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Monterey and the Leafing Failure

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This spring, I received many calls regarding the failure of vegetative buds to push, particularly in the Monterey variety. Affected trees are characterized by an entire scaffold that failed to leaf out, even though trees bloomed as usual and, in some cases, set a crop (Figure 1 & 2). In many cases, if you cut into the wood, the tissue is still green underneath the bark. As is true of many things in nature, we don't fully understand the phenomena. What follows is some information on what differentiates this condition from similar symptoms, what may be causing it, and what to do if your trees are showing symptoms.

What it isn't: This failure to leaf out normally is not the same as "non-infectious bud failure", which is most commonly seen in 'Carmel', but can also occur in other varieties. Non-infectious bud failure is a genetic disorder that affects vegetative buds and is a chronic condition that will continue to manifest each year. While there does appear to be a genetic component to the symptoms observed this year – they are primarily limited to Monterey – past experience with these symptoms suggests that most trees will resume normal growth next year.

What is causing it: Farm advisors across the state have seen this syndrome occur sporadically over the last 10 to 15 years, but no cause has been consistently identified. Some hypotheses have included excess water or deficient carbohydrate reserves in the buds. Unfortunately, it is difficult to link a specific set of causal conditions to a problem that occurs only occasionally.



Fig 1. Monterey showing a scaffold that has failed to leaf out normally.

What to do about it: Some growers have sent crews through to remove affected limbs. This is a mistake and is premature, as historical experience suggests that many of these trees will push buds like normal either later this season or next spring. More than one farm advisor across the state has reported that the affected limbs will leaf out and grow normally the year following symptom development. Nuts that have set on these branches may be harvested with the rest of the tree.



Fig 2. In many cases, these trees set nuts on affected limbs even though leaves are absent.



School is out, and the grades are coming in: July Leaf Analysis

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As the bulk of your almond fertility program for the season comes to an end, it's time to get the report card on how you did. Although little corrective action can be taken this season, this report card will help inform next year's program. The in-season corrective action that can be taken is to inform your last shot of nitrogen timed either just before or just after harvest. This last shot should account for no more than 20% of your total season's nitrogen application and can be reduced if July nitrogen levels are excessive (see August nutrition bullet in this newsletter). Published July critical values established for almond by UC researchers can help guide you in your fertilization practice. Analysis reveals specific nutrient deficiencies and alerts you to developing trends when results are compared from one year to another. Keeping mature trees below excessive levels for nitrogen can save on fertilizer costs and help reduce hull rot by avoiding over fertilization.

July leaf sampling has physiological importance as leaf nutrient levels change through the growing season. Critical values have been developed for July when many nutrient levels in leaf tissue are stabilized. Concentrations of nitrogen, phosphorus, and zinc on a leaf dry-weight basis start very high early in the season

and decline rapidly to a fairly steady state after mid-June, then drop off again from September to leaf fall. Potassium starts high in the spring then decreases, reaching a plateau about the same time as nitrogen, phosphorus and zinc. Concentrations of magnesium, manganese, boron and chloride remain fairly constant or increase slightly during the season. Boron, chloride, and sodium will increase steadily if excess amounts are present in the soil or water. Calcium is the one element that always starts low and increases steadily over the season as the leaves age.

Excessive amounts of chloride and sodium should be monitored if water quality is poor and/or chloride is a component of the fertilizers frequently used in the orchard. Depending on your location and water source in the Sacramento Valley, your boron levels could be toxically excessive or woefully deficient. Hull samples at harvest are the most sensitive test for orchard boron status.

Most laboratories group several key macro and micronutrients together in one easily requested analysis. Note that if micronutrients have been applied in a foliar spray (including fungicides such as ziram, Manzate, and/or Ph-D), contaminated leaves will show excessively high levels of those nutrients and the reported levels should be disregarded. To help reduce this problem, check to ensure that the laboratory you use washes leaf samples before analysis and that you promptly send in leaf samples (i.e. desiccated leaves cannot be washed).

The relatively new protocol for April leaf analysis is used to give an advance estimate of July nitrogen levels that can be compared to the July critical value by entering the April nutrient level results into the N-predication model. To learn more about this prediction model please see: almonds.com/sites/default/files/almond_early-season_sampling_and_in-season_nitrogen_application_maximizes_productivity_minimizes_loss%5B1%5D.pdf

When comparing lab results from one year to the next, or for an April and July sampling, it is important to consistently use the same sampling methods. The following methods should be followed:

- Define sampling block based on uniform soil type, variety, age, and management.
- Sample uniform, representative trees across the block at least 90 feet apart.
 - Consider flagging the trees and going back to those same trees for annual sampling.
- To overcome tree to tree variability, collect a representative sample from a minimum of 18 to 28 trees.
- From each tree, collect all the leaves from 5 to 8 well exposed, non-fruiting spurs around the canopy located between 5 and 7 feet from the ground.
- A minimum of 100 leaves per sample should be combined in a single paper bag for analysis.
- Take notes while sampling, noting relative vigor and other observations between blocks, to better inform the analytical results.

Leaves selected for analysis should be free of obvious tip burn, insect or disease injury, mechanical damage, etc., and should be from normal, healthy trees. If you have a weak area and you'd like to diagnose the problem, sample that area and compare the results with those of a sample from your best area to see if tree nutrition might be involved. This type of troubleshooting analysis can be done at any time during the season. Keep in mind that nutrient deficiency might be a symptom of another problem, like compromised root health.

Deficiencies that are most common in this area are nitrogen, potassium, and zinc. Zinc deficiency is most common in sandy or high pH soils and is easily identified in the field from leaf symptoms early in the season. Boron deficiency is more prevalent on sandy soils or on soils near the foothills. Manganese and iron deficiencies are sometimes seen on high pH soils or where soils are too wet or have areas with high water tables. Useful critical values are not established for iron or sulfur levels in almond leaf tissue.

Critical values for July leaf samples are shown in Table 1. Keep the results with your fertilizer application and yield records to better evaluate and estimate future fertilization needs. For more information on nutrient deficiencies and toxicities, sampling procedures, and critical values, see Chapter 26 in the Almond Production Manual, Publication 3364, or the CDFA Fertilizer Research and Education Program site for almond: apps.cdfa.ca.gov/frep/docs/Almonds.html

Interpreting results may be more nuanced than simply comparing your results to the critical levels. For instance, a July leaf nitrogen value of 2.2 or 2.3% appears to be adequate, however yield has been shown in certain cases to be reduced at these levels. This is because the critical levels were established by visual symptoms of single trees, while your leaf results represent an average of many trees. An average near the bottom end of adequate may therefore include an unacceptable number of deficient trees. Conversely, repeated results of 2.5% may indicate that at least a portion of the trees in the block are overfertilized. One key way to combat this problem is to follow the previously listed guidelines on reducing sampling variability.

Leaf analysis is one of the many helpful report cards we receive in orchard management. When responding to leaf levels, include orchard appearance and growth before corrective action is taken. Visual observation is an excellent complement to any lab analysis. Make sure that a deficient element is really the problem before you seek fertilizer applications as a solution. Learning from the report card of July leaf samples is one more way of taking an analytical approach to farming and continually improving your production practices each year.

Table 1. Critical nutrient levels for almond leaves sampled in July (Almond Production Manual; UC ANR Pub. 3364).

Nutrient	Deficient	Adequate	Excessive over
Nitrogen (N)	< 2.0%	2.2-2.5%	> 2.7%
Phosphorous (P)		0.1-0.3%	
Potassium (K)	< 1.0%	> 1.4%	
Calcium (Ca)		> 2.0%	
Zinc (Zn)	< 15 ppm		
Manganese (Mn)		> 20 ppm	
Copper (Cu)		> 4 ppm	
Magnesium (Mg)		> 0.25%	
Sodium (Na)			> 0.25%
Chlorine (Cl)			> 0.3%
**Boron (B)			
(Hulls)	< 80 ppm	80-150 ppm	> 200 ppm

* Fully expanded leaves from non-bearing spurs sampled in July.

** Use analysis results of hulls sampled at harvest to best assess almond boron status.

List of laboratories for tissue/soil/water analysis: cecentralsierra.ucanr.org/files/115331.pdf

Irrigation Management for Hull Rot Control

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[Hull rot](#) can be a heartbreaker, appearing suddenly at harvest in orchards where growers and PCAs are trying to “do everything right”. Hitting young, vigorous orchards especially hard, it reduces harvestable crop, increases NOW management costs (sanitation), and kills spurs that were future nut bearing sites. The most susceptible varieties include the most valuable and widely planted –Nonpareil and Monterey – as well as Sonora, Fritz, and Winters. Growers looking to maximize net return from their orchards planted with these varieties should consider a full hull rot management program in June and July, especially at hull split.

A complete hull rot management program includes three approaches: irrigation management in early hull split, adequate nitrogen levels in the orchard, and timely fungicide applications. In this article, we focus on irrigation management with emphasis on Nonpareil. See another article in this newsletter for the other approaches in hull rot management.

The goal of irrigation management for hull rot control is to use low/moderate levels of crop water stress in the Nonpareil trees between early onset and 90% hull split – a window of time lasting usually 2-3 weeks beginning about late June and ending mid-July. The hull split phase is targeted because the fungi (*Rhizopus*) invade the hulls as the sutures split and produces a toxin that kills spurs and eventually the shoots attached to the fruit. Reducing irrigation and allowing low/mild water stress during hull split reduces standing water in orchards and in turn decreasing, temperature and relative humidity. Decreasing wet humid conditions in your orchard modifies the growing conditions so hull rot is not as invasive. (http://ipm.ucanr.edu/PDF/PMG/HullRotmanagement_almonds.pdf).

The best tool to guide this practice is a pressure bomb, which directly measures tree water status. The target pressure bomb readings are within a range of -14 to -18 bars. Soil moisture sensors can provide valuable data, too, but the pressure bomb is the critical tool. To reach these moderate stress levels, the best approach is to “ease up on the throttle” but not “step on the brake” so growers should reduce the hours of each irrigation, not the number of times they irrigate. How much less water to use should be based on the situation in each orchard. The goal is moderate, but not excessive, water stress in the orchard, so pressure bomb readings taken twice weekly to avoid dropping under -18 bars is ideal. Once 90% hull split has been reached, full irrigations should resume along with less frequent pressure bomb measurements until irrigation cut off for harvest.

Soil type and variability influence the timing of irrigation changes for hull rot management. The target moisture levels (pressure bomb readings) at hull split can be reached quickly in sandier soils, which hold less water, and more slowly with loam to clay loam textured soils that are “bigger water banks”. Orchards with more soil variability can benefit more from this hull rot water management strategy if the irrigation system has some capability to irrigate the different soils separately. A reduction in hours of irrigation in heavier soils with higher water holding capacity will induce moderate water stress (-18 bars) and speed up hull split. Meanwhile, pressure bomb readings in sandier or gravelly soils with lower water holding capacity may signal no further reduction in hours of irrigation and help prevent too much tree stress and hull shrivel. The end result is more uniform hull split throughout the orchard.

Irrigation system can also influence the hull rot management strategy. Orchards with drip irrigation systems, which wet less soil than sprinklers or flood irrigation, can see change in water status with reduced water starting at first hull split on sound nuts, while microjet sprinkler irrigated orchards may need to reduce water beginning at blank nut split to reach the target by the time that sound nuts split. Orchards with irrigation systems that wet the entire root zone -- full coverage sprinklers or flood irrigation – may need to cut back on irrigation one or more weeks earlier than hull split in the blank nuts to achieve the pressure bomb numbers wanted for hull rot control by early and mid hull split.

The practices outlined above are not easy to hit perfectly when starting out. However, the benefits can be significant. We suggest growers first try using the pressure bomb to manage water at hull split in a limited area of their operation. Contact your local farm advisor for information on irrigating with a pressure bomb. More and more PCAs are also providing this valuable service.

Added benefits reported for applying moderate water stress (-14 to -18 bars) during hull split are more uniform hull split, earlier harvest and water and energy savings. These benefits can be especially valuable in managing navel orangeworm through earlier harvest.



June Hull Rot Reminder

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

Hull rot infections can cost growers a lot of money; money in lost crop this year, money in more sanitation costs this winter, and money in lost spurs and shoots for future crops. There are two disease organisms responsible for hull rot damage. The first is *Monilinia* (brown rot), which infects the hull just prior to hull split in early to mid-June and doesn't show the black mold characteristic of the second hull rot causing organism, *Rhizopus*, which infects the nut after hull split. *Monilinia* hull rot damage is often hard to diagnose as hull rot. The black mold is missing and the brown rot fungus doesn't show on dried nuts. One or both organisms can infect hulls in the same orchard. Darkening of the xylem tissue below infected nuts is a consequence of hull rot.

The following are practices that, when combined into an integrated hull management program, deliver the best possible control of this costly problem:

- Manage nitrogen (N) fertilizer inputs to keep summer leaf N levels across the orchard under 2.6% N. Leaf levels of 2.2% N or less = deficient, so 2.6% is more than adequate to maintain orchard health and yield potential. This can be done by carefully matching N inputs to cropland and/or tree growth needs. Spring leaf sampling can help. Don't apply fertilizer N after May 15 in blocks with a hull rot history. This will not impact nut growth if adequate N applied before this cut off date.
- When weather conditions (rain or dew) or orchard history of *Monilinia* hull rot exist, consider an **early June fungicide application**. Rainfall on June 8 last year, ranging from 0.08" in Arbuckle to 0.60" in Durham, could have produced a *Monilinia* hull rot infection event. See ipm.ucanr.edu/PDF/PMG/fungicideefficacytiming.pdf for effective fungicide materials. In general, FRAC 3, 11, and 19 fungicides (and mixtures containing those chemistries) are effective in reducing, but not eliminating, hull rot strikes. Best pest control results require good coverage, so a properly calibrated sprayer is crucial to efficacy of treatment.
- As hull split approaches, manage irrigation to deliver moderate water stress (-14 to -18 bars readings on a pressure bomb) during hull split. See article in latest newsletter on this practice. This practice can help tighten up hull split window and so help with early harvest for NOW control.
- Where conditions and/or orchard history show a need, apply a fungicide (same material options as for *Monilinia* infections) at early hull split to reduce *Rhizopus* infections.

The best hull rot control is delivered by a combination of these treatments/approaches.

With June arriving today, growers and PCAs are reminded of early June *Monilinia* hull rot treatments if rain appears in the forecast.

Pre- & Post-Harvest Almond Orchard Management Considerations

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

JUNE

- ✓ *Evaluate Navel Orangeworm and Peach Twig Borer populations.* If the next generations come prior to hullsplit they will go back to mummy nuts and shoots respectively. Generations can be predicted using your biofix and Degree Day models. Back up degree-day predictions by checking traps. Many signs indicate this will be another high NOW pressure year in some orchards. Check out <http://www.sacvalleyorchards.com/almonds/navel-orangeworm-considerations-2018/> on options for aggressive management of NOW.
- ✓ *Monitor for mites* weekly in the orchard's hot spots. Consider the presence of predators (*sixspotted thrips* and predator mites, in addition to the presence of mites, when making treatment decisions). UC IPM guidelines indicate it's acceptable to avoid treating until about 50% of leaves have mites if predators are present, about 30% of leaves if predators are not present. Expand monitoring to the whole orchard after July 1. For more on monitoring and treatment, see the easy-to-follow decision tree and more details at <http://www.sacvalleyorchards.com/almonds/insects-mites/approaches-to-spider-mite-management-in-almonds/>.
- ✓ *Survey ant colony concentration* on the orchard floor 2 to 3 days after irrigation, counting active colonies in five 1,000 square foot areas (roughly a 5 x 6 tree rectangle). Confirm they are the undesirable (protein feeding) pavement or southern fire ants, not the harmless pyramid ants with helpful photos at <http://www.sacvalleyorchards.com/photos-from-the-field/ant-mounds/>. Estimate potential harvest damage using the table at <http://ipm.ucanr.edu/PMG/r3300411.html> and proceed based on your damage tolerance.
- ✓ *Apply 30% of your total nitrogen budget* in early June to match the timing of tree demand. See <https://apps1.cdfa.ca.gov/FertilizerResearch/docs/Almonds.html> for more on rate and timing of nitrogen applications. If the block has a history of hull rot, don't apply nitrogen (N) in June. The last N application in those blocks should be in May.
- ✓ *Ground squirrels* switch from eating green vegetation to seeds and grains in late May. This means that June is the beginning of the window in which they will eat baited rodenticides. Test bait acceptance before use of rodenticide to avoid toxin shyness. For more on ground squirrel management, see <http://www.groundsquirrelbmp.com/>.
- ✓ *Manage young tree irrigation carefully* as summer heats up, especially with potted trees, to make sure water is getting to the rootzone. For more on dealing with the challenge of irrigating potted trees, see <http://www.sacvalleyorchards.com/blog/almonds-blog/why-you-should-irrigate-potted-trees-directly-onto-potting-media/>.

JULY

- ✓ *Get ready for hull split.* UC models estimate hull split starting as early as July 4th this year for Nonpareil at some locations in the Sacramento Valley. To predict hull split using data from your nearest CIMIS station, visit http://fruitsandnuts.ucdavis.edu/Weather_Services/almond_hullsplit_prediction/Hull_Split_Calculator/
- ✓ *Regulated Deficit Irrigation (RDI)* promotes earlier, more even hull split and reduces hull rot. This tightening of hull split may be an especially useful tool this year, given the prolonged bloom. Beginning at hull split initiation, induce moderate water stress by keeping mid-day stem water potential between -14 to -18 bars using a pressure chamber during hull split. Roughly the same effect can be achieved by shortening normal irrigation time by 50% for the first two weeks of hull split.

Then catch up the last two weeks before harvest by providing full irrigation (matching ETc). For more, see the hull rot and irrigation article in this issue.

- ✓ *Take leaf samples* in July to measure nutrient status. Adjust your nutrient management plan for the rest of the season based on July leaf sample results. For more on collecting samples and interpreting results, see the article on leaf sampling in this issue.

AUGUST

- ✓ *Watch for rust in young orchards.* Prevent early defoliation that can negatively affect flower bud formation for next year. Defoliation at harvest can also delay nut drying. For more, see <http://ipm.ucanr.edu/PMG/r3100711.html>.
- ✓ *Plan ahead to minimize dust at harvest.* Consider steps like adjusting sweeper head heights, blower spout angles and fan speed. Find more suggestions at <http://www.almonds.com/growers/in-the-orchard/harvest/harvest-dust>.
- ✓ *If you're harvesting third or fourth leaf trees,* keep an extra close eye on that shaker. Bark slips easily in young trees and can be an entry point for future infection, ultimately shortening the productive life of an orchard.
- ✓ *At harvest, collect nut samples for damage analysis.* Gather at least 100 nuts per orchard after shaking, but before sweeping. Checking these samples immediately after Nonpareil harvest can inform NOW spray decisions for pollinizer varieties. If not checked immediately, freeze them for later. These samples will allow you to better understand damage results on your grade sheets and adapt IPM strategies for next year. Sampling and pest damage diagnosis help, including a handy damage comparison table with helpful photos, can be found at <http://www.sacvalleyorchards.com/almonds/insects-mites/harvest-samples-for-almond-crop/>.
- ✓ *Collect and submit hull samples at harvest* for B analysis. For more information, see <http://thealmonddoctor.com/2014/07/12/hull-sampling-for-boron/>.
- ✓ *Apply a last shot of nitrogen either shortly before or just after harvest* to support bud development for next year. Generally, no more than 20% of the total season's nitrogen should be applied between hull split and early post-harvest. Decrease planned application if July leaf levels were higher than 2.8% N. In blocks with a hull rot history, the target leaf N level is 2.6%. If planning postharvest N application, do it early. October N applications have not improved yield the following year in several years of research.
- ✓ *Manage post-harvest irrigation to minimize water stress.* Water stress in late August to early October can interfere with flower bud development for the following spring. Fewer flowers will mean less crop next year. Defoliation reduces tree vigor by reducing sugar production. This is particularly important for orchards with a long window between harvest of Nonpareil and late pollinizers.
- ✓ *Assess hull rot and shaker damage post-harvest.* Hull rot symptoms can be found at <http://ipm.ucanr.edu/PMG/r3101811.html>.

2018 IPM Breakfast Meetings

Join Area IPM and Farm Advisors to discuss current pest management and production issues. We will largely focus on orchard crops (but everything is on the table for discussion!). These meetings are open to all interested growers, consultants, PCAs, CCAs, and related industry.

Meetings will be held the third Friday of each month (7:30-9:00 am) from March through October and will cover a wide range of timely pest and orchard management topics. Meeting locations will be rotated throughout the Sacramento Valley each month. Please contact Emily Symmes to request topics or bring your questions to the meeting!

Upcoming meetings:

- Glenn County: June 15th (Berry Patch Restaurant, Orland)
- Butte County: July 20th (Red Rooster Café, Durham)
- Yuba-Sutter-Colusa Counties: August 17th (IHOP, Yuba City)
- Tehama County: September 21st (Rockin' R Restaurant, Red Bluff)

Full 2018 schedule is available on the events page at sacvalleyorchards.com or by contacting UC IPM Advisor Emily Symmes at (530) 538-7201 or ejsymmes@ucanr.edu.

Seating is limited – please RSVP to Emily prior to the meeting date ☺

****DPR and CCA Continuing Education hours requested****

(No-host breakfast)

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