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Pre- & Post-Harvest Almond Orchard Management Considerations

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JULY

- **Navel Orangeworm (NOW) & Peach Twig Borer (PTB):** Continue monitoring for NOW and PTB to determine when and how to manage these pests in your orchard. Consider an edge spray when sound nuts in edge Nonpareil nuts reach hull split Stage 2C and a full spray once nuts in the upper canopy of trees within the orchard reach that same stage. Apply a second hull split spray prior to harvest as needed. See additional information on hull split in a tough year in this newsletter as well as an overall review of NOW hull split considerations at (sacvalleyorchards.com/almonds/navel-orangeworm-considerations-2018/). Consult with your PCA when making decisions about NOW and PTB management.



Stage 2C of hull split. This is the critical time for NOW insecticide and *Rhizopus* hull rot fungicide applications. The orchard is ready for harvest when all nuts are at Stage 2C.

- **Mites:** Leaf drop at harvest due to mite damage can lead to fewer flowers next year and slower drying this year. Start monitoring for mites and mite predators throughout your orchard on a weekly basis in July. For more monitoring and treatment information, see the hull split spraying article in this newsletter and the UC IPM site for mites in almonds: ipm.ucanr.edu/PMG/C003/m003fcspdmmites02.html.
- **Ants:** Monitor for protein feeding ants and consult with your PCA about ant bait materials and application timing. See the article on ant control in this newsletter.
- **Regulated Deficit Irrigation (RDI):** RDI can promote earlier, more even hull split in a normal rainfall year. This can help with navel orangeworm and hull rot control in your orchard. However, using this practice in already water stressed trees may contribute to further yield reduction. At the start of hull split, use pressure chamber measurements to

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check to see if the stem water potential (SWP) of your trees is already in the RDI target range (-14 to -18 bars). If SWP is above -14 bars (for example, -12 bars), there might be some water savings in reducing irrigation, slightly, so that SWP is below -14 bars, but not below -18 bars. Hold SWP in that range for two weeks during initial hull split and then return full irrigation (to 100% ETc) for the last two weeks of hull split leading up to harvest. As stated above, without the pressure chamber to guide you, this is a risky strategy in a drought year and should be approached very cautiously.

- **Leaf Samples:** Take July leaf samples and send them in for analysis to plan your nutrition program for next season, and monitor for potential impacts of using lower quality water during lean water times. Learn more about July leaf analysis sampling procedure and interpretation see this article from The Almond Doctor: thealmonddoctor.com/leaf-analysis-salinity-monitoring/.

AUGUST

- **NOW Management in pollinizers:** After Nonpareil harvest you may want to spray pollinizer varieties for NOW management. The decision of whether to spray or not should be based on the amount of NOW damage observed in your Nonpareil almonds, progression of the third NOW generation, and when the fourth generation egg laying will start. If you do choose to spray, plan your application timing based on when you expect to harvest your pollinizers, remembering that pre-harvest intervals are based on the date that you shake, not the date that you pick up the almonds from the orchard floor. (For more information on this important topic, see the article in this newsletter on hull split spraying.)
- **Hull Boron Samples:** Unlike many other nutrients, boron tends to accumulate in almond hulls, making hulls the best source of information about boron levels in your trees. If you have concerns about high or low boron levels in your orchard, collect hull samples at harvest and submit them to an analytical lab for boron analysis. For more information on hull boron sampling, see this article from the Almond Doctor: thealmonddoctor.com/hull-sampling-for-boron/.
- **Nitrogen application:** Apply your last nitrogen of the year just before or after harvest to support next year's bud development. Use your July leaf sample results to decide how much N you may need to apply this year. If the July leaf levels are adequate to high, no further N application may be needed. If leaf levels are low, consider irrigation water nitrate levels when deciding on N fertilizer rates. For more information about N application in almonds see the new publication "Nitrogen Best Management Practices" from the Almond Board (almonds.com/sites/default/files/2020-12/ABC_Nitrogen_8.5x11_vmags.pdf) and the CDFA's California Crop Fertilization Guidelines for Almonds: cdfa.ca.gov/is/ffldrs/frep/FertilizationGuidelines/Almonds.html.
- **Rust:** Look out for rust in young orchards. Rust can cause early defoliation, which can reduce flower counts next year. For more information on rust control in almond orchards, see UC IPM: www2.ipm.ucanr.edu/agriculture/almond/rust/.

Harvest

- **Harvest when 100% of nuts are at Stage 2C of hull split or more** (see image above) and test trees shake clean. This will minimize NOW egg laying and feeding damage on the harvested nuts.
- **Dust:** Dust at harvest can create unhealthy conditions for workers and community members in and around almond orchards. Plan to minimize dust at harvest by adjusting sweeper head heights,

blower spout angles, and fan speed. For other recommendations, see this article from the Almond Board of California: almonds.com/almond-industry/orchard-management/harvest/dust-reduction.

- **Shaker damage:** Limit shaker damage by making sure all trees in the orchard are ready to shake when starting harvest. Test-shake trees in areas that are historically the most vigorous and where nuts “stay green” the longest. Where scaffold heights allow, clamp closer to the scaffold crotch rather than lower down on the trunk to minimize root damage and get the best shake to the canopy. In young (third and fourth leaf) orchards, be extra careful when shaking.
- **Nut Damage Analysis:** Nut damage analysis (harvest samples) can help you understand the primary sources of nut damage in your orchard and plan for reducing damage next year. After shaking and before sweeping, collect 500 nuts throughout your orchard for analysis. Use the UC IPM Harvest Sample resource (ipm.ucanr.edu/PMG/C003/m003hcharvstsmpl.html) and our article on Harvest Damage Evaluation for Almonds (sacvalleyorchards.com/almonds/insects-mites/harvest-samples-for-almond-crop/) to conduct your damage analysis. If you don't have time to crack out your nuts at harvest, you can freeze them at harvest and crack them out later
- **Don't stockpile wet nuts:** Nuts with hull moisture above 12%, kernel moisture above 6% or total fruit (hull and kernel) moisture above 9% shouldn't be stockpiled as nut quality could be reduced by mold and concealed damage. When sampling for moisture ahead of nut pickup in the orchard, make sure to sample from the top and bottom of the windrow, as nuts on the bottom tend to have higher moisture content than those on the top of the windrow. See the stockpile article in this newsletter for further information on pickup and stockpiling to maintain nut quality.

Post-harvest

- **Post-harvest irrigation:** Return irrigation to your trees as quickly as possible after harvest to minimize water stress as much as possible. Water stress in August-October can interfere with next year's bud development and lead to defoliation, which reduces tree vigor. Dry trees after harvest = fewer flowers next spring.
- **Post-harvest hull rot and shaker damage assessments:** Check for hull rot and shaker damage on your trees after harvest. More information about hull rot assessment and management can be found on the UC IPM website for hull rot management in almonds: www2.ipm.ucanr.edu/agriculture/almond/hull-rot/.

SEPTEMBER

- **Plan fall Zn and B sprays:** Use your plant tissue analysis results to determine whether you need to apply foliar Zn and B this fall. See our Postharvest Nutrition Review article (sacvalleyorchards.com/almonds/horticulture/postharvest-nutrition-review/) to learn more about when and how to apply these nutrients.
- **Plan for your fall potassium application.** If applying fall potassium is part of your orchard nutrient management program, start preparing for application. Banded or targeted broadcasting down the tree row applications are good options for getting your money's worth out of a fall potassium application. See the Postharvest Nutrition Review article for more details (link above).

- **Prepare for cover crop planting:** Cover crops are a good tool if you're looking to improve soil health, provide pollen for bees, and/or reduce runoff in your orchard. If you're considering planting a cover crop this year, you'll want to get the seed in the ground by the end of October. Start considering your options now using the UC-Almond Board Cover Crop Best Management Practices guide: live-almonds-next.pantheonsite.io/sites/default/files/2021-06/ABC_CoverCropBMP_8.5x11_vmags.pdf.



Almond Hull Split Spray Considerations in a Tight Fiscal Year

David Haviland, UC Cooperative Extension, Kern Co.

In a tight fiscal year, the decision of whether or not to make a hull split spray is an easy one: do it. However, the number of hull split sprays, and how much money to put in the tank during each spray, are valid topics for discussion.

Navel Orangeworm

On an annual basis, all almond growers in the Sacramento Valley should invest in an insecticide application for navel orangeworm at the initiation of hull split. At this time, the second flight of navel orangeworm begins at the same time as Nonpareil nuts begin to split, making them susceptible to attack. However, the benefits of this spray go beyond the protection of early-splitting Nonpareils.

During the summer, it takes approximately one month for navel orangeworm (NOW) to complete a generation. Loosely speaking, this means that eggs that hatch in mid-July will become moths that lay eggs that hatch in mid-August, that in turn grow up to become moths that lay eggs in mid-September. This means that if you kill the egg in mid-July, you prevent its production of offspring in mid-August and mid-September.

Additional protection of nuts can be achieved without additional cost through timely harvest. More specifically, early varieties that are harvested before the beginning of the third NOW flight, or late varieties like Monterey that are harvested before the fourth flight, typically have reduced damage than when the same varieties are harvested one to two weeks later, after the respective flights begin.

On a case-by-case basis, almond orchards may require a second hull split spray for NOW, especially if a fourth flight or delays in harvest are anticipated. When determining whether or not to invest in a second hull split spray in the Sacramento Valley, consider asking the following questions: 1) how much damage did I have last year in this orchard, 2) how good was my sanitation, 3) did I invest in mating disruption, 4) what risk do I have from neighbors, 5) how do my pheromone trap captures compare to historic numbers in the same orchard, and 6) when do I plan on harvesting? Interpreting the answers to these questions is more of an art than a science, so the key is to look for trends. For example, getting a positive return on investment for a second NOW spray is unlikely for growers who had acceptable damage last year, had decent sanitation, plan on harvesting early, and are not located near a 'dirty' neighbor. To the contrary, growers with a history of damage, next to poorly managed orchards, and that anticipate delays in harvest, would likely get a positive return on investment in a second hull split spray.

The standard insecticides for NOW are Intrepid and Altacor. They have good efficacy on NOW eggs and young larvae and do not disrupt biological control. Also available are Intrepid Edge and pyrethroids such as Brigade and Warrior. However, these products kill sixspotted thrips – the primary predator of spider mites – such that a positive return on investment in the battle against NOW can be off offset by flare-ups of spider mites, additional miticide costs, and economic losses associated with defoliation.

Spider Mites

Hull split sprays also present an opportunity to save costs by integrating miticides – if needed – into a hull split spray. When making spider mite management decisions at hull split, almond growers have three choices, 1) do nothing by relying exclusively on biological control, 2) apply oil, or 3) apply a miticide. The key to determining which of these options is appropriate is to assess the status of biological control.

In the Sacramento Valley there are two main predators to look for. The first are species of predatory mites (phytoseiids, Photo 1). These are good mites that eat the bad mites. Phytoseiids have a tear-dropped shape, a shiny appearance, and are often seen running around on leaf surfaces in search of food. They have historically been the main predators found in almond and walnut orchards in the Sacramento Valley.



Photo 1. Predatory mite (right) eating the eggs of a spider mite (left) (Photo: UC IPM).

The second predator that has become increasingly important over the past few years is the sixspotted thrip (Photo 2). This predator feeds almost exclusively on mites, can double its population every 4 days, thrives in hot dry conditions, and loves to navigate within spider mite webbing in search of food.



Photo 2. Sixspotted thrip adult, characterized by three dark spots on each of its two fringed wings (Photo: UC IPM).

The most effective method for monitoring sixspotted thrips is to place two “Predator traps” in each orchard. This trap can be purchased through Great Lakes IPM and can be hung in the tree using a binder clip and a paper clip. A video showing how this is done can be found at [youtube.com/watch?v=ufJ4VCa-IFU](https://www.youtube.com/watch?v=ufJ4VCa-IFU). Research has shown that beginning at hull split, mite populations stay the same over a one-week period if

3 sixspotted thrips are caught per trap in a week. After 14 days, mite populations have consistently decreased.

Changes in natural enemy density over time can also be used with spider mite treatment thresholds. Research by Frank Zalom in the 1980s showed that when predators are present, the threshold for treating spider mites is when 40% of leaves are infested using a presence-absence sampling program. Recent research funded by the Almond Board has confirmed that this threshold is still valid today.

Therefore, for growers trying to save money in a tight budget year, the recommendation for spider mites is to keep track of natural enemies. If you have less than 40% of leaves infested and have at least 3 sixspotted thrips per trap in a week (or have less than 3 but are seeing numbers increase weekly), then let biocontrol finish the job for free. If you are seeing some mites and some natural enemies, but are riding the fence on whether or not biocontrol will be adequate, consider making an application of 1-2% 415 Oil. This will kill about half of the mites for about two weeks, giving the advantage to natural enemies to finish the job. If sixspotted thrips are not being found, and 40% of leaves are infested (or this is your last chance to spray and you anticipate hitting 40% in the next few weeks), then invest in a full miticide with 415 oil or an oil-like surfactant like Vintre. And whatever you do, avoid using insecticides for other pests that have the potential to kill the natural enemies that are working for you for free (see the last paragraph of the NOW section of this newsletter article for NOW products that harm mite predators).

For most almond orchards in the Sacramento Valley, a single application of Intrepid or Altacor, with perhaps 1% 415 oil as a surfactant that also reduces mites without disrupting biological control, is often adequate to provide sufficient control of both NOW and spider mites. All of this can be done for less than \$100 per acre. Additional expenses related to a second NOW spray, or application of a full miticide, can quickly add another \$50 to \$150 per acre that should only be considered on an orchard-by-orchard basis according to monitoring programs.

For more information about NOW and spider mite management decisions, consult the UC IPM Pest Management guidelines for Almonds (www2.ipm.ucanr.edu/agriculture/almond/) or contact your local UC Cooperative Extension office.



Ant Management

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

Protein feeding ants can cause significant nut damage between shaking and pickup (see Table 1). The longer nuts are on the orchard floor after shaking, the greater the risk of ant damage. In 2020, ant damage was up over previous years; based on conversations with PCAs and industry reps. These damage increases may have been linked to extended nut drying time under smoky skies with reduced solar radiation (see Figure 1). The fire risk is high again this year.

Ant bait materials, where needed and used properly, deliver inexpensive and effective ant control. Timing and best use practices are critical to successful ant control.

Only protein feeding ants (pavement or southern fire ants) feed on almonds. Other ant species can be beneficial in almond production as they may help control pests (for example, grey ant feeding on peach twig borer larvae). Check orchards before treating to make sure that protein feeding ants are present. See monitoring and identification details at: www2.ipm.ucanr.edu/agriculture/almond/Ants/.

Several different active ingredients are available in bait form for ant control. Best timing of different products for best results varies with product. Clinch® or Esteem® Ant Bait should go out early (4-8 weeks ahead of shaking, depending on the material) as it takes time for the product to reduce ant activity. Altrevin® is a short PHI material that provides rapid knock down of ant activity but provided fewer weeks of ant control than Clinch® in UC research conducted by David Haviland, UCCE Entomology Advisor in Kern County. Consult with your PCA for the timing and material(s) that have the best fit for your orchard.

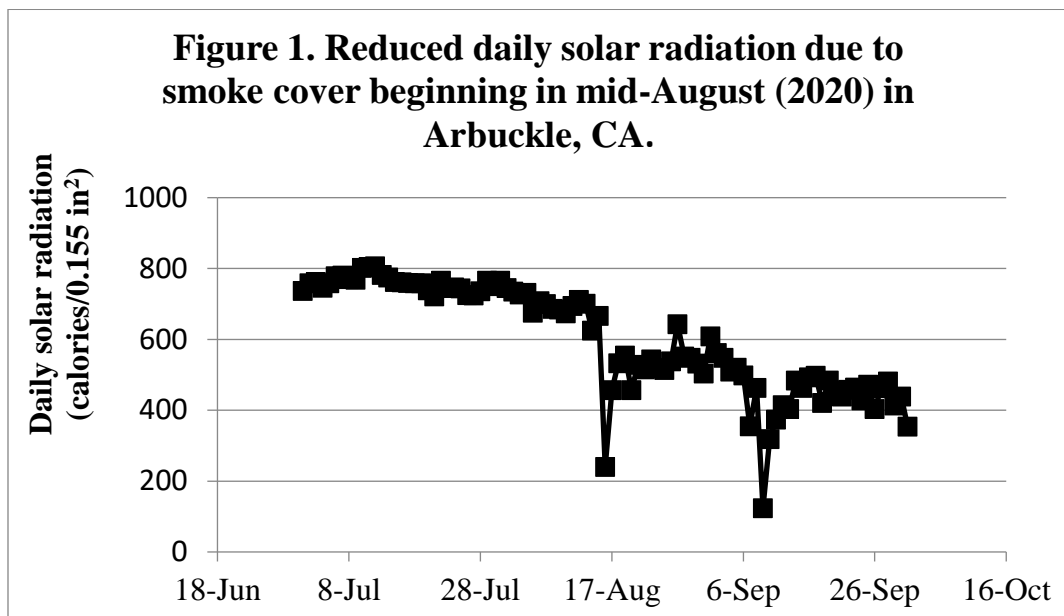
How baits are used affects how well they work. Ant bait materials work because ants are attracted to the soybean oil in the bait. Rancid soybean oil will not attract ants, and oil in bags open for only a week may be rancid. For best results, buy new material and use it quickly. Regardless of the material used, wet bait is less effective than dry material. Spread bait on dry soil several days ahead of irrigation, especially sprinkler irrigation, or wait a day or two after irrigation for best results.

Photos 1 & 2. Protein feeding ants. Pavement ants (left) are dark brown, and are covered in coarse hairs. Southern fire ants (right) are characterized by an amber head and thorax and a black abdomen.



Table 1. Percent damage by southern fire ants to almonds on the ground in an almond orchard (www2.ipm.ucanr.edu/agriculture/almond/Ants/)

Colony entrances per 5,000 sq. ft. April -- May	Days nuts are on the ground				
	4	7	10	14	21
15	0.9	1.6	2.1	3.1	4.9
45	1.4	2.3	3.2	4.7	7.0
185	2.0	3.6	5.0	7.0	11.1



Maintaining Quality with Pick Up & Stockpiling Best Practices

Luke Milliron, UCCE Orchards Advisor Butte, Glenn, and Tehama Counties

Bruce Lampinen, Tree Nut Extension Specialist, Planta Sciences Department, UC Davis

As of late June, a huge crop (3.2 B pounds!) is forecast for 2021. With another record statewide crop to be shaken, swept, and collected starting in August, will you and your handler be prepared? Research by Bruce Lampinen (UCCE Specialist, UC Davis) and others has shown that properly dried nuts are the key to maintaining quality and grower returns during stockpiling. Best practices help avoid *Aspergillus* growth and resulting aflatoxin contamination, and concealed damage to kernels. Aflatoxin and concealed damage reduce profits at a time when margins are critical. Maintaining a high-quality product is also key to marketing and moving a record crop at the best possible prices to growers. This may be a particularly challenging year for drying nuts if fire smoke slows nut drying as occurred in 2020.

At Harvest:

Let hulls dry completely on the orchard floor before pick up. Do not pick up and stockpile nuts with a hull moisture above 12%, kernel moisture above 6%, or total fruit (hull and kernel) moisture above 9%. For reference, hulls snap at or below 11-12% moisture. When sampling for moisture level, it is critical to take a representative sample. For windrows, sample from both the top, as well as the bottom of the windrow, where moisture levels can be 2% greater. For almonds that have not been windrowed, sample both in row middles and adjacent to tree trunks on the north side of the canopy where moisture levels may again be 2% higher. Orchard floor drying is faster with north/south oriented rows and where canopy light interception does not exceed 80%.

If almonds are picked up at a total fruit moisture above 9%, do not stockpile. Instead spread out the crop in a dry area that allows for turning and spreading. If needed, take the crop to a dryer. For more information on rain at harvest, including a table of prescribed actions based on your harvest stage, see: almonds.com/sites/default/files/coping_with_rain_at_harvest%5B1%5D.pdf.

Stockpile Management:

The record crop probably means that more crop than ever before will have to be stockpiled. If covered to fumigate for navel orangeworm control or because of a forecast rain, take steps at setup to avoid moisture accumulation. Ideally, stockpile locations are slightly raised to prevent puddling around the edges. Stockpiles should also be free of trash and placed away from equipment. The long axis of stockpiles should be oriented north-south to get sun on all sides. Piles should have smooth and flat tops, avoiding low spots that accumulate condensation. Finally, when needed, the use of white on black tarps is best, because they help avoid severe temperature fluctuations that increase condensation.

If a stockpile is built, monitor the relative humidity near the outer edge, where swings in temperature and the risk of condensation are greatest. If moisture levels are above the thresholds, open the tarps up during the day and close them at night, corresponding to low and high relative humidity, respectively. More details at:

almonds.com/sites/default/files/grower_stockpile_management_best_practices_from_abc_2014%5B1%5D.pdf.



Covered stockpiles: Designed to avoid moisture accumulation with N/S orientations, flat/smooth tops, and are ideally on a raised surface to avoid ponding (photo courtesy of Almond Board of California).



Volunteers needed for UC Davis study on glyphosate & herbicide selection.

Do you make weed management decisions in California orchards (grower, PCA or weed management decision maker). We are interested in finding out more about the factors that matter to you, especially as they relate to glyphosate (Roundup®, etc.) and other herbicides.

What's involved? One, approximately hour-long survey and interview session held virtually. Participants will be compensated with a \$30 Amazon gift card. FOR MORE INFORMATION, please e-mail Steven Haring (sharing@ucdavis.edu).

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Craig Ledbetter on the
USDA breeding program



Irrigation Management
with David Doll



Field Evaluation of
Almond Varieties



The Dangers of
Irrigation Leaks

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