Sacramento Valley Walnut News

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In This Issue

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Fall Walnut Orchard Considerations

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September:

Ethephon: If you use an ethephon spray program, target sprays on Chandler for when the hulls achieve 100% packing tissue brown (PTB), which is typically around mid-September. See the Sacramento Valley Orchard Source for more information: sacvalleyorchards.com/walnuts/ethephon-for-earlier-harvest/

Harvest Quality Considerations: Before harvest look for oilless nuts, which have white kernels and very dark pellicles (skin). These nuts often split and drop before healthy nuts, and can be destroyed when preparing the orchard floor for harvest. Aiming to harvest as early as possible can assist in reducing quality losses due to navel orangeworm, mold infestation, and darkening kernel color. At harvest, only shake what you can pick up that same day. Walnut quality declines most rapidly during the first 9 hours after shaking. Finally, once harvest is complete clean hullers and driers of trash nuts that may be harboring moth larvae.

Hardening off young trees: The nitrogen fertilizer program for all walnut trees should be wrapped up by the end of August, however this is particularly critical for hardening off young trees for the winter (Photo 1). To reduce the possibility of autumn frost damage, aim to cut off irrigation for young trees by mid-September to reduce growth and harden off the trees. Look to hold off on irrigation until a terminal vegetative bud has formed on the trunk (Photo 2).

2018 UCCE Winter Walnut Meetings

January 31st Time TBA	**Butte-Glenn Walnut Meeting** Chico - Location TBA
February 2nd Time TBA	**Tehama County Walnut Meeting** Red Bluff - Location TBA
February 22nd 12:30pm-4:30pm	**Sutter-Yuba-Colusa Walnut Day** Yuba City - Veterans Memorial Hall
March 6th 8:00am-12:00pm	**Yolo-Solano-Sacramento Walnut Mtg** Woodland - 70 Cottonwood Street

Photo 1. New, vigorous growth on young trees is especially sensitive to frost injury. Photo by Janine Hasey.

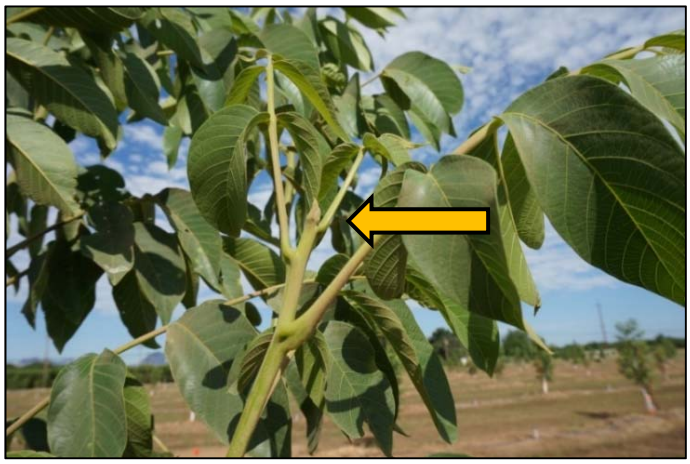

Photo 2. Withhold irrigation until a terminal vegetative bud sets on trunk. Photo by Janine Hasey.

Harvest Sample: Take harvest samples from the orchard floor to later inspect for worm damage and differentiate between codling moth and navel orangeworm (diagnostic crescent-shaped marking). Grade sheets only list percent insect damage. Performing a crack out of a representative collection of nuts from each production block tells a helpful story. Nuts may also be damaged by ants, walnut husk fly and sunburn. For more information please see the Sacramento Valley Orchard Source website: www.sacvalleyorchards.com/walnuts

October:

Prepping for cover crops: It is critical for any fall cover crop planting to be planned early, ensuring the correct seeding time by lining up seed and equipment before you are too deep into walnut harvest. Planting typically takes place in October and November, with young non-bearing orchards being seeded in October. In producing orchards, plan to seed just after harvest but before significant leaf fall for best stand establishment.

Fertilizer: If July leaf sampling indicated potassium deficiency, plan to apply potassium (K_2O) fertilizer in the fall. Apply potassium in a narrow band along the tree row in order to improve uptake efficiency, particularly on heavier soils. Information on potassium fertilizer forms and rates can be found at: apps.cdfa.ca.gov/frep/docs/Walnut.html

Time pruning to reduce *Botryosphaeria/Phomopsis* (BOT) infection: Often in August, black to dark brown lesions (the blight phase) start appearing on the hull from earlier, latent (symptomless) infections of the nut (Photo 3). *Botryosphaeria* can also cause cankers which can result from pruning wound infections and infections that move from blighted fruit or leaf scars into the spurs. In research conducted by Themis Michailides, UC Davis Plant Pathologist at the Kearney Agricultural Research and Extension Center, winter pruning (February 9-10) resulted in higher infection rates than fall pruning (October 27-28).

- Dr. Michailides found in 2015 that when pruning in February, wounds in medium-to-large wood (3- and 4- year old branches) are susceptible to *Botryosphaeria* infection for at least **four months after the pruning cut is made**.

- Pruning wound infection rates were compared for winter vs. fall pruning. Pruning cuts were made in either February or October 2015, inoculated with *Botryosphaeria* spores, and evaluated over a year later (March 2016 and November 2016, respectively) for infection.
- **Winter pruning** resulted in infection rates (cankers in shoots) from 78 to 99 percent compared to 28 to 75 percent in **fall pruned** shoots.
- Higher infection rates were seen in three- and four-year old wood compared to one- and two-year old wood, confirming 2015 results of longer cankers in older wood. It is suspected that the hollow pith inside older walnut branches provides a haven for *Botryosphaeria* infection and spore germination and pathogen growth since the pith holds water as a sponge.
- Therefore, if pruning or hedging is planned this year, aim for as early in fall as you can and when weather is forecast to be dry. Deadwood removal however, is best done through the dry summer months.

Photo 3.
Blighted fruit caused by BOT showing pycnidia in early September.
Photo by Themis Michailides.

November:

Sanitation for navel orangeworm (NOW): Keep in mind that the thicker shell of walnuts offers overwintering NOW more protection than the softer shell of almonds. There is less natural mortality in walnuts, even in wet years, and mowing or discing walnut mummies should always be done regardless of weather conditions. Remember that winter sanitation mummy removal and destruction objectives for NOW are two-fold: (1) Increase direct mortality of the overwintering generation, and (2) Reduce oviposition and development sites for early generations the following growing season to minimize population build-up.

Weed Management: A postharvest weed survey (ideally after first fall rains) allows you to identify weeds that have escaped your control program this season, as well as newly emerging winter weeds. The weed survey form and weed identification links are at: ipm.ucanr.edu/PMG/C881/m881dcweeds.html. Apply pre-emergent herbicides for winter weed control mid- to late fall. Watch the weather and apply shortly before rainfall so that rain will move the herbicide into the soil before seedlings emerge.

End of Season Flooded Orchard Damage Update

Janine Hasey, UCCE Farm Advisor, Sutter, Yuba, Colusa Counties
Greg Browne, USDA Plant Pathologist, UC Davis

This article briefly reviews our observations since early June in orchards either directly flooded in the river bottoms or those indirectly flooded with standing water for months via under-levee seepage. The two previous articles on the flooded orchard situation can be viewed at www.sacvalleyorchards.com/walnuts.

Observations

- A young Chandler orchard on RX1 clonal Paradox rootstock where a third of the orchard had seepage from January to early May (Photo 1), still had water at a fairly shallow depth in early August (Photo 2). Most Chandler trees were still struggling (Photo 3) whereas the rootstock was growing vigorously on trees where spring grafts had failed (Photo 4). We are studying the effects of waterlogging (anoxia) on roots in this orchard.
- By the end of June and continuing through the summer, walnut trees in several orchards flooded with seepage were producing shoots from adventitious buds (Photo 5). These latent buds normally are "quiescent" yet can "wake up" and sprout when needed from many plant parts (trunks, limbs, or roots).
- Many trees also produced suckers from the rootstock (black, seedling and clonal Paradox) where the English scion was showing some symptoms of waterlogging (sparse shoot growth, small, yellow leaves) to total collapse (Photo 6). Counter to our usual recommendation to remove suckers, we recommended leaving them to produce carbohydrate for root regeneration.
- We identified several *Phytophthora* species from bleeding root and aerial trunk cankers first noticed around mid-May in river bottoms where walnut trees were partially submerged for prolonged periods. In early August, we sampled aerial cankers from a river bottom orchard where every tree appears to have some infection with minor to severe bleeding symptoms (Photos 7 & 8).
- We will be back hoeing affected trees in several orchards at the end of summer to determine effects from waterlogging and/or Phytophthora by examining roots and crowns to look for patterns of root regeneration.

Keep in mind there are likely to be effects seen next year and in subsequent years. It is unknown whether trees that regenerated new shoot growth this summer will fully recover. Growers planning to file claims for Farm Service Agency programs who have not had tree losses assessed yet should contact their local office as soon as the loss becomes apparent.

Photo 1. View of young Chandler orchard on RX1 rootstock from the Sacramento River levee on June 29, 2017. Photo by Luke Milliron

Photo 2. On August 3, 2017, the water level was just under 3 feet deep, but the soil was wet to within 15 inches below the surface from capillary rise. Photo by Janine Hasey.

Photo 3. Most Chandler trees had very little new shoot growth in early August. Photo by Janine Hasey.

Photo 4. Where grafts had failed, the RX1 clonal Paradox rootstock grew vigorously.
Photo by Janine Hasey.

Photo 5. A shoot from an adventitious bud in a Chandler limb on June 29, 2017 in the Meridian Basin.
Photo by Luke Milliron.

Photo 6. Black rootstock suckering in a Chandler orchard flooded for 4 months next to the Feather River levee in Sutter Co. Photo by Luke Milliron.

Photos 7 & 8. Bleeding cankers associated with aerial *Phytophthora* on river bottom walnut trees on August 8, 2017. In right photo after bark removal, note the margin between healthy and diseased tissue where the canker is advancing. Photos by Janine Hasey.

Considerations for Replanting a Walnut Orchard

Katherine Pope, UCCE Orchard Advisor – Sacramento, Solano & Yolo Counties

As orchards age, yields decline for a number of reasons and eventually the decision is made to remove the orchard. The age at which an orchard is pulled is a unique decision for each block, depending on yield, price, demand, and resources. There are a number of recommended steps in removing an orchard, especially when preparing to replant that orchard into walnuts again.

Getting a walnut orchard off to a good start is essential considering the investment cost required to develop a new orchard. If you are removing an existing walnut orchard that will be replanted, it's a good idea to plan for an 18 to 24 month transition between orchard removal and planting new trees. Trying to rush the operation creates several opportunities for a less satisfactory outcome. When replanting a walnut orchard, first figure out what carry-over problems you'll need to deal with from the last orchard. Use this information to figure out whether to fumigate and with what product, what to plant during the fallow period and what rootstock to select for your future orchard.

1. Assess potential carry-over problems before harvest.

There are a few problems that may carry over from an old walnut orchard to a new one planted on the same ground if preventative or corrective steps are not taken: the walnut replant problem, nematodes and crown gall.

The walnut replant problem, sometimes called the rejection component, is not linked to any one pathogen. There are a variety of biota that build up in the soil, feeding on the roots of mature walnut trees. These populations will hinder the growth of young walnut trees when they are replanted into the same soil. Killing the roots of the old orchard and rotating in a non-walnut crop for a year is effective at addressing this problem.

The root-lesion nematode of concern in California is *Pratylenchus vulnus.* English walnut, seedling Paradox hybrid, and black walnut rootstock are all highly susceptible, with each root tip capable of supporting thousands of nematodes per gram of root. Any previous tree crop planting is likely to have hosted *P. vulnus*. Retired UCCE Nematode Specialist Mike McHenry estimated 85% of walnut orchards have nematode levels that are too high to replant without taking some measures to address them. To sample for nematodes, take a number of soil core samples down to 36 inches across the orchard. For more sampling details and other nematode management information, see http://ipm.ucanr.edu/PMG/r881200111.html or speak with the lab to which you'll be sending your samples.

Crown gall, caused by the bacterium *Agrobacterium tumefaciens*, can be a serious problem in some old orchards. Inoculum built up in the soil can infect through wounds or natural openings (e.g. where lateral roots develop). Once *A. tumefaciens* is introduced into a field site it has the ability to survive for at least 2 years in the orchard soil and at least 1.5 years in non-irrigated fallow soil, and still induce crown gall formation. Research found chloropicrin and 1,3-dichloropropene together in Telone® C-35 dramatically reduced *A. tumefaciens* populations in soil, but not in buried gall tissue. When applied alone, 1,3-dichloropropene (Telone® II) was not effective at controlling *A. tumefaciens*. In sites with a history of high crown gall incidence, fumigation with Telone® C-35 followed by chloropicrin combined with extensive gall removal from the soil should be considered. For more on preventing crown gall, see http://www.sacvalleyorchards.com/walnuts/diseases-walnuts/preventing-crown-gall/.

2. Kill the roots of the old orchard.

In decades past, methyl bromide fumigation could be relied upon to kill old roots and any nematodes in them, along with other pests and diseases in the soil. Fumigants that are currently available can address nematodes and some pathogens in the soil, but they are not good at killing old roots or anything living in them or feeding on them (i.e. nematodes, walnut replant problem biota). To accomplish this, an herbicide is necessary. During the month of **October** (some leaves should still be on the tree, but you can wait until after harvest), cut trees a few feet above the ground and **within 5 minutes** paint the stump with straight undiluted Garlon3A or a 1: 3 mixture of Garlon3A and MorAct or equivalent surfactant. Leave painted stumps in place for at least 60 days. This time is necessary to allow herbicide to fully circulate and kill as many roots as possible. For more on this approach, see UCCE Nematologist Emeritus, Dr. Michael McKenry's "Guidelines for replanting walnuts" http://ucanr.edu/datastoreFiles/391-53.pdf.

3. Wait a full growing season before replanting walnuts.

If fumigation is deemed necessary, based on nematode and/or crown gall pressure, a fallow period is critical to dry down the soil to 12% moisture, the level necessary for optimal fumigant efficacy. Fumigants move through air, not water. Soil aggregates with films of liquid can act as a secret hideout for the nematode you've paid so much money to try to kill. For most of the finer textured soils in the Sacramento Valley, a spring-summer crop of Sudan grass or safflower may be needed to pull out deep soil moisture. These crops also have

the benefit of decreasing nematode populations. Ripping and reworking the soil in the summer can also dry down the soil, but is not always sufficient.

An approach which has been applied in strawberries and is currently being tried in almonds is Anaerobic Soil Disinfestation or ASD. This alternative to fumigation is generally done in the sunny summer months after an orchard is removed. The soil surface is covered in plastic and soil microbes are encouraged to deplete the oxygen enough to create a toxic environment for undesirable microbes. The approach has not yet been tested in walnuts, but may show promise in the future. Research is ongoing.

4. Fumigate, if necessary.

Prepare soil for the new orchard planting as much as possible before fumigation. This will allow for more even delivery of soil fumigants, and minimize disturbing the soil you've spent good money to sanitize and reintroducing undesirable biota from below the fumigated soil zone. For more on orchard soil preparation, see http://www.sacvalleyorchards.com/walnuts/horticulture-walnuts/orchard-soil-preparation/.

Successful fumigation requires soil that is warm (above 55°F at one foot depth) and dry (ideally 12% moisture). For this reason, fumigation is generally done between August and November. The choice of fumigant will depend on the assessment of carry-over problems from the previous orchard. Telone II (1,3 dichloropropene) is a nematacide. It has been shown to be very effective at killing nematodes. It is not, however, effective alone at controlling crown gall. Work done on Prunus Replant Disease would indicate Telone II alone would also not be effective against the walnut replant problem. Chloropicrin and 1,3-dichloropropene together in Telone® C-35 will target nematodes and *A. tumefaciens*.

5. Replant an appropriate rootstock.

Clonal Paradox rootstocks have different strengths and weaknesses. VX211 has shown "some tolerance" to nematodes, whereas RX1 and Vlach are both intolerant of nematodes. It is quite possible that some nematodes will survive in a replant orchard even if the above steps are taken. For this reason, if nematodes were present in the previous orchard, VX211 makes sense as the rootstock of choice for the subsequent orchard. If there was high crown gall pressure, RX1, which showed "moderate resistance" to crown gall, would be a prudent choice. For more information on selecting the right rootstock for an orchard's conditions, see http://www.sacvalleyorchards.com/blog/walnuts-blog/selecting-the-right-clonal-rootstock-for-managing-soil-and-pest-problems/.

Pulling and replanting a walnut orchard presents many challenges and resources. Identifying problems ahead of time and developing a plan of orchard removal, field treatment, potential fumigation and the appropriate rootstock will help ensure a healthy, robust orchard.

Biofumigation Basics

Dani Lightle, UCCE Orchards Advisor, Glenn, Butte & Tehama Cos.
Andreas Westphal, Nematology Specialist, UC Kearney Agriculture Research and Extension Center

Winter cover cropping is a common practice, especially the further north one observes orchards throughout California. One question that frequently comes up in walnuts is how to use cover crops to suppress nematode populations. While there are several strategies employed in annual cropping systems, such as trap

crops or antagonistic plants, biofumigation is the process that has captured the imagination of many growers.

Biofumigation is the process of growth, maceration and incorporation of a cover crop with the goal of releasing compounds that suppress nematodes (and possibly other diseases or weeds). Cover crop species that contain high concentrations of glucosinolates (GSLs) are chosen for this strategy. When the plants are shredded and plant cells are ruptured, a protein called myrosinase is released which reacts with the free GSLs:

GSLs + myrosinase = isothiocynates

One example of isothiocynate, methyl isothiocynate (MITC), is the active ingredient generated from metam sodium formulated as Vapam® (or other products), a soil fumigant. Metam sodium breaks down in soil to produce the MITC that is active against soil-borne pathogens if applied properly. Hypothetically, similar processes occur in biofumigation when the GSLs are broken down.

The practical process of biofumigation is straightforward. A seedbed is prepared and an appropriate cover crop (here: Brassica) is planted and managed to produce a high biomass. Preferably at the beginning of flowering, the cover is shredded to release the GSL and myrosinase, and incorporated into the soil, where the isothiocyanates are released. This process hopefully reduces soil-dwelling nematodes. This appears to be a simple process but there are a lot of knowledge gaps. Some of these include:

- *Cover crop selection and harvest time*: Which crops have the highest levels of GSLs and are not hosting orchard-typical nematode pests?
- *Phytotoxicity risk*: if the isothiocyanates are potent enough to kill nematodes, will they also damage tree roots?
- *Incorporation process*: How should biomass be incorporated without damaging tree roots? Is soil sealing with plastic or irrigation required to achieve an ideal soil moisture and seal?
- *Appropriate site selection*: What aged orchards would benefit the most from biofumigation – pre-plant, nonbearing or mature?

We recently obtained CDFA funding to begin to address some of these questions in walnuts. In the greenhouse, we will be screening brassica species including tillage radish, oilseed radishes, mustards, and marigolds for host status to the key orchard culprits. In 2018, the most promising of these will be planted in replicated trials in Glenn/Butte counties as well as at the Kearney Agricultural Research & Extension Center. We will be evaluating their effects on root knot nematode, root lesion nematode and ring nematode populations in the field, while also monitoring trees for phytotoxicity or positive responses in growth.