HEALTHY FOOD SYSTEMS | HEALTHY ENVIRONMENTS | HEALTHY COMMUNITIES | HEALTHY CALIFORNIANS

Sacramento Valley Almond News

Serving Sacramento, Solano & Yolo Counties

January 2016

UC CE University of California Agriculture and Natural Resources Cooperative Extension

In this Sacramento Valley Almond News…

- Upcoming Almond Meetings
- Pre-Bloom Almond Orchard Management Considerations
- Wet or Dry, GetReady
- El Niño Rains and Pruning Don't Mix!
- Krymsk 86 in Cool, Wet Conditions
- Frost Protection
- Have Any of Your Trees Blown Down?

Upcoming Almond Meetings

Save the Date!

- **Young Orchards Workshop** – January 14th, 8:00-12:00
  Woodland Community & Senior Center, Woodland. *Topics include* vertebrate management, irrigation for young almonds, training & pruning young almonds, pest & disease concerns in young orchards.

- **Sacramento-Solano-Yolo Almond Day** – February 3rd, 8:00-12:00
  Norton Hall (UCCE Office), Woodland. *Topics include* weed management, irrigation, canker and foliar disease management, rootstocks and Laws & Regs.

- **Sutter-Yuba-Colusa Almond Day –** February 3rd, 1:00-5:00
  Colusa Fair Grounds, Colusa. *Topics include* weed management, irrigation, canker and foliar disease management, rootstocks and Laws & Regs (same agenda as Woodland meeting).

- **Glenn-Butte Almond Day** – February 5th, 8:00-12:00
  Elks Lodge, Chico.

Pre-Bloom Almond Orchard Management Considerations

Luke Milliron, UCCE Horticulture Intern, Sutter, Yuba, Colusa and San Joaquin Counties
Dani Lightle, UCCE Farm Advisor, Glenn, Butte, & Tehama Counties
Emily J. Symmes, UCCE Area IPM Advisor, Sacramento Valley

Pruning and Canker Diseases:

✓ Pruning has been reduced dramatically in recent years as long-term UC research trials demonstrated pruning was not needed to maintain or improve yield. Pruning to remove dead or diseased wood, to thin or control

tree height, or to eliminate branches that interfere with other orchard operations is still recommended. Avoid pruning prior to any forecast heavy rainfall since rain-splash can result in costly canker disease spread and infection of fresh pruning wounds (*see article in this newsletter*).

Nutrition:

- ✓ Now is the time to begin planning your nitrogen budget for the upcoming season. Nitrogen management tools, including a budget calculator, are available through the California Almond Board's sustainablealmondgrowing.org/, a background guide to nitrogen management can be found at ucanr.edu/sites/scri/files/189631.pdf. It is critical to test your water source for nitrogen and incorporate that contribution into your budget. Approximately 20% of the year's predicted nitrogen needs should be applied in February or March.

- ✓ Nutrient deficiencies will sometimes be most pronounced early in the season when trees first leaf out, **particularly in wet springs**. Photos of some deficiencies and toxicities in almonds may be viewed at fruitsandnuts.ucdavis.edu/pages/almond/ - select "Almond Deficiencies & Toxicities" at the bottom to launch the photo gallery.

Pest Management:

- ✓ Sanitation is the single, most important activity under your control that can help reduce navel orangeworm (NOW) pressure next season. This cultural activity is the baseline upon which the remainder of a NOW control program should be built. Remove mummies from trees by February 1st with a shaker or by hand poling. Leave no more than two mummies per tree. Inspect a sample of the remaining mummies for rates of infestation (live larvae or pupae), as this can indicate the level of in-orchard NOW pressure that can be expected going into next season based on the potential carry-over population. Sweep or blow fallen mummies into row middles and destroy them with a flail mower or disc by early to mid-March. This will destroy the overwintering generation prior to emergence of adults from the mummies. Don't rely solely on wet conditions to significantly reduce the overwintering populations, particularly following a season with high NOW numbers and a 4th generation. Remember that mummy removal and destruction not only increases overwintering larval mortality, but also limits the availability of oviposition and development sites for early generations next season.

- ✓ Dormant spur sampling conducted once by mid-January can prevent surprises from San Jose scale, European fruit lecanium, and mite eggs. Clip off 2 to 3 spurs from 35 to 50 randomly selected trees (100 total spurs) in each orchard and begin by carefully examining 20 random spurs with a hand lens or dissecting microscope, recording the number of spurs with any scales or mite eggs. Follow the treatment thresholds and guidelines on the sampling form at: ipm.ucdavis.edu/PMG/C003/almond-dormantspursampling.pdf

- ✓ Growers have reported sightings of walnut scale (ipm.ucdavis.edu/PMG/r881300311.html) on almond trees; particularly on Monterey. UC researchers do not yet have threshold levels for control of this species in almond.

- ✓ If peach twig borer (PTB) was a problem in last year's harvest, B.t. sprays will provide control with minimal impact on honeybees. This is the **only acceptable insecticide for bloom-time application for any insect pest**. Thresholds and treatment timings are available here: ipm.ucdavis.edu/PMG/r3300211.html.

Manage diseases & bee respectful:

- ✓ For any disease control measures taken during bloom, be sure to follow honeybee health and safety best practices. Almond Board's Bee BMPs:

almonds.com/sites/default/files/content/attachments/honey_bee_best_management_practices_for_ca_almonds.pdf

- ✓ Anthracnose may be initiated with warm, rainy weather during bloom, especially in orchards with a history of anthracnose. Symptoms include blossom blight, small nut infections and marginal necrosis on leaves followed by spur and limb dieback; if rains continue and disease spreads, eventually orange lesions and gumming will occur on larger nuts. Photos and management guidelines are here: ipm.ucdavis.edu/PMG/r3101111.html .

- ✓ Brown rot is also favored by warm rainy weather and may cause gumming at the base of infected flowers and cankers on infected twigs. Flowers are susceptible from pink bud until petal fall, but most susceptible when fully open. Multiple sprays may be required if rainfall occurs during bloom. Guidelines are available here: ipm.ucdavis.edu/PMG/r3100111.html

- ✓ If scab was a problem last season and inoculum is present in your orchard, prevention should be initiated about two weeks after petal fall. If twig lesions are sporulating and rains continue, additional sprays may be required. Rust can be an occasional problem on young trees and replants. Monitor and treat to prevent defoliation. Control measures can be found at the following links.
  Scab: ipm.ucdavis.edu/PMG/r3100411.html; Rust: ipm.ucdavis.edu/PMG/r3100711.html

Weed management:

- ✓ Remove or mow weeds and cover crops before bloom to aid in frost protection.

Wet or Dry, Get Ready

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

Spring isn't here yet, but it will be before we know it. What happens then, weather-wise, and how you react to those conditions could change the season for your operation. But, no one can be certain of the weather this spring. Will it be wet? The forecasters think there is a good chance for that. If that's the case, more bees and bloom sprays, and less irrigation will be needed. But, they could be wrong and 2016 could be another dry year. Better plan for a wet or a dry spring.

Here are some things to consider:

Topic	Wet	Dry
Bees	Higher hive stocking rates (3 hives per acre, minimum of 6-8 frames, with one frame of brood) are recommended in wet years. Spray carefully.	No difference from the last few years. Make sure bees have water sources and fungicides are applied with bee health in mind. Click HERE[1] for link to Almond Board BMPs for bees.
Bloom sprays	With rain at bloom, UC recommends 2 bloom sprays – pink (5% bloom) and full bloom. If it is warm at bloom, use material(s) with anthracnose activity. If it continues to rain, more fungicides will be needed. The more fungicides used, the greater the need to rotate chemistries. Click HERE[2] to see info on	One bloom spray, timed before or at full bloom will provide good disease control under dry (no rain) bloom conditions.

	fungicide efficacy/timing/resistance management.	
Weed management	Properly selected and applied preemergent herbicides, sprayed before rain saturates orchard soils, provides weed control when you can't get into too-wet orchards.	Pre or post emergent sprays will control weeds. Don't fall behind. Controlling weeds saves water.
Nitrogen management	20% of annual N budget should go on by mid-March. If it's still raining after petal fall, fertigating, which adds more water, could keep soils cold and wet. Consider banding dry fertilizer (urea, etc.) ahead of forecast rain instead of adding more water to wet soil with fertigation.	Deliver 20% of annual N budget by mid-March. Fertigation should work well if trees need water, too. Don't over-do it. Excessive irrigation in the spring can harm root health.
Irrigation	Wait, unless you like yellow trees.	Don't over-do it with spring irrigation. Deliver only enough water to replace crop water use (ETc) plus any leaching fraction. Know your irrigation water quality and make sure your system is delivering as uniformly as possible.
Pest management	Sanitize orchard before end of January and destroy mummies by March 1. Wet weather should hold off the insect and mite pests, but don't stop monitoring.	Sanitize orchard before end of January and destroy mummies by March 1. Look for adult leaf footed bugs in March and start scouting for mites early.
Crop yield	Wet January and warm low temps = light crops. Click HERE[3] to see supporting article.	Another good year if you have clean water…

[1] almonds.com/sites/default/files/content/attachments/honey_bee_best_management_practices_for_ca_almonds.pdf
[2] http://ipm.ucdavis.edu/PDF/PMG/fungicideefficacytiming.pdf
[3] http://californiaagriculture.ucanr.edu/landingpage.cfm?article=ca.v060n04p211&fulltext=yes

El Niño Rains and Pruning Don't Mix!

Luke Milliron, UCCE Horticulture Intern, Colusa, Sutter, Yuba and San Joaquin Counties.
Franz Niederholzer, UC Farm Advisor, Colusa, Sutter and Yuba Counties
Joseph Connell, UCCE Farm Advisor Emeritus, Butte County

Rainfall and disease spread:
Farming is a tough enough business. Don't help disease damage your orchard. There are a number of fungal and bacterial diseases in the Sacramento Valley that can infest your orchard and reduce orchard productivity. When you prune before rain, you could help the pathogen(s) damage your orchard – especially young orchards. Although these diseases can have vastly different biology, there are some basic practices to keep in mind that will help keep them in check.

The disease triangle during winter:
The "correct" environmental conditions, a susceptible host and an active pathogen are all needed before disease will occur (i.e. the disease triangle). It's safe to assume many canker-causing fungi and bacterial pathogens are present in your orchard, so prevention means minimizing conditions that favor disease and host susceptibility.

Each winter the conditions for infection can come together when pruning wounds make the tree susceptible, wind driven rains spread the pathogen, and water along with the right temperatures favor the pathogen's proliferation.

Pruning leads to susceptibility:
Bark protects the interior of the tree from disease infection. Pruning exposes sensitive tissue, and since pruning cuts require time to heal (reform a protective layer), pathogens can infect the wood before healing is complete. Almond studies on pruning wounds and *Phytophthora syringae* infections, showed that the wounds become less susceptible to infection after two weeks, when temperatures were still warm in the fall. However, pruning wound healing took six weeks to adequately reduce infections when temperatures were cold during winter. As the time between pruning and subsequent rainfall increases, the susceptibility to disease generally declines but it can vary widely depending on the pathogen.

Wet/cool conditions and *Phytophthora syringae*:
Phytophthora syringae, one of the fungal pathogens that causes trunk and branch cankers, is active under cool wet conditions with temperatures below 75 °F. This soilborne disease is particularly problematic in wet years like 2011 that bring saturation and flooding, as the fungal spores can float in standing water and infect the tree. Adequate drainage is thus another important disease prevention step in high rainfall years. Copper sprays right after the pruning of 1st or 2nd dormant scaffolds are toxic to the spores and may reduce infection. The application of phosphonates to prevent infection is not advised. The fungus dies out once temperatures rise above 75 °F with the cankered area healing over from the margins, much like a pruning cut heals following pruning.

Figure 1. An almond orchard in Colusa County with widespread Bot canker, likely the result of December pruning in 2014 and subsequent heavy rainfall. These almonds were adjacent to a row of black walnut trees which most likely served as a source of Bot initial spore inoculum. Photo: Luke Milliron (10/8/2015).

Control by avoidance:
Ideally, avoid pruning prior to predictions of significant extended rainy periods. Figure 1 shows what can happen when pruning cuts are made just prior to a rain event. When pruning is necessary such as training young trees or removing diseased limbs, try to avoid the practice when wet conditions are predicted in the two week forecast. Whatever you do, don't mix pruning and rain.

Protectants and cultural controls:
Spray applications of copper materials and broad spectrum fungicides applied to wounds prior to subsequent rains may be helpful in protecting new pruning wounds on young trees from infections. Pruning wound protectants have been tested by UC researchers in California for sweet cherry and grapevine. This work suggests that it may be beneficial to protect large pruning cuts with acrylic paint or pruning sealer. Florent Trouillas, Plant Pathologist at the Kearney Agricultural Research and Extension Center, and his Ph.D. student Leslie Holland (UC Davis) will be testing pruning sealers and fungicides on almonds in the coming year.

Special thanks to technical advice from Themis Michailides (UC Pathologist at Kearney Agricultural Research and Extension Center), as well as Brianna McGuire and Ara Avadisi Abramians (Gubler Lab at UC Davis).

Krymsk 86 in Cool, Wet Conditions

Dani Lightle, Orchards Advisor, Glenn, Butte, & Tehama counties

If you are like many growers in the Sacramento Valley, you may have planted a new almond orchard on Krymsk 86 (K86). In light of the potential for a cooler, wet spring, it is worth reviewing our observations concerning Krymsk 86 and other rootstocks in wet conditions. Some symptoms that may be observed are:

- Micronutrient deficiency symptoms. When trees first leaf out and soils are wet and cold trees may show interveinal chlorosis that are typically associated with zinc or manganese deficiencies. This can occur in trees on most rootstocks.
- Later in the spring as soils warm up but are kept too wet by late rainfall or over irrigation, trees on Krymsk 86 (and Marianna 2624) may turn yellow, roll their leaves, and stop growing.

What should you do if these symptoms are observed? First and foremost, make sure you're not over-irrigating! Roots need good aeration and soils to dry out and warm up to be able to grow and uptake nutrients efficiently. Carefully monitor soil moisture in the spring and be careful not to turn irrigation water on too early. Secondly, be patient. In our experience, once soils dry out, trees tend to push past the symptoms and will often begin to put on new growth. When over-irrigated during the growing season, symptoms can persist for the remainder of the season, particularly on 1st to 3rd leaf trees. If the problem is corrected, normal growth frequently resumes the following year.

Frost Protection

Joseph Connell, UCCE Farm Advisor Emeritus, Butte County,
Richard Snyder, UCCE Biometeorologist, Land, Air and Water Resources, UC Davis

Mild, **radiation frosts** occur on still, clear nights, often with the development of a strong inversion. Under these conditions frost protection can be provided by running water. **Advection frosts** are more severe and usually result in more damage. They occur with wind present as cold air moves into a field from areas outside the orchard. Cold air is heavier than warm air, flows down slope like water, and accumulates in low spots or in areas where air drainage is blocked.

Frost Sensitivity

If water is used for frost protection, critical temperatures for frost damage help us know when to turn irrigation systems on or off. At pink bud, flowers are more resistant to cold compared to full bloom, which is more resistant than at petal fall or with small nuts. The following table provides an estimated percentage of cold injury to almond fruit buds and small nuts exposed for 30 minutes to cited temperatures at indicated growth stages.

Soil and Groundcover Condition

Groundcover condition affects orchard minimums with any cover taller than 4 inches in height generally being colder. Soil heat storage is reduced because sunlight is reflected and water is evaporated. Keeping groundcovers cut short to 2 inches or less during frost season allows sunlight to reach the soil surface, and increases soil heat storage resulting in a warmer orchard through the night.

Bare soil with soil moisture near field capacity (about 2 days after wetting) is warmest because it transfers and stores heat best. If pre-frost conditions are dry and windy and a dry crust forms on the surface, then, bare soil can be colder than a surface with a short (less than 2 inch) groundcover that tends to keep the surface moist with dew from the grasses and weeds. The ground surface must be moist but not saturated for bare ground to be warmest.

Dry or recently cultivated soil has many air spaces, lower heat storage capacity, and low heat conductivity resulting in colder minimum temperatures. Moist soil stores more heat due to water content, has higher conductivity, and will have higher minimum temperatures. Irrigation should ideally wet the top foot over the entire orchard surface, soil moisture should be near field capacity, and these conditions should be achieved in advance to gain the most advantage. A light irrigation to moisten dry soil a day or two before a frost will help obtain the greatest heat storage.

Sprinklers and Micro-sprinklers

Under tree sprinklers provide protection because freezing water releases sensible heat into the orchard system. If enough water is frozen, the surface temperature will not drop below freezing. This sensible heat is **radiated or convected** into the trees, thus providing protection. Solid set sprinklers applying 40 gallons of water per minute per acre will provide frost protection under most conditions we experience. A lower application rate will provide less protection and is more likely to fail in severe frost conditions. Sprinklers can be safely turned off when the wet bulb temperature upwind of the protected orchard is above the critical crop damage temperature or when all the ice melts. You can measure wet bulb temperature for your site using a psychrometer. Doing so can save water and pumping costs by turning off the system as soon as it is safe to do so.

In some orchards, frost protection is limited by the amount of water or movable pipe available. To learn more about moveable pipe placement we ran an experiment comparing protection with sprinkler lines in every middle, every other middle and every fourth middle. Air temperature in all sprinkled areas was 1° to 2°F warmer than the unsprinkled control and there were no differences between these spacings. Soil surface temperatures were colder the further from the sprinklers, and the dry centers between the lines in every fourth middle were as cold as the unsprinkled control. Line spacing directly affects soil surface temperature but air movement evens out the benefits. Without air movement, protection may fail between widely spaced lines.

In our experiments with **micro-sprinklers,** applying 15, 25, and 40 gallons per minute per acre resulted in little difference in observed air temperatures. However, exposed temperatures were 1° to 2°F warmer at the higher water rates. Exposed temperature is what the buds themselves experience. The fact that the low water application gave a lower exposed temperature indicates that protection with under tree micro-sprinklers is coming mostly from direct radiation from the warmer wet spots under the trees rather than through convection of warmer air. We found a greater separation in exposed temperatures between the low and medium/high rates on the colder nights. Thus, micro-sprinkler application rate had little effect on air temperature but did affect temperature of exposed buds and flowers. The low application rate gave less protection than the higher rates and the higher soil surface temperatures from higher application rates led to more radiation heating. Under windy advective conditions this may be more important since convection heating is negatively affected by wind but radiation is unaffected.

Drip irrigating in advance of a frost can help keep the orchard warmer by increasing soil heat storage particularly if the soil surface is dry. Running the system during a frost may provide slight benefits due to radiation heating from the wetted area beneath the trees. **Flood irrigation** for frost protection works in a similar fashion but due to larger water volumes it will provide more protection as long as ice doesn't form on the water's surface.

Percentage of damage to almond exposed for 30 minutes to the cited temperature during various growth stages.

Variety	Temperature (°F)										
Stage	30	29	28	27	26	25	24	23	22	21	20
Sonora											
Green bud	--	--	--	--	--	1	--	--	5	--	5
Pink bud	--	--	--	--	--	20	10	30	10	5	10
Full Bloom	--	--	--	--	70	80	70	80	90	--	--
Small nut	--	1	5	60	100	--	--	--	--	--	--
Peerless											
Green bud	--	--	--	--	--	5	--	--	5	--	10
Pink bud	--	--	--	--	1	50	100	--	--	--	--
Full Bloom	--	0	5	90	100	--	--	--	--	--	--
Small nut	--	0	5	60	100	--	--	--	--	--	--
Nonpareil											
Pink bud	--	--	--	--	--	20	40	40	30	50	40
Full Bloom	--	--	--	50	70	90	90	90	--	--	--
Small nut	1	1	40	90	100	--	--	--	--	--	--
Price											
Pink bud	--	--	--	--	--	30	30	30	40	40	20
Full Bloom	--	0	5	50	70	90	100	100	--	--	--
Small nut	--	0	30	80	100	--	--	--	--	--	--
Carmel											
Pink bud	--	--	--	--	--	40	50	40	70	40	70
Full Bloom	--	--	--	60	90	100	100	100	--	--	--
Small nut	1	10	30	70	100	--	--	--	--	--	--
Butte											
Pink bud	--	--	--	--	40	80	70	80	90	90	--
Full Bloom	--	0	0	60	90	100	--	--	--	--	--
Small nut	--	1	5	80	100	--	--	--	--	--	--
Padre											
Pink bud	--	--	--	--	70	90	90	100	90	--	--
Full Bloom	--	0	1	50	100	100	--	--	--	--	--
Small nut	--	1	5	30	100	--	--	--	--	--	--
Mission											
Pink bud	--	--	--	--	90	70	90	80	100	--	--
Full Bloom	--	0	1	80	100	100	--	--	--	--	--
Small nut	--	0	40	90	100	--	--	--	--	--	--

Source: J.H. Connell and R.L. Snyder, Unpublished data.
Note: Dashes indicate data are unavailable.

Minimum turn-on and turn-off air temperatures (°F) for sprinkler frost protection for a range of wet-bulb and dew-point (T_d) temperatures (°F)*

T_d	Wet-bulb Temperature (°F)										
°F	22	23	24	25	26	27	28	29	30	31	32
32											32
31										31	32.7
30									30	31.7	33.3
29								29	30.6	32.3	34
28							28	29.6	31.2	32.9	34.6
27						27	28.6	30.2	31.8	33.5	35.2
26					26	27.6	29.2	30.8	32.4	34	35.7
25				25	26.5	28.1	29.7	31.3	32.9	34.6	36.3
24			24	25.5	27.1	28.6	30.2	31.8	33.5	35.1	36.8
23		23	24.5	26	27.6	29.1	30.7	32.3	34	35.6	37.3
22	22	23.5	25	26.5	28.1	29.6	31.2	32.8	34.5	36.1	37.8
21	22.5	24	25.5	27	28.5	30.1	31.7	33.3	34.9	36.6	38.2
20	22.9	24.4	25.9	27.4	29	30.6	32.1	33.7	35.4	37	38.7
19	23.4	24.9	26.4	27.9	29.4	31	32.6	34.2	35.8	37.5	39.1
18	23.8	25.3	26.8	28.3	29.8	31.4	33	34.6	36.2	37.9	39.5
17	24.2	25.7	27.2	28.7	30.2	31.8	33.4	35	36.6	38.3	39.9
16	24.6	26.1	27.6	29.1	30.6	32.2	33.8	35.4	37	38.7	40.3
15	25	26.4	27.9	29.5	31	32.6	34.2	35.8	37.4	39	40.7

*Select a wet-bulb temperature that is at or above the critical damage temperature for your crop and locate the appropriate column. Then choose the row with the correct dew-point temperature and read the corresponding air temperature from the table to turn your sprinklers on or off. This table assumes a barometric pressure of 1013 millibars (101.3 kPa).

Have any of your trees blown down? Give us a call!

Bob Johnson, UC Davis, Plant Pathology

A project funded by the Almond Board of California is investigating fungi associated with wood decay. If you have windfall trees or are removing an orchard we are interested in sampling your trees to determine which fungi are responsible for tree failures. If interested in helping us out, please contact: Bob Johnson, 530-302-6301, bobjohnson@ucdavis.edu