Sacramento Valley Almond News

Preharvest, 2022

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In This Issue

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Pre- & Post-Harvest Almond Orchard Management Considerations

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ALL SUMMER

- **Valley smoke:** Wildfire smoke blocks sunlight from reaching the ground and increases relative humidity. Consult with your PCA/CCA to plan ahead to head off possible trouble this summer due to wildfire smoke. Possible problems for almond growing include personal safety for anyone working outside without an N95 mask, increased risk of hull rot due to a higher relative humidity, and slower nut drying on the orchard floor (increased ant feeding and more orchard water stress due to delayed nut pickup).

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 (end of June/early July) when sound nuts in edge trees reach hull split Stage 2C (see photo), and a full spray once nuts in the upper canopy of trees within the orchard reach that same stage. Consult with your PCA when making decisions about NOW and PTB management. Switch insecticide chemistries between generations.

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:** Extensive leaf drop (defoliation) at harvest due to mite damage can lead to slower nut drying on the orchard floor this year and reduced yield and shoot growth the following year. Continue weekly monitoring for mites and mite predators

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throughout your orchard as hull split approaches. For more monitoring and treatment information, see the hull split spraying article in this newsletter and the UC IPM site for spider mites in almonds.

- **Ants:** Monitor for protein feeding ants and consult with your PCA about ant bait materials and application timing. If present, protein feeding ants can damage almonds on the orchard floor.
- **Regulated Deficit Irrigation (RDI):** RDI can promote an earlier, more even hull split in a normal rainfall year and can help with NOW and hull rot control. However, using this practice during a drought in already water stressed trees may lead to a yield reduction.

  How can you tell if RDI is a good option this year? At the start of hull split, check stem water potential (SWP) using a pressure chamber to see if the SWP is already in the RDI target range (-14 to -18 bars). If trees are drier than -14 bars (for example, -15 bars) then there is no need for further water reduction to manage hull split. If SWP is wetter than -14 bars (for example, -12 bars), there might be slight water savings in reducing irrigation run-time, so that SWP is in the target range as nuts enter hull split. During initial hull spilt, hold SWP in the range of -14 bars to -18 bars for two weeks and then return to full irrigation (100% ETc) for the last two weeks of hull split prior to preharvest irrigation cut off. This advanced strategy (in a drought year) should be approached with caution and precision.
- **Leaf Samples:** Take July leaf samples and submit for lab analysis to 1) evaluate your nutritional program for this year, 2) plan your nutrition program for next season, and 3) monitor for possible toxic element (chloride, sodium and/or boron) accumulation in the orchard. To learn more about July leaf analysis sampling procedure and interpretation see this article from The Almond Doctor.
- **Harvest prep:** Prepare shakers, sweepers and pickup machines for harvest. Equipment distributors may have preharvest "tune up" specials that can be scheduled to ready essential equipment for the long harvest season. To limit dangerous and damaging dust at harvest, review Almond Board of California information/videos on dust management.

AUGUST

- **NOW Management in pollinizers:** After Nonpareil harvest you may want to spray pollinizer varieties for NOW management. In a tight money year, this may not be an attractive option, but should be considered depending on the conditions in the field. The decision to spray or not should be based on the following: existing NOW damage observed in your Nonpareil almonds, progression of the third NOW generation, and timing the start of the fourth-generation egg laying. If you do choose to spray, plan your application timing based on when you expect to harvest your pollinizers, remembering that preharvest intervals are based on the date that you shake—not the date that you pick up the almonds from the orchard floor. A timely harvest is the least expensive option (shake vs spray and wait the PHI to shake) and can be very effective in limiting NOW damage.
- **Hull Boron Samples:** Boron accumulates in almond hulls, making hulls (not leaves) the best source of information about boron levels in your trees. To check orchard boron status, collect hull samples at harvest (from the windrows) and submit them to an analytical lab for boron analysis. For more information, see the article from the Almond Doctor on hull sampling for boron analysis.
- **Nitrogen application:** Use July leaf sample results to decide if any additional fertilizer N is needed this year. If the July leaf levels are adequate → high, research indicates no further N application is needed. If leaf levels are low → deficient, additional N may be needed. If leaf levels show additional N is needed, consider irrigation water nitrate levels when deciding on N fertilizer rates. For more information about N application in almonds and how to calculate lb N/acre in irrigation water from lab results see the new publication "Nitrogen Best Management Practices" from the Almond Board of California.

Harvest

- **When to start?** Trees are ready for harvest when 100% of nuts in the orchard are at least at Stage 2C of hull split (see image in the July section, above) and test trees shake clean. This will minimize NOW damage on the harvested nuts. (See article on harvest timing in this newsletter.)
- **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. See link to resources in the July section.
- **Shaker damage:** Shaker damage can be a major cause of orchard decline. Limit shaker damage ("barking" trees) by making sure all trees in the orchard are ready to shake when starting harvest. Test-shake trees in areas that are the most vigorous and where nuts "stay green" the longest. Where possible, 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. Be extra careful when shaking in young (third and fourth leaf) orchards.
- **Nut Damage Analysis:** Nut damage analysis (harvest samples) can help reveal the primary sources of nut damage in the orchard and assist in planning for reducing that damage next year. Collect 500 nuts throughout your orchard after shaking and before sweeping for analysis. Use the UC IPM Harvest Sample resource and our article on Harvest Damage Evaluation for Almonds to conduct your damage analysis. If there isn't time to crack out nuts at harvest, they can be frozen for later crack out.
- **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. Nut quality declines with mold and conceals 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 2021 article on pickup and stockpile practices for further information.

Post-harvest

- **Post-harvest irrigation:** Return irrigation to your trees as quickly as possible after harvest to minimize water stress. Water stress in August-October can interfere with bud development for the next crop. Dry trees after harvest = fewer flowers next spring. (see article on postharvest irrigation in this newsletter)
- **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.
- **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 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 information.
- **Plan for improved rainwater infiltration:**
    - Consider a filter strip of vegetation (cover crop or natural vegetation) around the field edge to slow and help capture runoff water. One easy way to help do this, depending on the year and site, is to shut off herbicide booms as soon as the sprayer leaves the orchard row.

- Cover crops reduce orchard runoff, improve soil health, and/or provide pollen for bees. 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.
- Consider using organic soil amendments (almond shells, compost, etc.) to protect the orchard floor from sealing off due to rain drop impact and slow runoff. See article in this newsletter.

When do you shake almonds?

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Almonds can be harvested as soon as 100% of the nuts on the tree reach hull split. 100% hull split occurs when the lowest nuts in the lower interior canopy reach stage 2C (Figure 1): there is a deep V at the suture and the nut splits open when hand pressure is applied to opposite ends of the hull. Historically, the recommendation from UC almond experts for the ideal time to shake was as soon as 100% hull split occurred throughout the orchard, keeping in mind pest and disease management, nut removal/drying time, and nut quality. However, these considerations vary widely among varieties and locations, so we would like to address potential challenges that growers should consider when timing harvest.

Figure 1. Almond hull split stages (photographs by C. Reyes and L. Milliron)
1. No separation of suture.
2A. Less than 50% of suture line separated.
2B. Deep V over 50% of suture line separated, the hull cannot be squeezed open.
2C. Deep V over the entire suture line can be squeezed open by pressing opposite ends of the hull.
3. Suture opening less than 1 cm (1/2") in width, exposed shell; visible brown edge along the split edge of the hull when observed from beneath the canopy.
4. Suture opening more than 1 cm (1/2") in width, fully exposed shell.
5. Hull edges begin to dry, shell changes from white to brown.
6. Completely dry hull, brown shell.

Pest and disease management:
Early harvest is an effective way to manage navel orange worm (NOW) by reducing the amount of time a nut is open and vulnerable to infestation. Additional NOW infestation risk is reduced once nuts are shaken to the orchard floor.

Early harvest has also proven to reduce the incidence and severity of hull rot in trees by reducing the amount of time a nut is open and vulnerable to infestation by fungi, and by reducing the amount of time an infected hull may transfer the toxin through the shoot.

A rapid removal of nuts from the ground can minimize ant feeding damage. However, shaking just at 100% hull split stage (greener hulls) can mean longer drying times on the orchard floor and greater vulnerability to ant damage.

Nut removal/drying time:
If shaken when hulls are still very green (stage 3 or earlier), nuts will require a longer drying time on the orchard floor. Sweeping nuts into windrows soon after shaking followed by conditioning windrows accelerates drying on the ground. Conditioning also provides the benefit of getting cleaner product from the field, speeding up the actual "pick-up" process, and reducing hulling/shelling costs (since hullers charge on incoming weight). Kernels and hulls must be dry when delivered to the huller because dry product processes rapidly and stockpiling nuts with high moisture content is detrimental to nut quality.

For Nonpareil at stages 4-5, the abscission zone (the separation zone between the fruit and the peduncle) has formed, nuts are only attached to the tree by a few fibers, and removal is normally excellent. Nonpareil normally shakes very well with a harvest timing of 100% hull split. Some varieties like 'Padre' and 'Independence' can have better removal when hulls are greener, and nuts are heavier.

An early harvest of Nonpareil typically requires an earlier water cutoff date compared to that for a later harvest. Hulls dry more quickly on the ground than when nuts are attached to the tree, thus advancing pickup. However, a longer drying time on the orchard floor, 7-14 days with early harvest vs. 4-7 days with later hull split stages, can prolong the time between irrigation and harvest for later-maturing varieties. To avoid water stress in the orchard, irrigation with drip or micro-sprinklers can be applied between variety harvests. If this is not possible, severe water stress may result in sticktights (nuts stuck in the tree) and/or hulltights (green hulls shriveling and drying tight around the nut) on later-maturing varieties and risk of mite infestation, and/or defoliation on all varieties. Extreme defoliation robs the tree of carbohydrates and can reduce bloom the following spring.

In the event of severe wildfires, smoke traps moisture in the air, extending overall drying time. This impacts hull moisture, harvest readiness, and drying time on the orchard floor. If smoke causes delayed drying and increased drought stress on trees, sticktights and/or hulltights can occur. If so, this may reduce nut removal and/or require shelling at the huller to remove the hulls, causing the grower to miss out on inshell premiums on a portion of the delivery.

Almond bark "tightens" and is less vulnerable to shaker damage as the harvest season progresses. Limiting trunk damage ("barking") risk at early harvest of Nonpareil requires attention to hull split status throughout the orchard. Localized areas of delayed hull split relative to the rest of the orchard may exist due to higher soil moisture (heavy clay streak, uneven irrigation distribution uniformity (DU), low spots in the orchard, etc.). These trees may not shake "clean" at the same time as the rest of the orchard. Trees with delayed nut maturity may be shaken harder by a less experienced, poorly trained operator trying to "get all the nuts off", resulting in trunk damage that limits the tree life and orchard productivity if enough trees are damaged.

Nut quality:
Stage 5 and 6 nuts have the highest chance of being cleanly hulled and receiving an inshell price premium. Harvesting too early can prevent color from developing on the pellicle (kernel skin), which reduces nut quality. Shaking early can also result in nuts that form curled hulls from rapid drying on the orchard floor. These curled hulls are similarly sized to kernels, difficult to separate, and may contribute to increased foreign material.

Table 1. Pros and cons of a timely "early harvest" of almond. "Early harvest" defined as shaking as soon as 100% hull split stage is reached.

Pro	Con
Reduces NOW infestation and hull rot strikes – less time that nuts are open and vulnerable on tree	
Maximum nut removal on Nonpareil at stage 2c or greater. Varieties like 'Padre' and 'Independence' have better nut removal at earlier, greener stages.	
Maintains kernel quality – no wrinkled kernels if water stress is avoided	Reduced kernel dry weight (a component of yield) if harvested too early – it typically increases until approximately stage 3.
Hulls generally dry faster on the ground than they do on the tree.	Longer drying time on orchard floor (7-14 days vs. 4-7 with later hull split stages) – more water stress in orchards with solid-set irrigation. Mold may develop on nuts in high moisture environments.
	More foreign material when harvested too early – curled hulls from rapid drying on the orchard floor or hulltights.
Spreads out equipment use to accommodate more acreage	Higher risk of barking damage if trees are shaken too early.

Many factors influence almond harvest time, including equipment scheduling, weather, irrigation timing, NOW pressure, and the potential of an inshell premium with shaking at a later hull split stage. With all these things in consideration, it is important for growers to prioritize their goals for the crop. Growers must account for site-specific challenges whereby subtle changes in the date of shaking help to mitigate costly problems with pests and diseases, nut removal, and nut quality.

The following article is reprinted from the April 2022 issue of The Advisor, published by the California Association of Pest Control Advisors (CAPCA)

Protecting Sacramento Valley Waterways from Pyrethroid Exceedances

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Protecting California's waterways from pesticides is the joint responsibility of all Californians. These protections need to be implemented within urban as well as agricultural environments because typical watersheds are influenced by hundreds, if not thousands, of individual point sources that are associated with homes, other residential buildings, farms and right-of-ways. While it is true that one individual point source can lead to contamination of a waterway, it is often the cumulative effects of numerous point sources that leads to exceedances of pesticides.

During the past two decades there has been a concerted effort to keep pesticides out of waterways in the Sacramento Valley. For many years the focus was on organophosphates. Significant amounts of research on reduced-risk pesticides chemistries, alternatives to dormant spray applications in orchards, improved application technologies, and the regulatory cancellation of many urban and agricultural organophosphate products have led to significant reductions in use. Between 2000 and 2019 there has been a steady decline in organophosphate use by farmers, ultimately leading to a 62% overall reduction in acres treated (Fig. 1) and 71% reduction in pounds applied (Fig. 2). When pesticide use data for 2020 and 2021 are released, it is anticipated that there will be further reductions due to the discontinued use of chlorpyrifos and other changes in grower practices.

As farmers have reduced their reliance on organophosphate insecticides for pest control, there has been a shift to other control tactics. This includes increased reliance on biological control, the adoption of innovative pest management techniques like mating disruption, use of resistant plant varieties, and shifts to a wide range of alternate pesticide chemistries. Most challenging for the topic of watersheds has been a shift towards increased use of pyrethroids (Fig. 1, 2). Similar to organophosphates, pyrethroids are broad-spectrum contact insecticides that control a wide range of agricultural pests.

Unfortunately, as the levels of organophosphate detections in waterways have gone down, the levels of pyrethroid detections have gone up. In general, the amounts found are low and within levels considered safe for aquatic life. Nevertheless, cases of exceedances do occur, and these cases need to be eliminated.

Between 2015 to 2019, Pesticide Use Reports from the California Department of Pesticide Regulation show that approximately 65,000 pounds of pyrethroid active ingredients were applied annually to 815,000 acres of farmland representing 104 different agricultural commodities in the Sacramento Valley. Approximately 80% of all usage was within four commodities: almonds, walnuts, rice, and processing tomatoes (Fig. 3). The overall piece of the pie that each of these commodities represents is due, in large part, to the acreages planted relative to other crops, and not necessarily due to high use on a per-acre basis. In almonds, for example, comparisons of acreages treated, and actual acres show that the average almond orchard is treated with a pyrethroid once every two years.

Farmers and pest control advisers currently have numerous tools to manage agricultural pests. These tools are commonly sorted into three buckets: cultural controls, biological controls, and chemical controls. The goal is always to rely on biological controls to the greatest extent possible, using cultural controls as needed to help prevent pest problems, followed by chemical controls as needed. When chemical controls are needed, the goal is always to use the least disruptive, yet effective chemical. On the sliding scale from least to most disruptive chemical controls are things like mating disruption, microbial and biological insecticides, selective insecticides, and then broad-spectrum insecticides like pyrethroids.

Using almonds as a case study, pyrethroids are typically used during one of three treatment windows routinely referred to as dormant sprays (January), 'May' sprays (mostly in April and May), and hull split sprays (July and August) (Fig. 4).

Applications of pyrethroids during the dormant season are usually made for peach twig borer. This pest was historically considered one of the most significant in the region due to the damage that it caused by directly feeding on almond kernels. That is no longer the case. As almond growers in the region have switched from flood-based to precision-based irrigation systems, increases in moisture uniformity during the period of shell expansion have led to a stronger shell seal. As a result, peach twig borer larvae are usually found feeding on the inside of the hull, but outside of the shell where feeding is of no concern.

Additionally, reductions in organophosphate use over the past two decades have increased levels of biological control in almond orchards. For peach twig borer this includes multiple species of parasitoids and field ants. In particular, the native gray ant is known for plucking peach twig borer larvae from their overwintering site (called a hibernacula) to eat them. Faced with decreased issues from this pest, almond growers have already demonstrated significant reductions in dormant insecticide sprays, and in cases where peach twig borer treatments are still needed, most growers have shifted to the use of the microbial product *Bacillus thuringiensis* during bloom, or other reduced-risk larvicides in April or May according to monitoring and degree-day model calculations.

'May' sprays are the second timing window where pyrethroids are sometimes used in almonds. This timing can be for worm pests, such as peach twig borer or navel orangeworm, but is often used to control large bugs, such as leaffooted bug and stink bugs, that can cause significant damage to almond kernels by using their proboscis to probe into the nutmeat. This causes shriveled kernels or nut abortion while the meat is still developing or can leave the kernel misshapen or blemished (dark stain/brown spot) if feeding occurs after it has already formed. Unfortunately, this is a case where there are few alternatives to pyrethroids. Reliable cultural controls for this pest don't exist, biological control is limited to egg parasitoids that are often in low abundance, and trials using reduced-risk insecticides at best have found products that can control a percentage of adults on contact, but that do not provide any residual control against additional bugs that continue migrating into the orchard. Fortunately, on an annual basis the need for stink and leaffooted bug treatments is the exception to the rule, and growers can make treatment decisions on an as-needed basis, while taking care that any pyrethroids applied stay on site and do not drift into waterways.

Hull split is the third period of the year when pyrethroids are used in almonds. Some of these treatments may be for stink bugs, but the majority are for navel orangeworm. This pest is the most significant pest of both almonds and pistachios at a statewide level, and it also attacks walnuts. Larvae drill into the nutmeat where they become the primary cause of nuts being classified as 'inedibles', in addition to the risks that they cause due to their associations with *Aspergillus* sp. fungi that have the potential to produce aflatoxins.

Almond farmers battle navel orangeworm each year using an integrated approach that includes sanitation, timely harvest, mating disruption and insecticides. Winter sanitation serves as the backbone of the program by removing larvae from the orchard by destroying nuts remaining in the tree after harvest, and by preventing spring survivors from being able to find places to lay eggs. Timely harvest helps by removing nuts before they can be attacked, and by removing second or third-generation larvae from the orchard before they can contribute to the third and fourth flights of adults. Mating disruption is a relatively new technique that has proven to consistently provide approximately 50% reduction in damage when deployed using aerosol canisters or MESO emitters. Lastly, the fourth technique for controlling navel orangeworm is insecticides. This is typically done using products containing methoxyfenozide or chlorantraniliprole, both of which are selective and classified as reduced-risk pesticides by the U.S. Environmental Protection Agency. By using an integrated approach to navel orangeworm management, almond growers can typically avoid the need to use pyrethroids while controlling this pest.

Almonds represent just one example of the many California commodities where pyrethroids still play an important role in pest management, but where shifts away from pyrethroids can occur over time. As more integrated pest management programs are implemented, growers typically see an increased abundance of biological control organisms and an increase in overall sustainability. Decreased reliance on pyrethroids, and on-farm efforts to prevent off-site movement of pyrethroids in cases where they are still needed, are effective ways for farmers to participate in the shared role of all Californians to protect the quality of local waterways.

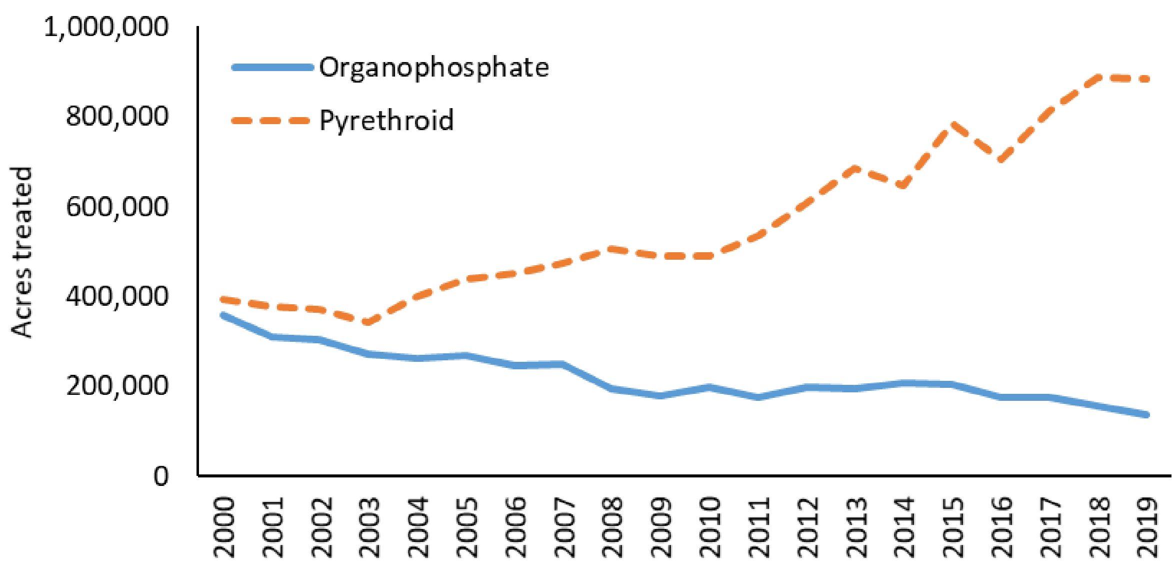

Figure 1. Annual acres treated with organophosphate and pyrethroid insecticides in the Sacramento Valley from 2000 to 2019. Source: California Department of Pesticide Regulation Pesticide Use Report data.

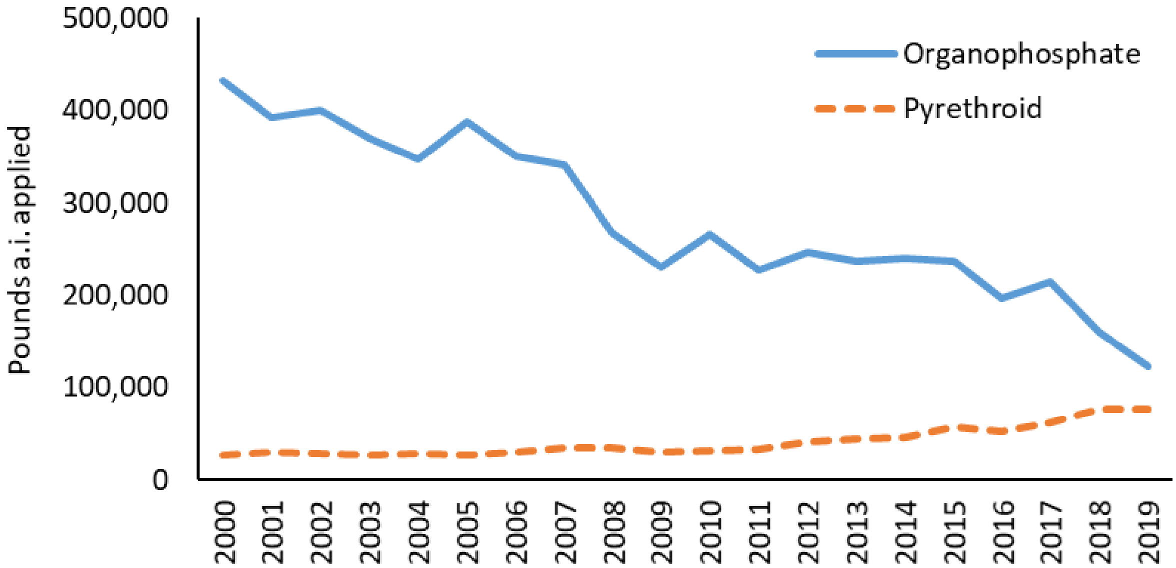

Figure 2. Annual pounds of active ingredient (a.i.) of organophosphate and pyrethroid insecticides applied in the Sacramento Valley from 2000 to 2019. Source: California Department of Pesticide Regulation Pesticide Use Report data.

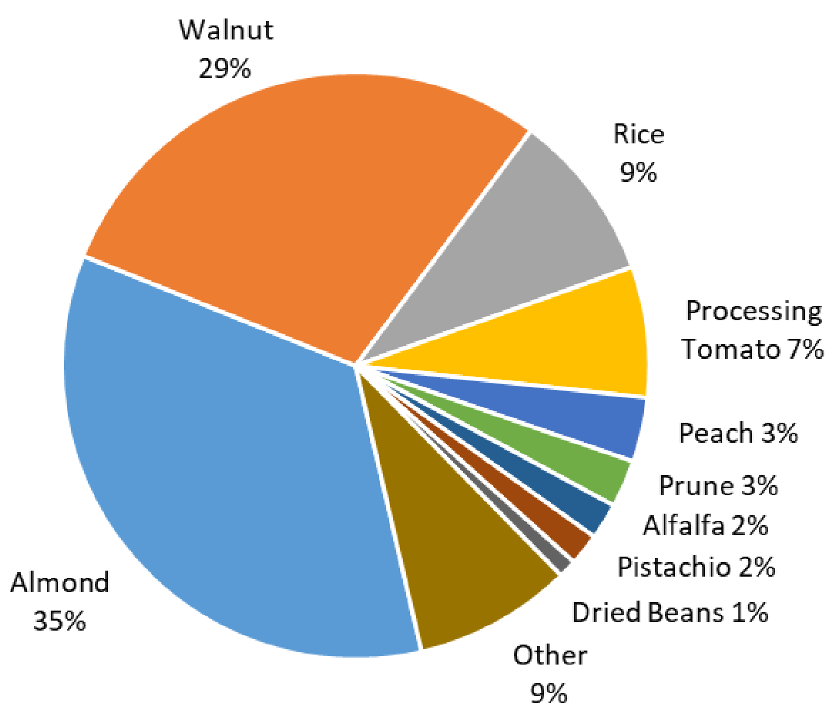

Figure 3. Percentage of total pyrethroid use by commodity, 2015 to 2019, Sacramento Valley. Source: California Department of Pesticide Regulation Pesticide Use Report data.

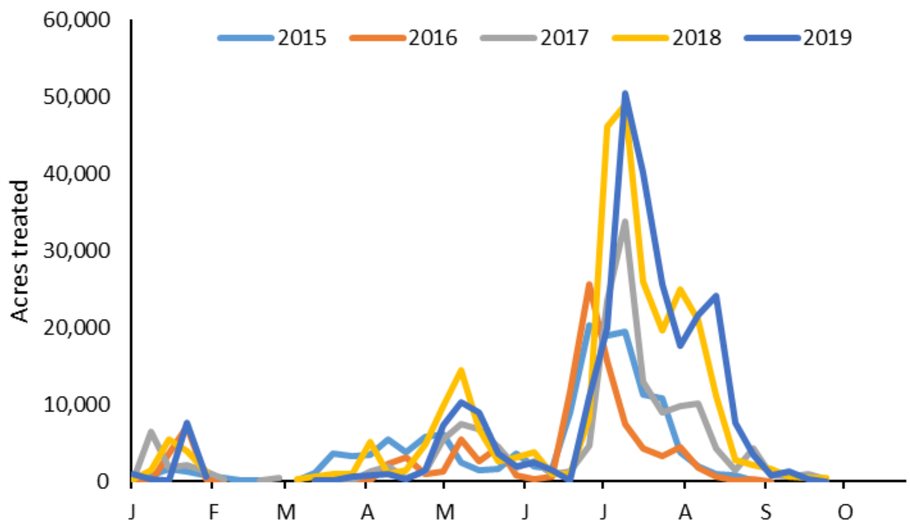

Figure 4. Almond acres treated weekly with pyrethroids, 2015 to 2019, Sacramento Valley. Source: California Department of Pesticide Regulation Pesticide Use Report data.

Is it time for a closer look at alternative nutrient sources?

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

Consistent, positive net return/acre to the grower is the key to sustainable farming. In 2022, hitting that goal is tougher due to 1) lower almond prices and 2) increases in major input costs including nitrogen (N) and potassium (K) fertilizer. With the real possibility of continued tight nut markets and high input costs, it's worth considering all nutrient input options in an effort to lower costs and maintain production. This short article briefly presents and discusses a few alternative nutrient (re)sources. Growers may already be working with some or all of these materials and practices.

Nitrogen (N) and potassium (K) cost was roughly 17% of total cash costs to grow almonds in the 2019 UC Cost to Establish and Produce Almonds in the Sacramento Valley. High yielding almond orchards export large amounts of these nutrients in the harvested nuts (hull, shell and kernel). In most conventional orchards, these nutrients are provided by soluble, mineral fertilizers such as nitrogen (N) fertilizers containing urea, nitrate, and/or ammonium. As well as potassium (K) fertilizers such as potassium sulfate (SOP), potassium chloride (MOP), potassium thiosulfate (KTS) and potassium carbonate. These materials can be directly injected into irrigation water and delivered into the active root zone. When carefully managed, use of these fertilizers is highly efficient. However, as stated above, current price and perhaps future availability of conventional fertilizers challenge a grower's bottom line. Alternative nutrient sources are locally available and, also, may be part of a sustainability program.

Except for irrigation water nitrate, all the alternative nutrient sources presented below are largely insoluble or slowly degradable soil amendments that contain low (<5% by dry weight) levels of essential nutrients. Application rates must be in tons/acre to deliver even partial crop nutrient requirement(s). In addition, the amendment must be incorporated (tilled) into the orchard soil or left on the soil surface for rain or irrigation (sprinkler) water to move nutrients into the soil. Availability of N-P-K from these materials generally ranks K = P > N. Growers should consider working with their CCA to trial different sources and practices to determine what practices might best fit their operation.

Irrigation water nitrate can be a significant source of N to an orchard. No extra effort is needed to “use” this N source except to include irrigation water nitrate-N (from lab test result) in the orchard N budget and reduce fertilizer N to match that applied with the irrigation water. See page 5 of the new Almond Board of CA publication Nitrogen Best Management for details on ground water as a nitrogen source.

Composted manure can be a significant source of phosphorus and potassium (up to 90% of the total P or K in that compost) compared to <10% of the total N if no runoff/erosion losses occur. In general, manure compost contains roughly 2x the N and 3-6x the P or K as composted municipal yard waste.

N fixing cover crops can capture as much as 80-120 lbs N/acre and some of that can be available to almond trees. The amount of N available to almond trees from cover crops varies with cover crop growth, composition (grains vs legumes), crop termination timing and method (mowing or tilling). See a Cover Crop Research Review post in The Almond Doctor and The Almond Board of California’s Cover Crop Best Management Practices for more information.

Almond shells contain significant amounts of K (1.5% on dry wt basis). Shells release K rapidly with rain or irrigation water. Shell/hull mixtures from shell piles can contain more than 2% K (roughly 50-60 lbs K_2O/ton). Spreading almond hulls and shells, preplant or in young orchards, is a way to preload soil K ahead of crop need and dispose of a crop residue at the same time. A research update on shells and hulls in almond orchards will post in the near future in the Sacramento Valley Orchard Source. Growers are experimenting with application of shells in the Sacramento Valley.

There are costs and tradeoffs with the materials and practices listed above. Compost and crop residue (hulls and/or shells) must be hauled to the orchard and spread. Cover crops must be planted, require rain or irrigation water to grow, mowed down ahead of frost threat, and finally mowed or tilled to terminate. However, the benefits from these locally available nutrient sources may be a worthwhile consideration for growers, especially if there is an added benefit of improving rainwater infiltration by increasing orchard floor surface cover (spread or grown) in the fall.

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