estab.)																								
Bermudagrass	N	N	N	N	P	N	N	N	N	N	N	N	N	N	P	P	P	P	N	N	N	N	P	N
Dallisgrass	N	N	N	N	P	N	N	N	N	N	N	N	N	N	P	P	P	P	C	N	N	N	P	N
Johnsongrass	N	N	N	N	C	N	N	N	N	N	N	N	P	N	P	P	P	P	N	N	N	N	P	N
Field bindweed	N	N	N	P	N	N	N	N	N	P	N	P	P	P	N	N	P	P	N	N	N	N	N	N
Nutsedge, purple	P	N	N	N	P	N	N	N	N	P	N	P	N	N	N	N	P	P	P	P	N	N	N	N
Nutsedge, yellow	P	N	N	N	P	N	N	N	N	P	N	C	N	N	N	N	P	P	C	P	N	N	N	N

NB = NB = non-bearing only
C = control, P = partial control, N = no control, -- = no information

This is not an endorsement for of any trade names listed, nor does the omission of specific trade names reflect the view of the author. Please refer to your local dealer or chemical representative for specific herbicide products available but not listed. Always read and follow the label directions carefully before using any pesticide. Ratings reflect appropriate timing and dose according to label recommendations. Kurt Hembree, UCCE, Fresno County. January 2012. http://cefresno.ucdavis.edu

Prune Orchard Nutrition

Carolyn DeBuse, UCCE Farm Advisor, Solano and Yolo Counties

Your crop is harvested and the trees are winding down for the season. It is time to think about overall tree health and what needs to be done now to increase tree health and success of next year's crop. There are two nutrients that can be effectively applied in the fall; potassium (K) and zinc (Zn). Both of these nutrients can become deficient in California prune orchards. Use July leaf samples to confirm nutrient status for these and other nutrients. Potassium leaf levels should be between 1.3-2.0% and zinc leaf levels should be above 18 ppm. If either of these two nutrients were low or border line and trees had a good crop, then consider applying zinc and/or potassium this fall or foliar applications next year during the next growing season.

Potassium is required by the tree and the fruit in large amounts. K is essential for many enzymatic reactions for growth, sugar transport, and cellular functions. Most of the annual requirement is used by the crop and is removed from the orchard at harvest.

Symptoms of K deficiency: Signs of K deficiency begin to show early to mid-summer. Upper canopy leaves will look pale with poor growth of new leaves and reduced shoot growth. Final fruit size and quality may also be reduced. Potassium deficient pale leaves turn brown and scorch, finally dropping. Fruit and branches are then vulnerable to sun burning and Cytospora canker infection. Dieback throughout the top of the tree is often characteristic of the K deficiency.

Application choices: Application of K can be done either in the fall or during the growing season depending on how you choose to apply it. In the fall, 400 - 500 pounds per acre of potassium sulfate (sulfate of potash) or potassium chloride (muriate of potash) can be banded or shanked in along the tree rows using irrigation or winter rains to move K into the soil. The band should be placed in the same spot every year, allowing a concentration of K to build up. This allows for the K to penetrate deeper into the root zone. The safer of the two fertilizers is potassium sulfate and it has no potentially negative consequences. Caution must be used if potassium chloride is used. Chloride toxicity can be a problem if potassium chloride is used in heavy clay soils, orchards with a high water tables, or in years when the winter rains are unable to leach the chloride away from the root zone.

Summer applications of K can be made by injection through a drip system or foliar sprays of potassium nitrate can be applied. Multiple applications are needed to meet the trees requirements.

Zinc is considered a micronutrient because much less is required by the tree. Never the less, zinc deficiency can be very detrimental to trees health and productivity.

Symptoms of Zn deficiency: Signs of zinc deficiency are visible in the spring with the first indication being a slow or late bloom. As Zn deficiency becomes more severe, the growing tips of the shoots will not elongate and the leaves are small and appear in tufts or rosettes. This symptom is often called 'little leaf' and affected leaves may also have wavy margins. Zinc deficient trees may experience dormant flower bud drop and may have reduced fruit size.

Application: Zinc can be applied as a fall foliar application which has the added benefit of aiding leaf removal to reduce tree blow over and possibly reducing aphid habitat. Zinc should be applied once natural leaf drop has begun and can be tank mixed with some aphid control materials if an application is necessary (oil should not be in the tank mix or used within 30 days of zinc sulfate application).

Fall Spray for Prune Aphid Management

Franz Niederholzer, UC Farm Advisor, Colusa/Sutter/Yuba Counties

Prune aphids - mealy plum and/or leaf curl plum aphid - are key pests of prune. High populations of these pests can reduce tree vigor, fruit sugar content and return bloom the next year. Honeydew from feeding aphids dropped on fruit can increase cracked fruit. Effective prune aphid control - when needed - is a key to successful prune farming.

Recent University of California research shows that a fall pesticide application gives excellent prune aphid control the following season. Effective timing for this spray is late October through early December. After early December, leaves have dropped and a standard dormant spray is very effective. In the fall, soils are usually dry, and spraying is easier and less expensive than in the full dormant season (winter).

Not all pesticides give good aphid control as a fall spray. Research shows that pyrethroids - Asana, Warrior®, Baythroid®, Mustang®, etc. - all give excellent control anytime between mid-October and mid-December. The neonicotinoid (neonic) materials - Provado® (and generics), Actara®, and Assail® - work well in late October but don't work well after leaves begin to drop in early November. This is because the neonic materials have to be absorbed into the leaf to be effective on feeding aphids. Organo-phosphate pesticides - diazinon, Imidan®, etc. - don't work well for aphid control when sprayed before December 1. After December 1, these materials are very effective. Oil is not needed in the tank in a fall spray.

Not all orchards need a spray program for aphid control. If you have a regular history of aphid damage anywhere in an orchard, then a fall spray or dormant treatment is required to control aphids. If you haven't ever seen aphid damage around hard-to-cover areas near buildings or power lines following a dormant spray by air or after every-other row dormant spraying, you may not need to spray for aphids.

What happens if you miss the fall or dormant spray timing? If a late walnut harvest and/or a wet (or dry) winter keep you from a fall or dormant spray in prunes, you still have effective options for aphid control. Watch the trees for aphids after bloom. No aphids in the spring? No need to spray. If you see aphids in the orchard after bloom, you can use a range of pesticides for good control. Talk with your packer regarding which pesticide residues are accepted in the market. Talk with your PCA about materials that give good aphid control without flaring mites. Recent registrations of effective in-season aphid sprays include BeLeaf®, Actara®, Assail®, and Provado® (and generics).

What won't a fall spray do? A fall spray is for aphids, only. It gives some peach twig borer control, no scale control, and has no effect on bloom timing. To find out if you need to control scale, take a dormant spur sample. See http://www.ipm.ucdavis.edu/PMG/r606900511.html or call your UC farm advisor for details on dormant spur sampling.

A fall spray for prune aphid control is a solid option for growers without a scale problem who are looking to control a regular aphid problem. A fall spray provides good aphid control with low cost and little hassle (no mud) while avoiding in-season spray issues such as complying with "no spray" lists and flaring spider mites.

Prune out Cytospora Cankers to Reduce Disease

Joe Connell, UC Farm Advisor, Butte County and Franz Niederholzer, UC Farm Advisor, Sutter/Yuba Counties

Dormant pruning renews fruit wood, moderates a heavy crop, and reduces limb breakage, potassium deficiency, small fruit sizes and high dry away ratios. It is also the first step toward eliminating cytospora cankers and the dead wood associated with them. To identify limbs killed or weakened by cytospora cankers, look for dark, sunken cankers on the bark of limbs showing dieback or branches where dead leaves are still attached. Cankers will have distinct

zonate margins (Figure 1) that are different from the streaking and flecking in the tissue that is characteristic of bacterial cankers. Small white spots called pychnidia found on dead wood will confirm the presence of Cytospora.

Pruning out diseased limbs and burning them will reduce disease pressure and spores that can spread disease to new wood next season (Figure 2). Be sure to cut into healthy wood several inches to one foot below any canker symptoms. Check the cut surface of damaged limbs to ensure that all disease has been removed (Figure 3). Incomplete canker removal wastes time and money and won't control the disease. In older blocks where cytospora is a real problem, consider a using a specially trained pruning crew dedicated to identifying and cutting out the entire cankers.

Cytospora canker is a weak pathogen caused by the fungus Cytospora leucostoma that's spread by wind and rain to bark damaged by other stresses. To minimize this disease and the loss of fruit wood, scaffolds, and potentially entire trees, avoid in-season stress factors that predispose prune trees to disease spread such as potassium deficiency, water stress, sunburn, and subsequent borer attacks. The fungus shows maximum growth in hot temperatures around 90ºF and is particularly active in late summer to early fall. Trees planted on shallow and/or heavy textured (clay) soils are generally more likely to suffer economic damage since the disease spreads more rapidly in water stressed trees.

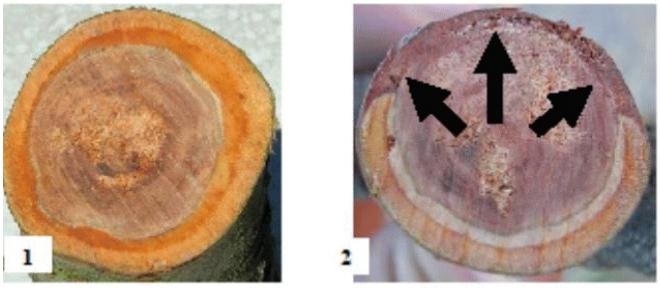
There are no chemical controls for cytospora cankers. To manage infection and reduce disease spread, avoid tree stress and remove cankered wood from the orchard and burn it. Prune to minimize sunburn potential, and, paint exposed trunks and scaffold crotches with white interior latex paint to further protect them from sunburn. Maintain adequate orchard water status, especially after harvest, and avoid potassium deficiency, spider mite or prune rust defoliation that can increase sunburn and disease potential.

For more detailed information on disease management and for excellent photos of disease symptoms and fungus signs that will help you know what to look for, visit the IPM web page (www.ipm.ucdavis.edu) and click on Agriculture and floriculture; Prune; and cytospora canker (under diseases).

Cytospora cankers are detected as sunken areas on the branch where bark has been killed. Arrows anker edges, revealed by a knife cut in the second photo.

Pychnidia, black or white pimple-like spore producing structures found on dead wood.

Good cut (1) below canker showing only clean bark. Bad cut (2) not far enough down showing bark (arrows) and canker remaining in the tree.



Two Different Spots on Prune Leaves

Richard P. Buchner – UC Farm Advisor, Tehama County

Each year farm advisors get questions regarding yellow prune leaves with what appears to be "green spots" (Figure 1). These "green spots" do not sporulate and are not disease related. Symptoms usually show up in early summer and can be confused with rust lesions. Leaves with "green spots" are typically found on stressed trees or in areas of the orchard that are more prone to stress. Consequently, the cause is thought to be physiological. Sometimes "green leaf" is diagnosed as rust and a sulfur application is made just to be safe. This is probably not a good decision as sulfur is detrimental to predator mites that can help prevent spider mite damage.

Prune rust (Figure 2) caused by the fungus *Tranzschelia discolor* may develop any time from late spring to autumn following rain or high humidity. The first evidence of a rust infection is small yellow angular lesions on the leaf surface. Later, when the fungus sporulates, a rusty reddish/brown pustule develops on the lower leaf surface within the angular lesion. Sporulation confirms the rust fungus.

Leaves with multiple rust infections yellow and drop making early defoliation the major problem associated with rust. Reductions in leaf area make it more difficult for the tree to mature the fruit and increase fruit sugar content. Prune rust is notorious for its explosive capacity to become epidemic. The spores can germinate and infect within hours when free moisture is present or the relative humidity is 100%. Rainfall in late spring through summer sets the stage for outbreaks and rust can be exacerbated by morning dews and high humidity. In the Sacramento Valley start monitoring for rust on May 1st. Monitor trees weekly and treat immediately if any rust lesions are found.

Figure 1. Yellow prune leaves with green spots that do not sporulate are thought to be related to tree stress.

Figure 2. Prune rust lesions on the upper and lower leaf surface. Rusty reddish/brown spores on the lower leaf surface confirm rust.

Points to Consider in the Prevention of Crown Gall

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Crown gall caused by the bacterium *Agrobacterium tumefaciens* can cause significant economic loss in both commercial walnut orchards and nursery operations in California. This results from the fact, Paradox hybrid, the most popular walnut rootstock in California, is extremely susceptible to infection by the crown gall causing bacterium.

Since *A. tumefaciens* is a commonly found soil-borne pathogen we have taken a comprehensive approach in the development of a sustainable crown gall prevention strategy. By comprehensive, we mean we are examining all avenues of *A. tumefaciens* infection from the moment a black walnut seed is picked from the mother tree to the later life stages of a commercial English walnut orchard. We will discuss five areas being examined in our quest to develop a robust comprehensive approach to crown gall prevention. These areas include:

- Pre-plant fumigation/chemical control
- Use of "clean" black walnut seeds in Paradox hybrid rootstock production
- Contamination of graft wood and cutting tools
- Long term soil survival of *A. tumefaciens*
- Identification of novel crown gall resistant rootstocks

Pre-plant fumigation: Methyl bromide (MeBr) has been the standard pre-plant soil fumigant for both nursery and commercial walnut production in California. However, under the Montreal Protocol, MeBr is being phased out worldwide. To identify effective MeBr alternatives, we investigated the direct effect of alternative soil fumigants on *A. tumefaciens* populations in native field soil brought into the laboratory**.** The MeBr alternatives, Vapam, Telone® C-35, and Telone® C-35 followed by an additional application of chloropicrin, all reduced soil populations of *A. tumefaciens***.** However, while 1,3-dichloropropene (Telone® II) applied alone was not effective at controlling *A. tumefaciens*, it is a known reliable treatment for lesion nematode, another major pest of walnuts. The addition of chloropicrin to 1,3-dichloropropene in Telone® C-35 dramatically reduced *A. tumefaciens* populations in soil, but not in buried gall tissue**.** The additional chloropicrin applied after Telone® C-35 in the "Telone® C-35 plus Chloropicrin" treatment, was needed to reduce *A. tumefaciens* in gall material. Based on our laboratory data, Telone® C-35 is an effective preplant alternative to MeBr for the control of *A. tumefaciens* in soil. In sites with a history of high crown gall incidence, fumigation with Telone® C-35 plus chloropicrin combined with extensive gall removal from the soil should be considered. In conjunction with prior reports on 1,3-dichloropropene (Telone® II) efficacy on lesion nematode, and our laboratory-based data, Telone® C-35 or Telone® C-35 followed by chloropicrin are candidates for consideration in an integrated pest management program controlling the major soil-borne plant pathogens in the California walnut industry. For rates and more specific fumigation information, see "Fumigation Guidelines" in an earlier issue of this newsletter at
http://cesutter.ucdavis.edu/newsletters/Fall_2008_Sacramento_Valley_Walnut_News36490.pdf

Long term Agrobacterium survival: Once *Agrobacterium tumefaciens* is introduced into a field site it has the ability to survive for years in the soil in the absence of any plant host. For example, we documented *A. tumefaciens* survival for at least 2 years in orchard soil and at least 1.5 years in non-irrigated fallow soil. In addition, the *A. tumefaciens* strain we introduced in the orchard soil, and reisolated 2 years later, retained the ability to induce crown gall formation. Given these data, a fallow rotation does not appear to be an effective approach to reduce *A. tumefaciens* populations and limit crown gall formation.

Importance of using "clean" black walnut seeds for Paradox hybrid rootstock production: Soil fumigation dramatically alters the composition of the microbial community in soil. The end result is a community which often is compromised in its ability to limit or inhibit soil-borne pathogenic microorganisms which enter fumigated field sites. Consequently, it is imperative that only "clean" (i.e., free of plant pathogens) planting material be used in these situations.

Recently we explored avenues for *A. tumefaciens* to enter the rootstock production system and cause crown gall. We found if black walnut seeds were shaken to the orchard floor, where they could sit for up to 48 hours, we were able to detect *A. tumefaciens* on the seeds. Interestingly, we found the longer the seeds remained on the orchard floor prior to harvest, the greater the percentage of *A. tumefaciens* contaminated seeds were discovered. Even though this represents a previously undiscovered way in which *A. tumefaciens* can enter the rootstock production system, it should not have come as much of a surprise to us since, as mentioned above, *A. tumefaciens* is an excellent survivor in soil.

We now hypothesize the following avenue as being important in crown gall incidence. Black walnut seeds are shaken to the orchard floor where they may lay for 6 to 24 hours. During this time, the seeds become contaminated with soil which may harbor the crown gall pathogen. These *A. tumefaciens* contaminated seeds are then planted in freshly fumigated soil which contains a compromised native microbial community unable to suppress populations of *A. tumefaciens* which are hitching a ride on contaminated seeds. This results in establishment of the crown gall pathogen in soil where it is ready to infect the walnut seedling upon emergence from the germinating seed. Given this scenario, we propose a cost effective way to reduce crown gall incidence is to limit or eliminate contact of the black walnut seed with the ground prior to planting in fumigated soil. This could be accomplished using a catching frame or even shaking the mother trees on tarps spread on the ground prior to shaking. Regardless of the method, the key point remains, eliminate soil contact by the black walnut seeds prior to planting in fumigated soil and you will, most likely, decrease crown gall incidence on susceptible walnut rootstocks.

Contaminated grafting tools and graft wood: The importance of grafting tool sanitation has been demonstrated for numerous crops in which plant pathogens, including *Agrobacterium*, are readily transferred from plant to plant via grafting tools. We recently demonstrated the importance of grafting tool sanitation in crown gall prevention during production of grafted walnut trees on Paradox seedling rootstock. When sanitation measures are not followed, Paradox seedlings can develop galls at the graft union or bleeding wounds. This implicated not only the involvement of improperly sanitized grafting and cutting tools but also potential *Agrobacterium* contamination of graft wood. Grafting tools and graft wood should never be left on soil where they can become contaminated with *A. tumefaciens.*

Bleach, a standard sanitizing agent is an effective disinfectant of water and solid surfaces. However, it is corrosive and rapidly inactivated by dissolved or suspended solids such as organic matter, which are common in field situations. Surfactants/detergents are potentially effective alternatives for the control of microorganisms in environments with high levels of organic matter. We have shown that surfactants known as quaternary ammonium compounds, effectively reduced populations of *A. tumefaciens* in solutions and on solid surfaces. The detergents, benzalkonium chloride (BC), Cetyl trimethylammonium bromide, (CTAB) and Physan 20 rapidly reduced populations of *A. tumefaciens*. More importantly, BC and CTAB activity was only reduced by 16% in the presence of organic material which reduced bleach efficacy by 64%. In our laboratory trials, these detergents dramatically reduced bacterial contamination on cutting blade surfaces which lowered gall formation in grafted test plants and were less phytotoxic than bleach. We are now exploring potential use of these materials in the field.

On a bit of a side note, it is important to remember, crown galls can harbor large populations of the crown gall pathogen *A. tumefaciens*. Therefore, when conducting any type of gall removal operation, it is important to disinfect cutting tools after use on gall tissue and properly dispose all gall material after removal (i.e., remove from orchard and burn). Finally, before using disinfectants or other pesticides, be certain they are registered for that use in California.

Host Resistance: The best form of disease control is the identification and development of disease resistant hosts. Our walnut rootstock improvement team has made significant advancements in the identification of walnut genotypes

which exhibit resistance/tolerance to key soil-borne pathogens including *Phytophthora*, *Armillaria* (oak root fungus), lesion nematodes and *A. tumefaciens* (crown gall). In particular, Texas black walnuts *(Juglans microcarpa*) have been found to exhibit elevated resistance to several of these key pathogens. By crossing Texas black walnuts with English walnuts (*J. regia*) we generated a hybrid that continues to exhibit tolerance to crown gall. These new hybrids will now be examined under various field conditions. The clonal Paradox rootstock 'Vlach' also has shown some resistance to crown gall in the field and in screening trials. However, these observations need further validation.

Overall Prevention Strategy: Since the crown gall pathogen is a common soil-borne bacterium, we need to maintain a comprehensive approach in our disease prevention strategies for crown gall. Based on our laboratory-based research and field observations, we developed a series of suggestions we feel will aid in the battle against crown gall. These include:

- Eliminate exposure of walnut seeds and graft wood to field soil prior to planting or grafting/budding.
- Surface sterilize grafting tools frequently.
- Limit time between nursery or cold storage pick up and planting and keep nursery planting stock cool prior to planting.
- Fumigate planting sites with Telone® C-35 or Telone® C-35 followed by Chloropicrin in heavily infested crown gall sites.
- Limit wounding of plant material.
- Avoid planting too deep.
- Avoid mounding soil up on newly planted trees.
- Keep crown of tree as dry as possible; *Agrobacterium* is favored by wet environments.

Guidelines for Handling and Planting Bareroot Walnut Nursery Trees

Carolyn DeBuse, UC Farm Advisor, Solano and Yolo Counties and

Bill Krueger, UC Farm Advisor Emeritus, Glenn County

Handling bareroot nursery trees

Walnut bareroot trees may look sturdy, but they are very vulnerable to environmental stresses of heat, freezing, and drying out. Though their outward appearance may be unchanged, damage can happen that will decrease their survival or increase possibility of disease. Here are some guidelines that will help ensure their health.

- Prepare the orchard site before delivery of the trees (see article on site prep in current newsletter). Professional tree cold storage is the best place to store trees once they are dug from the nursery field.
- Once trees are picked up or delivered, it is very important to keep the roots moist and protect the trees from sunlight, heat and extreme cold. Do not pick up more trees than you can plant in a day. Plan to plant the trees as quickly as possible after delivery.
    - If trees have been in cold storage, continue the cold storage at your orchard while you're progressing with planting by renting a refrigeration truck trailer for the trees. Trees must be kept moist even in refrigeration.
    - If refrigeration is not possible, then store the trees in a cool fully enclosed warehouse keeping the trees moist and covering them with a tarp.
- Continue the same care of keeping the trees moist and cool while moving the trees to the field and during planting. Take the trees from your onsite storage or refrigeration in very small lots. Move them under tarps or

covered trailer keeping them in the shade as much as possible. Keep them moist by spraying them with water while waiting to be planted. If possible, move the refrigeration truck to the field and remove trees as needed.

Planting Walnuts

The most important detail is to manage soil settling so that after a few months when settling has finished the trees are at the same depth as they were grown in the nursery. A tree planted too deep is more susceptible to Phytophthora crown rot from moist soil against the upper rootstock portion while a tree planted too high can get sunburned roots and dry out too quickly. The following guidelines will help to avoid problems while planting your trees.

- Field soil should be moist, but not overly wet for planting.
- Dig the holes just deep enough for the roots. A deeper hole will settle the whole tree lower than desired.
- Augered holes should have the sides roughed up with a shovel to disrupt glazing and prevent roots from circling rather than growing out into the soil.
- Planting on berms or mounds is recommended to allow proper drainage from around the crown of the tree and reduce the chance of disease.
- Trim off broken roots or roots that are too long for the hole. It is best to enlarge the hole to fit the roots than trim them, but this is not always possible.
- K-84 bacteria can be used before planting to protect the roots from crown gall. The success of this spray will depend on the type of crown gall bacteria found in the field. It has been shown that it works with some crown gall strains and not others. If used, it is better to spray it on the roots and crown rather than dip trees.
- Use a planting board to ensure that the crown of the tree is in the proper position and slightly above the soil level. This will allow for some settling so the final tree placement is at the proper depth.
- Spread the roots in all directions in the hole. The strongest roots should be placed towards prevailing wind.
- Fill the soil around the roots and pack it down multiple times in the process of filling until the hole is filled. Make sure there are no voids under the root system. The soil should be mounded above soil level to allow for settling.
- Water the tree in with 1-2 gallons of water to help remove air pockets and help settle the soil.
- Head back the trees at 4-5 good buds above the graft or bud union. This will ensure that only a few shoots will start to grow maximizing growth from stored reserves in the tree and decreasing shoot competition.
- Paint the whole tree with a white wash to prevent sun burning. This is critical and should be done the same day as planting. Be sure to paint the crown of the tree all the way down to the soil line. (whitewash: latex interior paint cut with 50% water)
- First irrigation should be applied after the trees have begun to grow.

Additional planting notes

- Do not place fertilizer or organic matter in the hole.
- Avoid planting on extremely hot days. Trees dry out too quickly between storage and planting and can be heat damaged if they are not painted and watered in immediately.
- Placing stakes at planting can save the extra step of post pounding and they are ready to go when the trees need staking. For standard spaced orchards, use 10 ft. stakes and place 2 feet below soil level and 8 feet above. Eight foot stakes (2 feet below and 6 feet above) work for hedgerow orchards. Stakes should be placed 12 inches away from the tree on the side perpendicular to prevailing winds with the tree tied loosely to allow for movement and strong trunk development.
- Potted walnuts at this time are sold as unbudded rootstock. The recommended time of planting is in late February or early March. Look for an article in the Spring Walnut News covering this topic more fully. For more information, you should contact your local farm advisor.

Orchard Removal and Site Preparation for Walnut Planting

Joseph Connell, UCCE Farm Advisor, Butte County

Getting a walnut orchard off to a good start is essential considering the investment cost required to develop a new orchard. It's a good idea to plan for an 18-24 month transition between existing orchard removal and planting new trees. Trying to rush the operation can create several opportunities for a less satisfactory outcome. Nematode management and soil preparation are two important issues to consider when planning for a new orchard. If you are planting a new orchard in land that has been fallow or in non-host field crops for two or three years, fumigation may not be needed.

Root Lesion Nematodes. The root-lesion nematode of concern in California is *Pratylenchus vulnus.* Almost every woody perennial will host this nematode species to varying degrees. English walnut, Paradox hybrid and black walnut rootstock are all highly susceptible with each root tip capable of supporting thousands of nematodes per gram of root. Most *Prunus* rootstocks are a notch lower as hosts but are still considered good hosts of *P. vulnus.* Equally important, *P. vulnus* can flourish in any soil type and at any depth on deep rooted woody perennials. These nematodes will slowly spread across an orchard via tillage and irrigation and can considerably enlarge the area of plant damage.

Kill existing orchards root systems (and nematodes) before tree removal. The main value of killing existing roots is to mimic what occurs when you fumigate. Research has shown that glyphosate is best for killing *Prunus* species roots (prunes, almonds, and peaches) while Garlon3A® is best for killing walnuts. Use of Garlon 3A on orchard cut stumps is currently allowed under a Special Local Needs label. Users should have the Garlon 3A label and the SLN for cut stump use in hand when they make the application.

Glyphosate will kill roots as deep as they go while fumigation will kill them down to 4 feet or so. Root killing herbicide application is especially useful in reducing the walnut replant problem whether or not fumigation is planned. Wait at least 60 days after applying the root killing herbicide before removing treated trees or stumps and wait one full year before replanting or you will not get much value from the kill treatment.

There are two methods for killing root systems. The most common method is to cut the tree down and paint the freshly cut stump with herbicide. This method can be used for any orchard crop. The second method is to spray the whole tree before it is cut down allowing the tree to die completely before removing. Whole tree herbicide treatment is only practical for small stature prune and peach trees. If you are removing large almond or walnut trees, use the stump killing method.

For orchard stump treatments, cut trees with a saw a couple of feet above the ground and paint the cut surface *within 5 minutes.*

- **For almonds, prune, and peaches cut and paint stump with a straight 50:50 mix of Roundup® (41% glyphosate) and MorAct® before the end of October.**
- **For walnuts cut and paint stump with a straight 50:50 mix of Garlon3A® and MorAct® before the end of October.**

Unless the label says otherwise, dabbing a sponge fastened to the end of a broom handle into the liquid, then onto the freshly cut surface has worked well. An old 5 gallon container with a lip around its top should be filled no more than half full. Avoid getting the bucket handle wet. These mixtures are thick and paint-like and may damage sprayers or their components, and, they are also likely to clog the sprayer. Applicators will need boot covers, eye protection, and other personal protective equipment as labels require. Roundup® and Garlon3A® labels include stump killing recommendations. Be sure to check the labels on the materials you're using to make sure these relatively simple procedures are in compliance with the label. For more information, go to Dr. M. McKenry's website http://www.uckac.edu/nematode/.

Fallow period: It is recommended to not plant directly after tree removal in the same year. Remember that 60 days is required for root killing herbicide to take effect before stump removal. The land should be left fallow or a crop that is not a host to nematodes may be planted the following summer such as Sudan grass or safflower to further reduce nematode populations and create conditions for more effective fall fumigation.

Plan for effective fumigation if necessary. Send soil samples to a lab to determine if nematodes are present. Plan to fumigate if lesion nematode (*Pratylenchus vulnus*) is found. Where soil is fallowed, it should be ripped and reworked

through the summer to dry the soil to a 5 foot depth. Moisture content at the time of application should be at or below 12-18 percent. Fumigants work better at high soil temperatures so it is important to fumigate before the soil temperatures drop. Complete the fumigation treatment before 2 inches of rainfall occurs after July 1st and before November 15th while soil temperatures are above 55°F at one foot depth.

Sealing the soil. Tarping the soil is recommended following a gas fumigant like methyl bromide. Less volatile fumigants can be followed by sealing the soil with tarps or soil compaction and/or water sealing. The more completely the soil is sealed the more thoroughly the fumigant will work killing the soil pathogens and weeds. If fumigant is broadcast, follow the label recommendation of additional water to increase penetration. Follow label recommendation for time needed to aerate the soil before planting.

Know your soil and your field. Before planting or replanting, review your local soil survey for information on the type of soils present on your site and their distribution. Soil surveys describe each soil type and provide information about drainage, flooding, exchangeable sodium content and other details important to successful orchard establishment. Using a backhoe to dig pits 5 to 6 feet deep in strategic locations where soil differences are expected will allow for a first hand examination of the soil. Look for stratified soil, compacted zones, hard pans, clay pans, or sand or gravel layers. Abrupt changes in soil density or texture can result in perched water during extremely wet years resulting in unhealthy walnut roots.

Do your best to identify and fix problems before your new orchard is planted. Stratified soils or soils with compacted layers should have these layers disrupted prior to planting. Soil modification in late summer or fall when the soil is dry will ensure the most disruption possible while allowing winter rains to settle the soil before planting. A slip plow, a ripper shank with a steel plate coming from the point of the ripper at a 45 degree angle to the surface, can lift soil at the bottom of the shank to the soil surface and permanently disrupt restrictive layers. Ripping breaks apart compaction or shatters hard pan, while slip plowing mixes soils with a clay pan or other restrictive layers. Both are typically done in two directions, with the second pass diagonal to the first. This subsoil work should be done far enough in advance to allow soil settling to occur before planting. Once settled, low spots should be graded and leveled to improve surface drainage to help keep the future orchard healthy. Planting trees on berms is often recommended to reduce the chance of developing crown rot.

Diagnosing and Managing Branch Wilt Disease

Janine Hasey, UC Farm Advisor, Sutter/Yuba/Colusa Counties

The extreme heat waves we experienced this summer may cause problems in walnuts that we often do not see in milder summers. Webspinning spider mites which flare in hot weather were certainly evident in many orchards this year. We usually see more sunburn on nuts of susceptible varieties although many orchards used Surround® or a similar material to prevent damaged nuts. Hot weather also favors the fungal disease Branch Wilt (*Nattrassia mangiferae,* formerly *Hendersonula toruloidea*). Below are the main points you need to know to recognize and manage this walnut disease.

Symptoms and Damage

Typically in July and August after a hot spell, the first symptom of branch wilt is yellowing and browning of the outermost branches usually on the southwest exposure of the tree (Photo 1). Next, the leaves suddenly wither and turn brown on the infected larger limbs and remain attached to the twigs even after leaf fall, making diseased trees easy to spot in the fall. The thin outer layer of the walnut bark will peel away, revealing black sooty fungal spores (Photo 2). The fungus kills both the bark and the wood of infected limbs. Look for gray to black discoloration extending to the center of the branch in the shape of a cylinder or partial cylinder (Photo 3). The disease will progress killing large branches if left unchecked for a period of years, eventually even extending into the trunk (Photo 4).

Frequently branches killed by branch wilt are colonized by *Botryosphaeria* species. Sometimes though, *Botryosphaeria* may be misdiagnosed as branch wilt since symptoms of smaller branch dieback caused by *Botryosphaeria* resemble those of branch wilt. See http://cesutter.ucdavis.edu/Orchard_Crops_254/Botryosphaeria_Blight_-_Phomopsis_Cankers_57/ for photos of branch dieback caused by *Botryosphaeria*.

Seasonal Development

The fungus can only invade bark that is split, frost damaged, or sunburned which is the most common entry point. The black sooty spores that can survive for long periods under hot dry conditions are spread by wind or rain throughout the year; the disease, however, can only develop under warm temperatures growing best at 90ºF. The southwest side of the tree is the most likely place to find branch wilt because of a higher frequency of sunburn injury.

Prevention and Management

Trees weakened by a disease such as deep bark canker common on Hartley, crown rot, water stress, nutritional deficiencies or low vigor, are more susceptible to sunburn injury and subsequent infection by the branch wilt spores.

- Prevent sunburn injury by maintaining vigorous tree canopies through proper irrigation, fertilization, pruning, and pest control.
- Look for branch wilt symptoms annually right after harvest while there are still healthy leaves on trees.
- Remove diseased limbs cutting back to a lateral branch into healthy wood that shows no discoloration. Pruning does not spread infections so there is no need to sterilize equipment between cuts. Burn all infested wood to prevent further spread.

Photo 1. The first symptom is sudden leaf browning of the outermost branches.
Photo by Janine Hasey

Photo 2. Note the outer peeling bark and black sooty spores.
Photo by Janine Hasey.

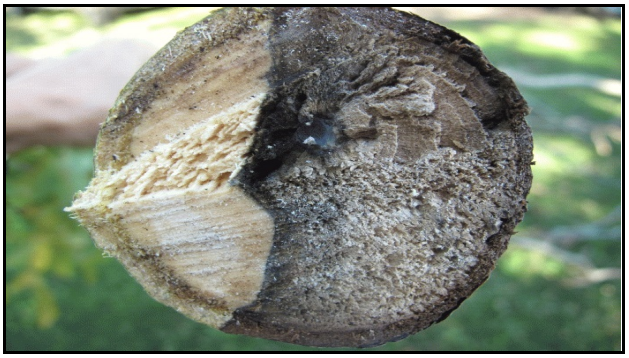

Photo 3. Note gray to black discoloration extending to the center of the branch.
Photo by Janine Hasey.

Photo 4. Branch wilt can extend into trunk if left unchecked for several years.
Photo by Janine Hasey.

Management of First Year Walnut Trees in Fall and Spring

Carolyn DeBuse, UC Farm Advisor, Solano and Yolo Counties

Fall Management

✓ No fall fertilization. Last nitrogen should be applied in the first two weeks of August on first year trees.

✓ Wind damage prevention: in late September, check all staking and tying to prevent blow overs or breakage.

✓ Freeze damage prevention: trees should be encouraged to set a terminal bud and begin going into dormancy, or "harden off", to reduce risk of freeze damage from cold snaps early in November. To do this, stop irrigation in September until the terminal bud is set. After the bud is set, you may irrigate in October depending on the weather and autumn rainfall. Do not over stress the trees during this period of hardening off or keep them too wet.

✓ Make sure that the trees go into the winter with adequate soil moisture. Dry trees are more likely to have damage in cold weather. If rainfall is inadequate into December like last year, winter irrigation may be needed.

✓ If early freeze/frost damage occurs, white wash the trees so damage does not increase with sun burning in the winter months.

Spring Management

✓ The first pruning or heading should be delayed until late February or early March when risk of freezing temperatures is reduced.

✓ Head the leader for standard orchard spacing at 8 feet and for hedgerow plantings at 6 feet.

✓ Remove lower lateral branches that grew the previous season and rootstock suckers while green and small.

✓ Remove necked buds that are in possible scaffold positions from about 4 to 5 feet up to the top. Remove them by pushing to the side so the secondary bud is not damaged.

✓ If the leader has not reached the proper height, cut the tree back to 4-5 good buds at the base of the previous season's growth and regrow the tree as if it was in its first growing season.

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