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Pomology Notes

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ALMONDS

IN THIS ISSUE

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General Guidelines for Sacramento Valley Orchardists Wishing to select Rotation Crops and Intercrops that do not increase Nematode Pests

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The two nematodes of major concern to Sacramento Valley orchardists are root lesion nematode, *Pratylenchus vulnus*, and ring nematode, *Criconemoides xenoplax*. Any crops considered in the following discussion as intercrops in young orchards or as rotation crops should not be planted two years in succession if used as alternatives.

Root-knot nematodes *Meloidogyne* spp. are of lesser concern in the Sacramento Valley but can become noteworthy if the orchard crops roots are also a great root-knot host such as Lovell, Kiwifruit or Krymsk 86. Second, root-knot nematodes present in the Sacramento Valley tend to be *Meloidogyne hapla.* This species produces barely visible root galls and is not damaging to perennials unless their population levels exceed at least a thousand or more per soil sample.

Root Lesion Nematodes. There are eight species of root-lesion nematode in California. The single species currently of concern is *Pratylenchus vulnus.* Almost every woody perennial will host this nematode species but to varying degrees. English walnut, Paradox hybrids and Black walnut are all highly susceptible with each root tip capable of supporting thousands of nematodes per gram of root. Cherry and rose are similarly great hosts of *P. vulnus* and one can expect these nematodes to slowly spread across an orchard via tillage and irrigation and considerably enlarge the amount of plant damage.

Most of the Prunus rootstocks such as almond are a notch lower as a host but can still be considered to be good hosts of *P. vulnus.* Equally important, populations of *P. vulnus* can flourish in any soil type and on deep rooted perennials can flourish at any rooting depth. Across a list of potential intercrops, none will host this nematode as well or as deep as woody perennials.

There are also annual crops such as sudan grass and milo that have a negative impact on *P. vulnus.* To quantify this impact consider that one year of fallow can reduce *P. vulnus* soil populations by 50%. Five years of fallow can reduce

P. vulnus by 95%. One year of growing sudan grass instead of simply fallowing can reduce *P. vulnus* by 60%. Relative to this nematode sudangrass and milo are among the best choices when seeking a useful rotation crop.

Annual crops that host *P. vulnus* make a much shorter list but whatever crop is chosen; do not replant it again down the same rows in two consecutive years. The list of annual crops that will host *P. vulnus* is best determined by referring to NEMAPLEX. Google® "NEMAPLEX Pratylenchus vulnus" and then click on "Host". This compiling effort by Howard Ferris, Nematologist at UC Davis, is as complete as one can expect to find but there remain limitations. One example is some cultivars of strawberry are hosts for *P. vulnus* but this is not catalogued. Similarly, some selections of field corn or sweet corn may host *P. vulnus* but are not included in the list, because it is publication based. Most published studies with this nematode are focused toward perennial crops so the host listing could be overly weighted in that direction.

Ring Nematodes. There are numerous species of ring nematode in the Sacramento Valley. But there is one that prefers to feed on roots of perennials including almond and walnut. Unfortunately, its genus name changes every decade or so. *Criconemoides xenoplax, Mesocriconema xenoplax,Criconemella xenoplax* and *Macroposthonia xenoplax* are recent name changes for the same nematode. This nematode has the ability to feed near root systems that leak out some rather nasty substances. Almond, for example, produces cyanide materials from its roots. *Criconemoides xenoplax* has a lengthy host list. Some of its favorite foods are legumes but it will be difficult to accurately determine which crops it does not feed upon. Again we can Google® "NEMAPLEX *Criconemoides xenoplax"* for the quickest list available.

Most importantly, *C. xenoplax* builds to its highest population levels within soils that are highly porous. Fine sandy loams can support several hundred per soil sample but do not usually exceed that population level over the life span of a perennial. This is in contrast to the higher population levels they achieve in coarser sands or well structured clay loam soils. Three years of alfalfa intercrop or rotation should not be attempted in soils having high porosity. Bacterial Canker or ring nematodes are of concern. In addition, weedy orchards can be a good source of ring nematode build up and their presence can be every bit as important as intercropping choices.

How good of a nematode host are vegetables or seed crops such as pumpkin, squash, butternut, watermelon, cucumbers and cantaloupe when planted as intercrops in young orchards? These are all great hosts for *Meloidogyne* spp. (root knot) but the Sacramento Valley is generally safe from the really harmful species of this nematode. These intercrop choices are also not of concern for *P. vulnus* (lesion) but could easily be as much of a host for ring nematode as are common weeds.

How good of a nematode host are oats, barley, alfalfa and sunflowers?
Barley and oats are good intercrop choices because of their timing, their cost, and their nematode host status. First, winter time crops (mid November to mid April) do not increase nematode populations because soil temperatures are generally below 60F. With the availability of NEMAPLEX, use it to determine if some cultivars have been reported as a good host.

California selected alfalfa tends to be a good host for *M. hapla* only. This species produces barely visible root galls and is not damaging to perennials unless their population levels exceed at least a thousand or more per soil sample. Our California selections of alfalfa are not a good host for *P. vulnus*. Alfalfa cultivars from some northern states (such as one we tested from Minnesota) can

host *Meloidogyne* spp. other than *M. hapla* so select carefully. However, all legumes such as alfalfa should be considered a good host for ring nematode. Avoid intercropping almonds and other Prunus spp. with alfalfa.

Sunflowers and safflower are of minimal concern with *Meloidogyne* spp. and *P. vulnus* but they will probably grow ring nematode. Crops like safflower render soils so dry that during the spring warming periods nematodes cannot find enough soil moisture to migrate to a root.

In summary, there are multiple factors to contend with when answering questions about intercropping. The safest answer north of Sacramento is do not replant the same intercrop or rotation crop two years in succession.

What Do New Changes in Aluminum Phosphide Labels Mean for Burrowing Mammal Control?

Roger A. Baldwin, UC IPM Wildlife Pest Management Advisor

The California ground squirrel (*Spermophilus beecheyi*) and pocket gopher (*Thomomys* spp.) are widely considered to be the two most damaging wildlife pests in California agriculture. Numerous techniques are available for controlling ground squirrels and gophers including trapping, anticoagulant baits, acute toxicant baits, and burrow fumigants. Trapping can be an effective method to remove small to medium size populations of gophers and ground squirrels but often becomes too time consuming for large acreage. Both anticoagulant (e.g., diphacinone and chlorophacinone) and acute toxicant baits (e.g., zinc phosphide) can be quite effective at controlling ground squirrels when used appropriately. These rodenticides are less consistent but can still be effective when baiting for pocket gophers. Baiting is typically considered the cheapest and least time-consuming method for controlling both gophers and ground squirrels. However, there are potential concerns for non-target poisonings when using rodenticides which can limit their applicability in some situations.

Burrow fumigants, such as gas cartridges and aluminum phosphide, do not typically pose as great of a concern for non-target exposure as baits, and usually involve shorter application times than trapping. Aluminum phosphide is particularly effective at controlling gophers and ground squirrels. Recent studies on ground squirrels and gophers indicated excellent control for both species (reduction in ground squirrel population = 97–100%; reduction in gopher population = 100%). Aluminum phosphide is a restricted use material; specific guidelines must be adhered to when using this material. Additionally, fumigation is generally only effective when soil is moist. Therefore, fumigation is restricted to late winter and spring or following irrigation. Nonetheless, aluminum phosphide fumigation is a very valuable part of an IPM program for controlling gophers and ground squirrels; its continued availability to growers is needed to maximize control efforts in many situations.

Unfortunately, recent changes in aluminum phosphide labels have been implemented due to the gross misuse of this product that led to the death of two young girls in Utah. These changes include the following:

1. Use is strictly prohibited around all residential areas, including single and multi-family residential properties, nursing homes, schools (except athletic fields, where use may continue), day care facilities, and hospitals.
2. The products must only be used outdoors for the control of burrowing pests, and are for the use on agricultural areas, orchards, non-crop areas (such as pasture and rangeland), golf courses, athletic fields, parks, and other non-residential institutional or industrial sites.
3. Products must not be applied in a burrow system that is within 100 feet of a building that is or may be occupied by people or domestic animals. This buffer zone for treatment around non-residential buildings that could be occupied by people or animals has been increased from 15 to 100 feet.
4. When this product is used in athletic fields or parks, the applicator must post a sign at entrances to the treatment site containing the signal word DANGER/PELIGRO, skull and crossbones, the words: DO NOT ENTER/NO ENTRE, FIELD NOT FOR USE, the name and EPA registration number of the fumigant, and a 24-hour emergency response number. Signs may be removed 2 days after the final treatment.
5. When this product is used out of doors in a site frequented by people, other than an athletic field or park (such as agricultural fields), the applicator shall post a sign at the application site containing the signal word DANGER/PELIGRO, skull and crossbones, the name and EPA registration number of the fumigant, and a 24-hour emergency response number. Signs may be removed 2 days after the final treatment.

Because of these changes, I have developed a questionnaire designed to develop accurate facts on various methods, including fumigation with aluminum phosphide, for controlling burrowing mammals in California. The information will be provided to registrants, the U.S. EPA, and others to help develop use policies, labels, etc. My primary objectives are to:

1. Identify the level of use of aluminum phosphide for various burrowing mammals in agricultural areas prior to the new aluminum phosphide label restrictions.
2. Identify how new aluminum phosphide label restrictions will alter use of a variety of control methods.
3. Identify the potential impact of the new aluminum phosphide label restrictions on burrowing mammal populations.
4. See if there is support to further increase safety for residents and other public bystanders by requiring a new Certified Applicator Category for use of aluminum phosphide fumigants for burrowing pest control IF such a category would ease restrictions set forth in the most recent aluminum phosphide labels.

The data collected should provide a much clearer picture of use patterns and importance of several methods, including aluminum phosphide, for controlling agricultural populations of burrowing pests in California. The survey can be accessed at the following web address: http://ucanr.org/sites/AluminumPhosphideSurvey/

Two surveys are found at this website; one is for agricultural users, the other is for rodent control professionals who control burrowing mammals in urban/residential areas. Be sure you complete the appropriate survey. Once completed, the survey can either be: 1) saved and e-mailed to me, or 2) mailed to me via USPS. My e-mail address, mailing address, and phone number are provided at the end of this article. If you do not have internet access or have problems accessing the survey on-line, give me a call or send a letter and I will mail a copy of the survey to you.

I must emphasize the importance of your participation in this survey if you use aluminum phosphide for burrowing mammal control. Data needs to be collected and subsequent results provided to the pertinent regulatory agencies to show the importance of aluminum phosphide for burrowing mammal control. Otherwise, there is a real possibility that we may completely lose aluminum phosphide for burrowing mammal control.

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Herbicide-Resistant Weeds in California Tree and Vine Crops - Manager Perception Survey

Brad Hanson, UC Davis Cooperative Extension Weed Specialist

Purpose of the Survey

The goal of this survey is to determine grower, applicator, and pest control advisor perceptions and experiences related to herbicide-resistant weeds in perennial cropping systems. This research is being conducted as a part of a larger project (Evolution and Management of Herbicide Resistant Weeds) which involves several UC Davis, UC Cooperative Extension, and Fresno State University faculty.

Methods

We need your help to conduct a survey of at least 1,000 weed managers who work in California orchards and vineyards. In late 2010 and early 2011 we used a series of in-person surveys at grower meetings. To expand upon that technique, we developed this web-based survey which has a similar format and will be open from June 2011 through February 2012. Participation is voluntary, all data will be collected anonymously, and no personally identifying information will be kept or shared.

The survey is online at: http://ucanr.org/hrwsurvey. The survey, which should only a few minutes to complete, includes a series of simple questions to gauge:

1. Demographics (respondent farming system, approximate acreage, and region)
2. Weed control practices used
3. Experience and concerns with herbicide resistant weeds

Impact on Weed Management

Once complete, the results of the survey will be presented to scientific and extension audiences and will be used to help develop future research directions and extension education programs to benefit growers and pest managers. Compared to annual cropping systems in other parts of the country, there has been very little research on understanding the production impacts, economic consequences, or management changes imposed by herbicide resistant weeds in the unique perennial cropping systems in California.

Drawing for Weed and Crop Production Books
After the survey is completed in February 2012, we will draw the names of 15 participants to receive their choice of several UC Publications related to weeds, integrated pest management, or tree and vine crop production. These high quality publications are 150-250 pages and are usually sold for $20-$80.

To participate in the drawing after completing the survey, you will have the option to go to another webpage where you can enter your name and contact information for the drawing as well as your preferred UC book. This information will not be directly associated with the survey responses to preserve anonymity. Thank you for your participation.

Using Leaf Tissue Analysis for Almond Nutrition

Carolyn DeBuse, Farm Advisor, Solano/Yolo Counties

July is the month to test the nutrient status of orchards with leaf tissue analysis. It is easy to do and gives you a tool to track changes in your orchard's nutrient status from year to year and directs changes in fertilization programs to maximize tree health and reduce the possibility of over fertilization. July tissue sampling is preferred for orchard nutrition because published critical values are based upon leaves sampled in July.

In the Sacramento Valley the nutrients most likely to show deficiency are the macronutrients nitrogen (N) and potassium (K) and micronutrients boron (B) and zinc (Zn). Macronutrients are elements used in large quantities by plants for growth and development while micronutrients are used in small quantities. Excessive amounts of chloride, sodium and possibly boron, depending upon location, should also be monitored if water quality is poor and/or chloride is a component of the fertilizers frequently used in the orchard. Most laboratories group these nutrient analyses together with the other nutrients in one easily requested procedure. Note that if micronutrients have been applied in a foliar spray, leaf analysis will excessively high and the reported levels should be disregarded.

Collecting procedures:

- Divide the orchards into blocks with each block uniform in soil type, location, age of tree, and variety (Sampling varieties separately is optional. There is relatively little nutritional difference between varieties although some display deficiency symptoms more readily than others).
- Collect samples across the block in a pattern that can be repeated from year to year and is representative of the whole block (every fourth tree /every fourth row or down one row and back on another that is at least 200-400 feet away). Collecting from the same trees every year creates a better year to year comparison.
- Take one leaf from each selected tree; collect leaves from 80-100 trees.
- Leaves should be fully expanded and mature taken from a non-fruiting spur at about 5-6 feet in height.
- Avoid collecting from sick, injured or stunted trees unless the sample is specifically for diagnostic purposes. If such collections are made, make sure to keep them separate from healthy tree samples.

- Place the leaf sample in a paper bag. Store the leaf sample in a cooler and away from the sun to avoid heat. Be sure that they are not wet when collected or become wet in the cooler.
- Mark each sample with identifying information. (Name of grower, block, variety, date and anything else requested by the lab)
- Send or deliver samples to the lab as quickly as possible.

Contact information of agricultural laboratories can be requested from your local UCCE office.

Table 1 shows the critical values for July leaf samples and is useful to evaluate lab results. Keep the results with your fertilizer application records to better evaluate and estimate future fertilization needs.

Nutrient	Deficient	Adequate	Excessive over
Nitrogen (%)	< 2.0	2.2-2.5	
Phosphorous (P) %		0.1-0.3	
Potassium (K)%	< 1.0	> 1.4	
Calcium (Ca) %		> 2.0	
Zinc (Zn) ppm	< 15		
Manganese (Mn) ppm		> 20	
Copper (Cu) ppm		> 4	
Magnesium (Mg)%		> 0.25	
Sodium (Na)%			> 0.25
Chlorine (Cl)%			> 0.3
Boron (B) ppm	< 30	30-65	> 300
Iron (Fe) ppm		100	

Table 1. Critical levels of nutrients in almond leaf samples (Almond Production Manual; UC pub. #3364).

Understanding and applying information from a Soil Test: Salinity

Allan Fulton, UC Farm Advisor, Tehama County

This is the final article on soil testing. The specific topics discussed in the five previous articles are summarized below and can be reviewed at UCCE county websites. Tehama County website is located at http://www.cetehama.ucdavis.edu. Select UCCE Tehama, orchard crops, Fruit and Nut newsletter then scroll down to each article:

1. General overview of soil testing and the types of information provided from them (May 2009).
2. Interpreting soil pH and Saturation Percentage measurements (April 2010).
3. Primary plant nutrients: Nitrogen (N), Phosphorus (P), and Potassium (K) (July 2010).
4. Secondary plant nutrients: Calcium (Ca), Magnesium (Mg), and Sulfur (S) (November 2010).
5. Plant micronutrients: boron (B), chloride (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni), and zinc (Zn) (April 2011).

The focus of this article is soil testing to diagnose salinity conditions. Soil testing can help diagnose three different types of field conditions that adversely affect orchard performance: 1) osmotic effects caused by excessive root zone salinity; 2) specific ion toxicities resulting from the accumulation of too much boron, chloride, or sodium and 3) soil chemistry properties that can affect soil structure and reduce water infiltration.

Osmotic Effects

Electrical conductivity measured in the saturation soil extract (EC_e) increases as soil salinity increases and is a measure of the osmotic influences on crop growth and yield. Under non-saline soil conditions, the concentration of solutes in plant root cells is higher than in the soil-water surrounding the roots. This gradient allows water to move freely from the soil into the plant root. When soil salinity increases in the soil-water surrounding the root and exceeds a critical threshold, the gradient between the solute concentration in the root cells and the soil-water around the root lessens, causing reduced water availability to plants. In response to increased soil salinity, agricultural crops such as almond internally produce more sugars and organic acids to increase the solute concentrations inside root cells and attempt to re-establish the gradient for water to again move freely into root cells. However, this internal plant process that adjusts for soil salinity competes for energy that would otherwise be used in photosynthesis, thereby, suppressing crop growth and yield. Symptoms of soil salinity are subtle, typically characterized by smaller less vigorous trees with lower productivity.

Table 1 provides guidelines to identify excess salinity in the root zone of almond orchards and the effect on almond yield potential. Salinity is usually expressed as deciseimens per meter (dS/m). Almonds with average rootzone salinity less than 1.5 dS/m would not be expected to affect almond production potential when the leaching fraction is 15 percent or more. Generally, osmotic effects from salinity in soils or irrigation water are uncommon in the Sacramento Valley and more likely to be observed in the San Joaquin Valley.

Table 1. Guidelines to identify excess salinity in orchard soils and water supplies, and their effect on yield potential for mature almond trees.

	Percent of full almond yield potential		
	100 %	99 to 40 %	< 40 %
Average root zone salinity in (dS/m)	< 1.5	1.5 – 4.8	> 4.8

Specific Ion Toxicity

Specific elements such as boron (B), chloride (Cl), and sodium (Na) may accumulate in soil. If these specific elements become overly concentrated in the rootzone, crop injury is expressed first as scorching in older leaves and sometimes stems and shoots die back as concentrations in plant tissues increase. Thresholds for ion toxicity are specific for different crops and specific elements. For almond, thresholds of 5.0 meq Cl/l, 0.5 mg B/l, and an average sodium adsorption ratio (SAR) greater than 5.0 represent rootzone conditions where the onset of specific toxicities may be expected. SAR is a value that describes the balance between sodium versus calcium and magnesium in the soil-water. Using the SAR to diagnose sodium toxicity is preferred to examining only the Na levels in soil because it considers the exchange reactions that are affected by the sodium, calcium, and magnesium balance. The risk of specific ion toxicity is more likely as levels in the rootzone

increase above these thresholds. Severe limitations for planting almonds are expected when Cl, B, and SAR levels exceed 15.0 meq Cl/l, 3.0 mg B/l, and 15.0, respectively.

Slow Water Infiltration

Low salinity and high SAR levels contribute to unstable soil structure. Soil aggregates swell and disperse into individual particles when irrigated. After the applied water recedes, the particles settle: finer textured clay and silt particles fill the pore spaces between larger sand particles to form a slowly permeable surface crust. The salinity of the soil-water (ECe) and the sodicity (SAR) of the soil-water must be considered together to assess the extent that salinity is contributing to a water infiltration problem. As a general rule, if the SAR of the soil-water is 10 times greater than the EC the probability of slow water infiltration developing is high. If the SAR is 5 to 10 times higher than the EC there is a possibility that salinity is contributing to an infiltration problem but other factors may be more significant. When the SAR is less than 5 times higher than the EC, it is unlikely that salinity is contributing to slow water infiltration.

Some scientific evidence suggests that magnesium can contribute to soil dispersion when it is predominant in a soil. The above guidelines do not address soils where sodium is low but magnesium (Mg) is relatively high in comparison to calcium (Ca). As a general rule, when Mg levels in a soil-water extract exceed a 1:1 ratio to calcium, soils may develop infiltration problems.

Help needed for grad student in carbon use/ storage in almond production

A grad student at UC Davis is working on a project funded by the Almond Board of California evaluating energy use and carbon sequestration in almond orchards. He needs to collect data regarding equipment use for various operations, pesticide and fertilizer use, crop yields, and biomass accumulation in almond trees.

If you are interested in sharing equipment use, yield data, and tree size data and so help the Almond Board look at energy use and carbon storage in almond orchards, please call or e-mail me and I'll put you in touch with the graduate student at Davis. He is looking for your help.