Sacramento Valley Almond News
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## In This Issue



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# Post-Harvest Orchard Management Considerations

*Katherine Jarvis-Shean, UCCE Orchard Advisor Yolo, Solano, & Sacramento Cos.*

**OCTOBER**

- ✓ Consider a **fall nutrient spray**. Check hull boron and leaf zinc results to help determine if a foliar spray of either nutrient is needed. Boron is deficient if hull content is below 80 ppm. Zinc is deficient if July leaf samples read below 15 ppm. More on rates and additional considerations at sacvalleyorchards.com/almonds/horticulture/postharvest-nutrition-review/.
- ✓ Watch for **shot hole fruiting structures in leaf lesions** after fall rains begin. If fruiting structures producing spores are present in leaf lesions in the fall, there is a greater risk of shot hole development the following spring. If foliar zinc sulfate fertilizer is applied in late October or early November as part of a nutrient program and that hastens leaf fall it may reduce shot hole inoculum. For more, see ipm.ucanr.edu/PMG/r3100211.html.
- ✓ Survey for **stick-tights**/mummy nuts. Nuts stuck to the tree well after harvest may indicate hull rot. In certain areas, this could also be a result of high boron. If hull rot is indicated, make a note to reconsider irrigation and nitrogen management practices next year. If more than 2 nuts per tree remain, plan to knock off and destroy mummies by February 1st to reduce navel orangeworm and brown rot. When mummy nuts are on the ground, check for NOW infestation. This rate of infestation can help inform your NOW management next year. See the article on sanitation in this newsletter for more details.
- ✓ If **rust infection** was heavy this year, consider a foliar zinc sulfate fertilizer spray to get zinc into the trees as the leaves start to naturally drop. This will also hasten leaf fall and reduce infected leaf carry over into next season. Wait until late October or early November to allow leaves time to continue making photosynthate and build up energy storage in the trees after harvest. See sacvalleyorchards.com/almonds/foliar-diseases/leaf-rust-of-almond/ for more details.
- ✓ Scout for **weeds** after the first fall rains. Look for late summer weeds that escaped this year's control and winter annual weeds that are just emerging. Find tips, and links to map and weed ID tools at sacvalleyorchards.com/almonds/weed-control/post-harvest-weed-scouting/.

- ✓ If planting a **cover crop** to improve soil, provide pollen to bees, and/or reduce runoff, get it in the ground by the end of October for best stand establishment. A good stand of resident vegetation provides many of the same benefits. For information on cover crop seed selection visit: sacvalleyorchards.com/almonds/horticulture/cover-crop-seed-selection/.

**NOVEMBER**

- ✓ Apply **banded potassium** to the soil if that is part of your fertility management plan. For every 1,000 lbs of almond kernels harvested there are 80 lbs of potassium removed from the orchard or captured in new growth. See further details here: sacvalleyorchards.com/almonds/horticulture/potassium-management-for-sustained-almond-yields/.
- ✓ Avoid **pruning** ahead of forecasted rain. Disease spores are spread in rain events and pruning wounds are entry points for infection. Topsin-M can guard pruning wounds against infection from wood canker pathogens such as *Botryosphaeria* and *Cytospora*. Research on how to prevent pruning wound infections is at sacvalleyorchards.com/almonds/trunk-soil-diseases/pruning-wound-protection/.
- ✓ Sample **dormant spurs for scale and mite eggs** and check green shoots for scab lesions between mid-November and mid-January. Collect a total of 100 spurs from 35-50 trees, randomly selected from each orchard. Details for examining spurs and making treatment decisions can be found at ipm.ucanr.edu/PMG/r3900211.html.
- ✓ Evaluate stored **harvest samples**. Grab those harvest samples from your freezer or fridge, now that harvests have quieted down, and sort through to evaluate sources of damage and how your IPM program could be improved for next year. Try the handy chart here to differentiate causes of damage: sacvalleyorchards.com/almonds/insects-mites/harvest-samples-for-almond-crop/.
- ✓ Order 2-3 **honey bee hives** per acre for standard orchards, or 0.5-1 hives per acre in self-fruitful orchards. Make sure you have a written contract with your beekeeper that outlines the expectations of each party. Information on colony strength and grower and beekeeper responsibilities at: sacvalleyorchards.com/almonds/pollination/honeybees-colony-strength-and-beekeeper-challenges/.

**DECEMBER**

- ✓ Now that leaves are off the trees and mummies are easier to see, recheck your mummy count and update your plan for knocking and destroying mummies by February 1st.
- ✓ Check out the new online UC Air Blast Calibration Course while it's still free to round out your CE credits for the year. To access the course visit https://campus.extension.org/course/view.php?id=1787. You'll need to create an account through extension.org before taking the course, but there is no charge to do so.

## Orchard sanitation is key to a quality crop

*Franz Niederholzer, UCCE Farm Advisor, Colusa and Sutter/Yuba Counties*

Navel orangeworm (NOW) is the key pest of almonds, causing more income loss due to reject nuts than any other pest. Pesticide sprays, alone, cannot control this pest. A combination of several specific practices has been proven to reduce NOW damage and limit loss of grower income. These practices are winter sanitation, timely harvest and pesticide sprays (where needed). Mating disruption is an additional option that is seeing increasing adoption. The first of these practices on the orchard calendar is sanitation.

Navel orangeworm find food and shelter in unharvested ("mummy") nuts through the winter and spring, making those mummies a bridge of trouble from one year to the next in your orchard. Multiple research studies show that NOW damage increases with increasing mummy counts the previous winter. Destroying mummy nuts is the first step towards a cleaner crop and improved grower returns through quality incentives from processors. The goal of orchard sanitation is to turn that "NOW bridge" from a four-lane highway (no sanitation at all) into a narrow footbridge.

Orchard sanitation is practiced by removing mummy nuts from the trees by February 1 and destroying (flail mow or disc) all nuts on the orchard floor no later than March 1st. In light of the expected reduced nut price for the 2020 crop, some growers may consider eliminating this key step in NOW management to "save money". This is a risky move. The Sacramento Valley 2021 crop has a good chance to be lighter than the record 2020 crop resulting in 1) fewer nuts/tree and so higher % damage even if NOW populations stay the same and 2) larger nuts, on average, with the potential for poor shell seal and greater risk of NOW damage. Don't play Navel Orangeworm Russian Roulette with your next crop. Sanitize.

The following steps are needed for effective orchard sanitation:

- Before January 15, scout an orchard and count mummy nuts in 20 trees per acre. Include all varieties in this count.
- If average number of mummy nuts/tree exceeds 2, sanitation is recommended. The <2 mummies per tree target was developed in the early 1980's, when industry average NOW damage was around 3.5%, much higher than today's range of 1.3%. In the high pressure area of the southern San Joaquin Valley, the recommendation is to limit mummies to 1 per 5 trees (0.2 nuts/tree) and 8 or fewer mummies on the ground per Nonpareil tree, based on research from in 2003-2006 in Kern County. However, in 2019, northern California had higher % rejects level than the "high pressure" south San Joaquin Valley. Simply put, the fewer mummy nuts in an orchard, the lower NOW pressure at the start of the season.
- To sanitize, shake trees to remove nuts by January 31. Shaking can remove flower buds as they begin to swell and gain weight in late January/early February. Unless it is an early bloom season and buds begin to swell ahead of normal timing, shaking can be done into early February without reducing yield. Some buds are removed by shaking in early February, but since only 25% flower set = good commercial crop, some bud loss does not mean less crop at harvest. Some growers hand poll after shaking if too many nuts remain.
- Sweep downed nuts into windrows and mow or disc by March 1. Mow slowly (2 MPH) and check for intact nuts after mowing. If some nuts remain intact, mow again. NOW can survive if the nut is intact.

**Final thought.** NOW overwinter in almond, walnut and pistachio mummies. NOW are also strong flyers, traveling at least a quarter of a mile to lay eggs. If you sanitize, but your neighbor(s) don't, your orchard is at risk from NOW damage due to mated female moths, ready to lay eggs, flying over from the neighbors. Talk with your neighbors about sanitizing all orchards in the area and removing seedling "wild" almonds along fence lines as these can harbor NOW, too.

# Almond Leaf Scorch

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*Original article "Almond Leaf Scorch" in Western Fruit Grower (2013) by Joe Connell, UCCE Farm Advisor Emeritus, Franz Niederholzer, UCCE Orchards Advisor Sutter, Yuba, and Colusa Counties, Brent Holtz, UCCE Farm Advisor, San Joaquin County, and Beth Teviotdale, UCCE Plant Pathologist Emerita*

Figure 1. Almond leaf scorch symptoms in mid-July 2020.

Beginning in late June, several PCAs and growers reported trees in almond orchards in the Sacramento Valley with symptoms like those of almond leaf scorch (ALS), a disease caused by the bacterium *Xylella fastidiosa*. This is the same bacteria that causes Pierce's disease in grapes. In addition, ALS symptoms appeared far more widespread and severe at the Regional Almond Variety Trial at the California State University, Chico Farm where the disease was first confirmed in 2018 after appearing on only a handful of trees. UC farm advisors working with UC and USDA plant pathologists have begun a survey to confirm disease presence and improve understanding of the disease in the Sacramento Valley.

The disease has been present in California for over 70 years, and in recent years has only been periodically a widespread issue. However, the increased prevalence this year brings new concerns. Firstly, warmer summer and winter temperatures can increase disease prevalence, and there is a concern that this could move from a minor issue for the industry to a potentially serious problem as the climate changes. In addition, USDA researchers previously showed that rootstock susceptibility to the disease varies. They showed that Nemaguard had resistance to infection, isolating ALS infections to the scion and eventually

leading to disease remission. Nemaguard although widely planted in the San Joaquin is not widely planted or adapted for the Sacramento Valley. Since that work, the Sacramento Valley has become heavily reliant on Krysmk 86, which is untested as a *Xylella fastidiosa* host. Finally, different types of *Xylella fastidiosa* have very different biology. There is some data showing one type (*multiplex* subspecies) in the Sacramento Valley and another type (*fastidiosa* subspecies) isolated in the San Joaquin Valley. Due to differences in strain, it is possible that varietal selection and breeding efforts, as well as other disease management measures will have to be distinct in the Sacramento Valley.

**Symptoms**

The bacteria live in the xylem, the water transporting structures in plants, and reduce the flow of water to leaves. Leaf tissue dies when xylem plugging results in insufficient water arriving at the leaf margins. Almond leaf scorch symptoms first appear on individual leaves in early June to mid-July. The leaf tips or margins initially turn light green or yellow (chlorotic), with brown scorching occurring with the onset of hot weather (figure 1). By late July, symptoms are fully developed and are most noticeable (figure 2).

Figure 2. Severe scorching by late season (September 2019, symptoms on Wood Colony).

Figure 3. Severe scorching throughout the canopy of a Wood Colony replant in 2019.

Scorch symptoms may first appear in a single branch, scaffold, or portion of the tree, but can subsequently spread to affect the entire tree. The rate of symptom spread from when first visible to infecting the entire tree can occur slowly over several years, or relatively fast, infecting the entire tree from one season to the next. It may be easily overlooked when only a few leaves on one branch are affected. Almond leaf scorch is also known as Golden Death because of the striking yellow and brown color of a fully infected tree's canopy (figure 3).


Figure 4. Almond leaf scorch symptoms contrasted with salt burn symptoms (figure by Dr. Florent Trouillas, UCCE Plant Pathologist, Kearney Ag Center).

If you suspect that a tree may be infected, first test its leaf tissue for excess toxic salts, particularly chloride and sodium. Salt injury, particularly chloride burn, may be mistaken for almond leaf scorch. Sometimes the two are indistinguishable. With salt damage, there is usually just healthy, green tissue and dead, brown tissue without the yellow margin between the healthy and dead tissue. Salt injury may occur at any time but often worsens as the growing season progresses (figure 4). Ordinarily it is a result of excess chloride and/or sodium in soil or water. Unlike almond leaf scorch, salt injury affects numerous trees in a concentrated area rather than individual trees widely scattered throughout an orchard. Salt damage also usually effects the entire tree, not individual branches as ALS can.

If leaf sodium and chloride levels are normal you may wish to have the tree tested for leaf scorch. The best time to test for almond leaf scorch is July through September.

The same testing practices and labs that can detect *Xylella fastidiosa* in grapes can be used for testing almond leaves for ALS. The cost per sample runs from approximately $150-400 depending on the lab and the number of tests run.

Foliar ALS symptom development patterns over time further complicate disease identification. The classic understanding of the disease is that within a few years affected trees lose vigor, become unproductive, and may eventually die. This assumes that ALS infects more of the tree with each succeeding year. However, a group of USDA and UC researchers have contrary observations, showing that infected trees do not precipitously decline, but instead have a relatively stable infection that produces a relatively consistent yield decline each year. Thus, do not rule out ALS as a cause of symptoms just because tree decline is not precipitous or dramatic.

It is important to identify and mark affected trees while the scorched areas of the tree canopy contrast clearly with healthy green leaves. Once harvest begins, mites, dust, and drought stress combined with tree shaking often make signs of almond leaf scorch more difficult to detect.

**Variety susceptibility**
Older reporting noted that varieties that appear more susceptible in the field include Peerless, Sonora, Winters, Livingston, and Wood Colony. In 2020, ALS symptoms in Monterey were observed in the Northern Sacramento Valley and are being tested for the disease. Nonpareil is also susceptible and can be significantly affected. The disease is rare in Carmel and Butte and is seen less often in other varieties.

**Pathogen and vectors**
ALS presents a potentially serious threat to California almond orchards since it is spread by sharpshooter leafhoppers or spittlebugs which feed in the water conducting xylem vessels of the trees. These insects carry the pathogen from plant to plant. Common annual weeds in the orchard can also be sources of infection. At this time, there is little evidence of tree-to-tree disease spread. Instead, sharpshooters feeding on infected trees infect annual weeds and sharpshooters feeding on the infected annual weeds can infect additional trees in the orchard. Irrigated pasture, weedy grasses, alfalfa, and permanent cover crops are the most common habitat for sharpshooters in almond growing regions of California.

The grass sharpshooter or green sharpshooter (*Draeculacephala minerva)*, is the most common vector of this disease in Sacramento Valley almond orchards according to a 2011 survey by Cooperative Extension specialist Kent Daane and others. Blue-green sharpshooter (*Graphocephala atropunctata*), and glassy-winged sharpshooter (*Homalodisca coagulata*) can also be vectors. The small, green potato leafhopper (Empoasca sp.), prune leafhopper (Edwardsiana prunicola), and the white apple leaf hopper (Typhlocyba pomaria) that commonly feed on almond leaves are not vectors of this disease.

**What to do**
No chemical or nutritional treatments control almond leaf scorch. In addition, no research or practical experience suggests that disease occurrence is reduced by controlling the vectors with insecticides.

In young orchards less than 10 years old, early identification and removal of diseased trees may minimize the problem and reduce further tree losses. If your orchard is 16-20 years old, you may want to simply live with some infected trees until the orchard is removed and replaced. Orchards between 10 and 16 years old are the difficult call – do you remove the infected trees or live with the problem? The answer to this question may depend on what is around the infected block. If infected trees jeopardize a newly planted nearby orchard, then, removing the trees might be the best course.

Pruning out early infections in a single infected scaffold can be successful. However, cuts must be made at least 5 feet below the lowest symptomatic leaves to have any chance to save the rest of the tree. Be sure to mark trees if you attempt to prune out the disease and re-inspect the tree the following year.

## Allan Fulton, Irrigation/Water Advisor Retires

Allan Fulton retired as Irrigation and Water Resources Advisor in Tehama, Glenn, Colusa, and Shasta Counties on June 29, 2020. Allan worked for UC Cooperative Extension in Tehama, Glenn, Colusa, Shasta, and Kings Counties for 32 years. He has worked in both orchard and field crops focusing on water management tools and practices to achieve competitive production and efficient use of water and nutrients. He has also worked to support local efforts to achieve sustainable groundwater management. In retirement, Allan is helping new UC irrigation scientists establish their field research programs while wrapping up a couple unfinished projects of his own. He plans to spend more time with family and have an opportunity to travel.