Walnut Newsletter

Cooperative Extension Butte County

UC CE University of California Agriculture and Natural Resources

Summer 2020

In this issue:

Submitted by:

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View archived newsletter articles at: sacvalleyorchards.com

Advisor Farewell

Emily J. Symmes

As of April 2020, I have decided to make a career change and enter the private sector. It has been a true pleasure and honor serving as the UC Cooperative Extension Area IPM Advisor in the Sacramento Valley and Associate Director of Agriculture for the Statewide IPM Program. Over the past 5+ years with UCCE, I have been privileged to work alongside growers, PCAs, and others in the orchard industry to address pest management issues and share advancements with all of you.

I have now joined the team at Suterra as a Technical Field Manager. In this role, I look forward to continuing my relationships with the agricultural industry in California, as well as the University, to bring effective, economic, and sustainable pest management solutions to our industry. I can be reached at emily.symmes@suterra.com and (530) 227-0189.

Many thanks to all of you for your dedication to agriculture and best wishes for health and prosperity!

Pre-Harvest Walnut Orchard Management

Katherine Jarvis-Shean, UCCE Orchard Advisor, Sacramento, Solano and Yolo Counties
Janine Hasey, UCCE Farm Advisor Emerita, Sutter, Yuba, Colusa Counties
Luke Milliron, UCCE Orchard Advisor, Butte, Glenn, and Tehama Counties

JULY

- ✓ Examine your IPM strategy for the season in light of lean prices. With crop value down, the damage level at which it "pays" to treat may increase. See last year's article on IPM in a lean year for more details: sacvalleyorchards.com/walnuts/cost-and-expense-considerations/cost-saving-strategies-for-insect-mite-management/.
- ✓ Monitor **codling moth** traps to watch for third flight biofix, which comes 1100-1200 degree-days after the second biofix, on average. Based on our late walnut leaf-out this will likely be in early August for most varieties in the Sacramento Valley, but could be in late July, depending on summer temperatures. Check out www2.ipm.ucanr.edu/agriculture/walnut/codling-moth for more on treatment timing and materials.
- ✓ Continue monitoring for **walnut husk fly**, checking traps at least weekly through the summer. Be sure traps are high in the tree on the north side to have meaningful trap information for your treatment decisions. There are about three weeks of protection after a spray application combined with the time needed for egg development in females. For help with treatment decisions, see UC IPM: ipm.ucanr.edu/PMG/r881301211.html

- ✓ Keep checking **spider mites** and their predators (sixspotted thrips, photo 1, and predator mites) through August. To cash in on biocontrol, allow subeconomic populations of spider mites and avoid broad-spectrum insecticides. See more at the lean price year IPM strategies link above.

Photo 1: Adult sixspotted thrip.

- ✓ Take **leaf samples** to check on the effectiveness of your nitrogen management program, as well as potentially monitor for deficiencies in potassium and zinc, and toxicities in chloride and boron (depending on your site and orchard history). Sample four terminal leaflets from at least 29 trees, each at least 100 feet apart, on the same rootstock, scattered throughout the orchard.
- ✓ Ensure the **lightest pellicle nuts** possible by avoiding stress from too much water from mid- to late-summer. This can be achieved when using a pressure chamber for irrigation scheduling, by avoiding irrigation until stem water potential measurements show trees are 2 to 3 bars below baseline (more dry). There's additional information on maximizing nut quality at: sacvalleyorchards.com/walnuts/cost-and-expense-considerations/maximizing-walnut-quality-to-improve-value-in-a-low-price-year/
- ✓ Reduce ***Botryosphaeria*** **and** ***Phomopsis*** inoculum by pruning out dead blighted limbs. Burning prunings outside of the orchard, where permitted, provides the best inoculum reduction. However, chipping prunings in place is acceptable if disease levels are already high and being managed with an extensive spray program.

AUGUST

- ✓ As harvest approaches, monitor for **navel orangeworm (NOW)**. Nuts that have not been damaged by sunburn, codling moth, etc., are generally not susceptible to NOW damage until hull split. See the lean price year IPM strategies link above for more tips.
- ✓ If you plan on using ethephon in a block, start monitoring for **Packing Tissue Brown** about 35 days before the expected harvest date. With this year's prolonged spring and possible differences in timing of maturity within a canopy, many growers may turn to ethephon to help tighten the window in which nuts in their orchard are ready to shake. See the article in this newsletter for more on ethephon use.
- ✓ There have been increasing reports of **mold** in recent years. The main fungi involved in this damage are *Fusarium* and *Alternaria* species. New research has shown early indications that the application of a short preharvest interval fungicide during hull split can reduce mold infestations. Mold levels are also reduced with timely harvest, and same day pick up. Learn more about controlling mold in the article in this newsletter.

Managing Mold in Walnut

Luke Milliron, UCCE Orchards Advisor, Butte, Glenn & Tehama
Dr. Themis Michailides, UC Davis Plant Pathologist at the Kearney Ag Research and Extension Center

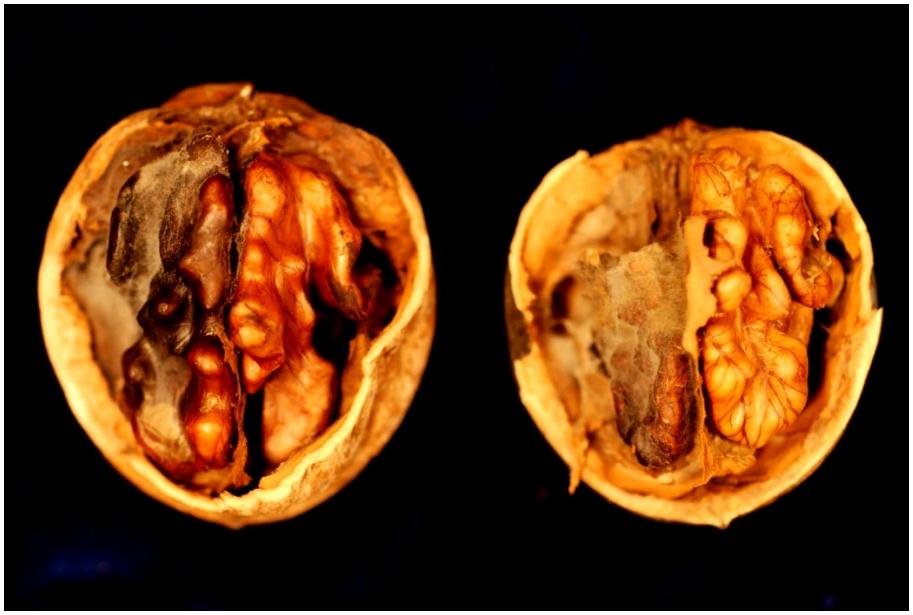

Photo 1. In the past five to six years there have been increased reports of walnut mold. Photo courtesy of Dr. Themis Michailides.

What is walnut mold?

Growers and processors have reported elevated mold levels in harvested walnuts to farm advisors, which has resulted in pathology sample submissions to Dr. Themis Michailides, UC Davis Plant Pathologist. Although *Botryosphaeria* and *Phomopsis* (BOT) can cause walnut mold, most walnut mold develops from *Fusarium* and *Alternaria* species. Furthermore, walnut mold spray timing is later than BOT prevention spray applications *and* therefore your fungicide program for BOT will not control mold. Walnut mold does not begin to develop until the hull completes maturity and begins to split, long after most BOT-controlling sprays have been applied. Before these alerts and ensuing research, not much was known about managing mold in walnut.

Increased mold reports have led to the California Walnut Board funding the lab of Dr. Michailides to investigate the management of walnut mold. Although all possible predisposing factors have not yet been investigated, conditions that compromise the integrity of the hull, such as walnut blight, sunburn or insect-damage can serve as an entry point for mold fungi.

Photo 2. Brown Apical Necrosis (BAN) mold infections in Ivanhoe. Photo courtesy of Dr. Themis Michailides.

Secondary blight predisposes nuts to mold:
Secondary walnut blight (*Xanthomonas arboricola* pv. *juglandis*) infections that do not penetrate to the kernel nor result in nut drop, can create an entry for not only moth pests, but for the mold causing *Fusarium* and *Alternaria* species. These infections are a specific type of walnut mold called brown apical necrosis (BAN), named because the black blighted lesions at the apical end of the fruit turn brown following fungal colonization. As the fungal infection expands under the hull, the hull is decayed and the infection spreads to the kernel through the stem end opening. It stands to reason that improved walnut blight management, particularly of secondary infections will lead to less BAN, however this has not been studied. More on walnut blight best management practices at: sacvalleyorchards.com/walnuts/diseases/walnut-blight-management/

Predisposing factors and cultural controls for mold:
Practices that help maintain hull integrity are part of the pre-hull split management of walnut mold. One predisposing factor is sunburn, with mold commonly isolated from the sunburnt side of developing walnuts. Higher incidence of mold has also been found in insect infected nuts. Thus, controlling sunburn and insect damage will also help keep down mold infections. Finally, a critical management practice is timely shake and pick up. Bill Olson (UCCE Butte Emeritus) did early work showing that mold and other quality problems increase the longer walnuts remain both on the tree and especially on the ground. Picking up the same day as shaking is a critical best practice for overall quality and grower returns, particularly for non-Chandler blocks.

Some varieties are more susceptible to mold than others, and therefore more diligent attention to mold management may be required. In earlier research, higher incidence of mold was discovered in walnut varieties with larger openings at the stem end and larger sized nuts.

Fungicide management for mold:
Investigating fungicide efficacy[1] for walnut mold is just in its infancy, with initial studies first conducted in 2019. In a trial in Chandler located in Butte County, the fungicide Rhyme (flutriafol) was tested because of its short preharvest interval (PHI). A single spray at either 30 or 60% hull split, reduced mold incidence by over 70%. More efficacy testing of various chemical controls for walnut mold are planned and these results will be reported at: ipm.ucanr.edu/PDF/PMG/fungicideefficacytiming.pdf

[1]Mention of pesticides and spray timings do not constitute a pesticide recommendation; it is merely the sharing of research results. Always follow the pesticide label and consult with your PCA.

Ethephon in a Straggled Leaf-Out, Lean Price Year

Katherine Jarvis-Shean, UCCE Orchard Advisor, Sacramento, Solano and Yolo Counties
Janine Hasey, UCCE Farm Advisor Emerita, Sutter, Yuba, Colusa Counties

Given the prolonged leaf-out window we saw in walnuts this spring, it is likely that there will also be a wide window in the timing of hull split and nut removal. This will likely result in the need for two shakes in some varieties. Ethephon, also known as Ethrel®, is a commonly used tool for advancing hull split and harvest-readiness in walnuts. Ethephon is an ethylene-based plant growth regulator applied at walnut maturity (100% packing tissue brown), or shortly thereafter, which accelerates hull cracking and separation from the shell. It's important to remember that there are two potential timings of ethephon, based on different goals.

Ethephon to Tighten Harvest-Readiness

If your goal is to tighten the harvest-readiness window in a block, to avoid having to return for a second shake, apply ethephon 5 to 7 days after 100% of the nuts in the orchard have reached packing tissue brown (PTB), approximately ten days before you would otherwise harvest. This timing of ethephon application does not change the timing of harvest. Rather, it facilitates a one shake harvest.

Ethephon to Advance Harvest

If, on the other hand, your goal is to advance harvest, either to increase kernel quality or spread out the harvesting of

different blocks of the same variety, the timing of application for this is different. To advance harvest timing as much as possible while still maintaining good oil content, apply when **100%** of nuts reach PTB. This will move harvest up by 7-10 days, with a second shake approximately two weeks later.

Knowing the percentage of nuts that are at PTB is critical to meeting your ethephon-related goals. Check out more on ethephon use, including sampling to know when a block has achieved PTB, at: sacvalleyorchards.com/walnuts/ethephon-for-earlier-harvest/.

Photo 1. Immature walnuts.
Photos by R. Beede.

Photo 2. Mature and ready for ethephon treatment.

Considerations for Solano and Ethephon

Several growers in the Sacramento Valley have planted or are considering the newer variety Solano because of its early harvest timing, light kernel color, and vigor. With newer varieties, it takes time to learn how to manage them for optimum yield and nut quality. There have been years, 2014 and 2019, where some kernel color decline was observed where Solano harvest was delayed past optimum timing. Because of the apparent need to advance harvest timing in Solanos to retain light kernel color, they are a candidate for using ethephon for early harvest. Different varieties have different sensitivities to ethephon, e.g. it is more effective on Chandler and Howard than on Serr. Anecdotal evidence suggests Solano may be more sensitive than many common varieties to ethephon. Until we have ethephon use research on new walnut varieties such as Solano and Durham, it may be advisable to use lower rates (especially on younger trees).

Managing Walnut Orchards for Insect-Eating Birds

Dr. Sacha Heath, UC Davis and Living Earth Collaborative and
Rachael Long, UCCE Farm Advisor

Codling moth spells trouble for walnut growers with larvae feeding on developing nuts, causing major yield and quality losses if left uncontrolled. Adult moths are active in the spring, have several generations per year, then go dormant during the wintertime, with larvae hibernating in protected areas, like bark crevices. During the growing season, codling moth are challenging to control because the larvae burrow inside nuts to feed, keeping them safe from natural enemies and insecticides. However, during winter months, larvae are more vulnerable to predators, offering opportunities for biocontrol by natural enemies, including insectivorous birds (Figure 1).

Figure 1. Codling moth larva cocoon eyed by a northern flicker, a predator of codling moth pests. (Image by Sacha Heath)

In apple orchards, insect-eating birds are well-known predators of codling moth, helping to reduce larval numbers by 35% to 95%, according to research over the past several decades. Our study focused on walnut orchards and the impact that insectivorous birds have on codling moth control, with two questions in mind. First, does habitat on walnut farms increase beneficial bird abundance and diversity; and second, does this lead to enhanced pest control in adjacent orchards?

To determine the potential for birds to help control codling moth, we studied bird activity in 20 different walnut orchards in the Sacramento Valley during the wintertime. Our focus was on birds that search for prey in tree bark as they travel up and down tree trunks, pecking and flaking bark with their beaks, hunting for insects. The most abundant insectivorous birds that we found in orchards with this feeding behavior included woodpeckers, flickers, oak titmouse, nuthatches, as well as families of bushtits that forage communally.

To measure the impact of bird predation on codling moth control, we obtained larvae from the USDA lab in Parlier, CA, where a colony is maintained for research purposes. The larvae were inside cocoons inside pieces of corrugated cardboard, after we forced them into dormancy by manipulating day length and temperature in growth chambers where they were reared. Armed with bags of hibernating larvae, we set out in orchards, and glued them individually on tree trunks. Some larvae were available to predators (Figure 1), others had cages over them to prevent bird predation, serving as the control group (Figure 2). Field cameras were set up to track avian predators at work.

Figure 2. Cages were placed over some codling moth larvae, preventing bird access, whereas others were open (Fig. 1) to evaluate the impact of birds on codling moth control. (Image by Sacha Heath)

About a month later, we checked for predation and found that 46% of the uncaged codling moth larvae were eaten, while 11% of the caged larvae were eaten (by other natural enemies, such as lacewings, spiders, and parasitoid wasps), suggesting that up to 35% of predation was due to birds (Figure 3). White-breasted nuthatches and Nuttall's woodpeckers were captured by wildlife cameras foraging on codling moth larvae on several occasions (see video link below). This reduction of codling moth larvae during the winter months by natural enemies likely helps reduce the numbers of codling moth adults during springtime flight, helping to reduce pest pressure during the growing season.

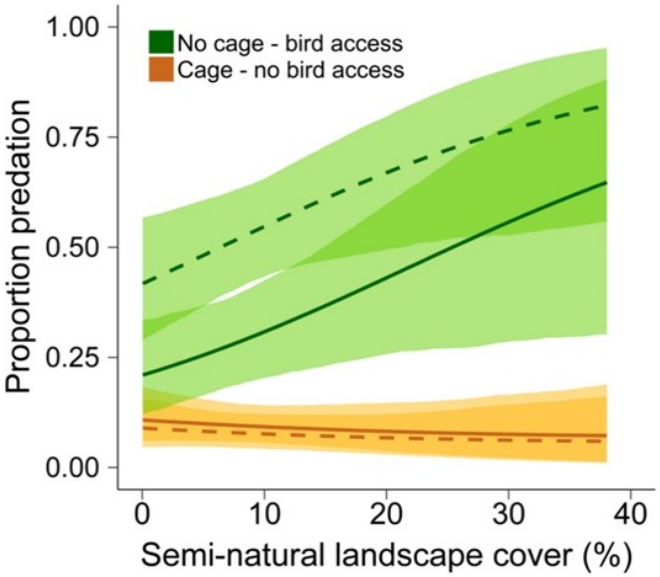

Figure 3. Predicted effects of bird exclosure cages on codling moth larval predation across a gradient of landscape cover (habitat from none to 40%) within about ¼-mi of the walnut orchards in our study. Lines indicate means, color ribbons around lines are 95% confidence intervals. Dashed lines indicate larvae on trees where at least one other larva was depredated and solid lines reflect larvae on trees where no other larvae were consumed; this differentiation helps researchers account for a birds' ability to quickly become accustomed to novel food items (Heath and Long 2019).

In another Sacramento Valley study among multiple crop types, we discovered that one driver behind bird abundance and diversity on farms was the presence of natural vegetation in the uncultivated crop margins, including hedgerows of shrubs, tree-lines, and remnant riparian vegetation (Figure 4). Similarly, walnut orchard margins with natural vegetation had ten times more bird codling moth predators than bare or weedy orchard margins. The more natural vegetation on and around farms, the more beneficial birds were found in the orchards, leading to better biocontrol of codling moth pests (Figure 3).

Conversely, field edge habitat does not appear to attract more pest birds. During a pilot study for this work, it was found that three of the most common avian crop pests (crows and red-winged and Brewer's blackbirds) were detected 5 to 10 times more often in agricultural fields *without* hedgerows in their margins, compared to fields with hedgerows (White et al. 2012).

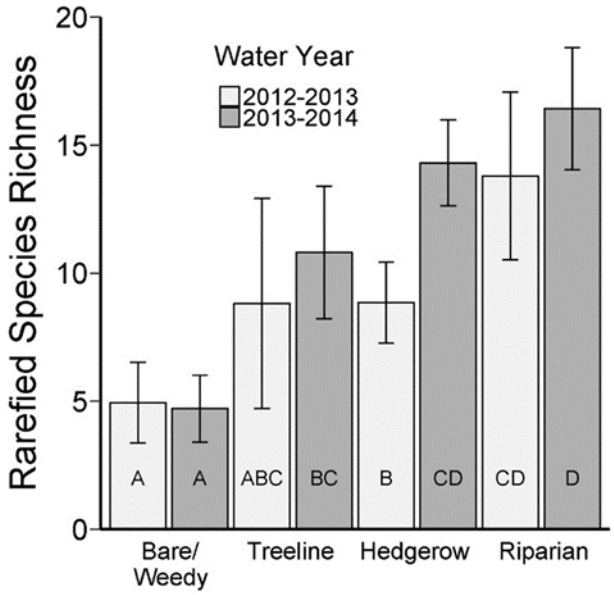

Figure 4. Average number of bird species in different field edge habitat types on 111 farms in the Sacramento Valley

Birds forage in croplands because in many cases this is among the only remaining available habitat, especially in intensively farmed areas like the Central Valley. Increasing bird activity and pest control benefits can be achieved by planting habitat in and around farms. This includes native California shrubs like California lilac (Ceanothus), redbud, coffeeberry, toyon, coyote brush and elderberry. Field edge habitat does not appear to attract more pest birds, like starlings and blackbirds (White et al. 2013). For example, in strawberries, researchers found that bird abundance and feeding damage was lower on farms with more surrounding natural habitat, likely because the birds had somewhere else to go (Gonthier et al. 2019). Adding habitat on farms makes a difference by providing beneficial birds a safe place to forage, rest, and nest, benefiting birds and farmers.

For more information on habitat plantings on farms contact Rachael Long, rflong@ucanr.edu or 530-666-8143 or the Yolo County Resource Conservation District, pratt@yolorcd.org, 530-661-1688. We are thankful for project support from Yolo and Solano County walnut growers, who participated in this study. More information on our studies can be found at **Heath and Long 2019** and **Heath et al. 2017**.

Watch a video of Nuttall's woodpecker eating our experimental codling moth larvae in a walnut orchard: **Insect-eating bird video** (Video by Sacha Heath).

Heath, S. K., and R. F. Long. 2019. Multiscale habitat mediates pest reduction by birds in an intensive agricultural region. *Ecosphere* 10(10):e02884.

Heath, S. K., C. U. Soykan, K. L. Velas, et al. 2017. A bustle in the hedgerow: Woody field margins boost on farm avian diversity and abundance in an intensive agricultural landscape. *Biological Conservation* 212:153-161

White, H.M., Long, R.F., Velas, et al. 2013. Avian Use of Hedgerows and Adjacent Crops in Central California Agricultural Landscapes. *Ecesis*, *21*, pp.26-32.

Gonthier, D.J., Sciligo, A.R., Karp, et al. 2019. Bird services and disservices to strawberry farming in Californian agricultural landscapes. *Journal of Applied Ecology*, *56*(8) 1948-1959. DOI: 10.1111/1365-2664.13422