Sacramento Valley Almond News
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In This Issue

Franz Niederholzer
UCCE Farm Advisor
Sutter, Yuba, Colusa Counties

Krymsk 86 in Cool, Wet Conditions

Dani Lightle, UCCE 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.

Wet or Dry, Get Ready

Franz Niederholzer, UCCE Farm Advisor, Colusa, Sutter and 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.

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 fungicide efficacy/timing/resistance management.	One bloom spray, timed before or at full bloom will provide good disease control under dry (no rain) bloom conditions.
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, UCCE 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.

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.

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

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).

Upcoming Almond Meetings

- **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. *Agenda in this newsletter.*

- **Sutter-Yuba-Colusa Almond Day** – February 3rd, 1:00-5:00
  St Bernadette's Hall, Colusa. (Across the street from the Colusa Farm Show at the Colusa Fairgrounds.) *See agenda and meeting site detail/directions in this newsletter.*

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

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	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0
32											32.0
31										31.0	32.7
30									30.0	31.7	33.3
29								29.0	30.6	32.3	34.0
28							28.0	29.6	31.2	32.9	34.6
27						27.0	28.6	30.2	31.8	33.5	35.2
26					26.0	27.6	29.2	30.8	32.4	34.0	35.7
25				25.0	26.5	28.1	29.7	31.3	32.9	34.6	36.3
24			24.0	25.5	27.1	28.6	30.2	31.8	33.5	35.1	36.8
23		23.0	24.5	26.0	27.6	29.1	30.7	32.3	34.0	35.6	37.3
22	22.0	23.5	25.0	26.5	28.1	29.6	31.2	32.8	34.5	36.1	37.8
21	22.5	24.0	25.5	27.0	28.5	30.1	31.7	33.3	34.9	36.6	38.2
20	22.9	24.4	25.9	27.4	29.0	30.6	32.1	33.7	35.4	37.0	38.7
19	23.4	24.9	26.4	27.9	29.4	31.0	32.6	34.2	35.8	37.5	39.1
18	23.8	25.3	26.8	28.3	29.8	31.4	33.0	34.6	36.2	37.9	39.5
17	24.2	25.7	27.2	28.7	30.2	31.8	33.4	35.0	36.6	38.3	39.9
16	24.6	26.1	27.6	29.1	30.6	32.2	33.8	35.4	37.0	38.7	40.3
15	25.0	26.4	27.9	29.5	31.0	32.6	34.2	35.8	37.4	39.0	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).

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.

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

Always read and follow the label when using pesticides.
The following tables (from 2013) are the most recent available from UC IPM.

ALMOND: FUNGICIDE EFFICACY

Fungicide	Resistance risk (FRAC)[1]	Brown rot	Jacket rot	Anthrac -nose	Shot hole	Scab[3]	Rust[3]	Leaf blight	Alternaria leaf spot[3]	PM-like[5]	Hull rot[16]
Bumper/Tilt[4]	high (3)	++++	+/-	++++	++	++	+++	ND	++	+++	++
Indar	high (3)	++++	+/-	+++	++	++	NL	ND	+	ND	----
Inspire Super[4]	high (3/9)	++++	++++	ND	+++	+++	+++	ND	+++	ND	+++
Luna Sensation	medium (7/11)[3,7]	++++	++++	++++	++++	++++	++++	ND	++++	+++	+++
Pristine	medium (7/11)[3,7]	++++	++++	++++	++++	++++	+++	ND	+++	+++	+++
Merivon	medium (7/11)[3,7]	++++	++++	++++	++++	++++	+++	ND	++++	++++	+++
Quash[4]	high (3)	++++	++	++++	+++	+++	++++	ND	++++	+++	+++
Luna Experience	medium (3/7)[3]	++++	+++	++++	+++	++++	++++	ND	++++	+++	+++
Quadris Top	medium (3/11)[3]	++++	+++	++++	+++	++++	++++	ND	+++	+++	+++
Quilt Xcel	medium (3/11)[3]	++++	+++	++++	+++	++++	++++	ND	+++	+++	+++
Rovral + oil[8]	low (2)	++++	++++	----	+++	+/-	++	ND	+++[9]	ND	----
Scala[3]	high (9)[3, 7]	++++	++++	ND	++	----	ND	ND	+	----	----
Tebuzol (Elite**)	high (3)	++++	+/-	+++	++	++	+++	ND	+	ND	++
Topsin-M/T-Methyl/ Incognito[2]	high (1)[2, 7]	++++	++++	----	----	+++[8]	+	+++[6]	----	++	----
Vangard	high (9)[3, 7]	++++	++++	ND	++	----	ND	ND	+[9]	----	----
Fontelis	high (7)[4]	++++	++++	++	++++	+++	+++	ND	+++	ND	----
Abound[4]	high (11)[3, 7]	+++	----	++++	+++	++++	++++	+++	+++[10]	+++	+++
Elevate	high (17)[7]	+++	++++	----	+	ND	ND	ND	ND	ND	----
Protexio	high (17)[7]	+++	++++	----	+	ND	ND	ND	ND	ND	----
Gem[4]	high (11)[3, 7]	+++	----	++++	+++	++++	++++	+++	+++[10]	+++	+++
Laredo	high (3)	+++	----	++	++	----	+	+++	----	+++	----
Rovral/Iprodione /Nevado	low (2)	+++	+++	----	+++	----	----	ND	++[9]	----	----
Bravo/Chloro-thalonil/Echo /Equus[11,12]	low (M5)	++	NL	+++	+++	+++[15]	++++	NL	NL	----	----
Captan[4,12]	low (M4)	++	++	+++	+++	++	----	+++[6]	+	----	----
CaptEvate*	low (M4/17)	+++	+++	+++	+++	+++	----	+++	+	----	----
Ph-D	medium (19)	++	+++	----	++	+++	+++	ND	++++	ND	++
Syllit*	Medium (M7)	+	----	ND	+++	++++	ND	ND	+	ND	----
Rally[13]	high (3)	+++	----	++	+/-	----	+	+++	----	+++	----
Ziram	low (M3)	++	+	+++	+++	+++	----	++	+	----	----
Copper[14]	low (M1)	+/-	+/-	----	+	+[15]	----	----	ND	----	----
Copper + oil[14]	low (M1)	ND	ND	----	+	+++[15]	----	----	ND	----	----
Lime sulfur[12]	low (M2)	+/-	NL	----	+/-	++[15]	++	NL	NL	----	----
Sulfur[4,12]	low (M2)	+/-	+/-	----	----	++	++	----	----	+++	----
PlantShield***	low	----	----	----	----	----	----	----	----	----	----

Rating: ++++ = excellent and consistent, +++ = good and reliable, ++ = moderate and variable, + = limited and/or erratic, +/- = minimal and often ineffective, ---- = ineffective, NL = not on label, and ND = no data

*** Registration pending in California**

****Not registered, label withdrawn or inactive**

*** Section 24C (special local needs) registration approved in California for silver leaf disease of almond.

[1] Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see http://www.frac.info/). Fungicides with a different group number are suitable to alternate in a resistance management program. In California, make no more than one application of fungicides with mode of action Group numbers 1, 4, 9, 11, or 17 before rotating to a fungicide with a different mode of action Group number; for fungicides with other Group numbers, make no more than two consecutive applications before rotating to fungicide with a different mode of action Group number.

Strains of the brown rot fungi *Monilinia laxa* and *M. fructicola* resistant to Topsin-M and T-Methyl have been found in some California almond orchards. MBC-resistant strains of the jacket rot fungus, *Botrytis cinerea* and powdery mildew fungi, have been reported in California on crops, other than almond and stone fruits and may have the potential to develop in almonds with overuse of fungicides with similar chemistry. MBC-resistant strains of the scab fungus, *Cladosporium carpophilum*, have been found in California.

[3] Field resistance of *Alternaria* sp. and *Cladosporium carpophilum* to QoI and SDHI fungicides has been detected in almond orchards. AP-resistant populations of *Monilinia* spp. have been found on other stone fruit crops in California.

[4] Of the materials listed, only sulfur, Abound, Gem, and some of the DMI fungicides (FRAC Group No. 3) are registered for use in late spring and early summer when treatment is recommended.

[5] PM-like refers to a powdery mildew-like disease on almond fruit that is managed with fungicides. Recent information suggests an *Acremonium* species is involved.

[6] Excellent control obtained when combinations of Topsin-M or T-Methyl and Captan are used.

Continued on next page

[7] To reduce the risk of resistance development start treatments with a fungicide with a multi-site mode of action; rotate or mix fungicides with different mode of action FRAC numbers for subsequent applications, use labeled rates (preferably the upper range), and limit the total number of applications/season.
[8] Oils recommended include "light" summer oil, 1-2% volume/volume.
[9] Not registered for use later than 5 weeks after petal fall.
[10] Efficacy reduced at high temperatures and relative humidity; experimental for Alternaria.
[11] Bravo Ultrex, Bravo WeatherStik, Echo, Echo Ultimate, and Chlorothalonil are currently registered.
[12] Do not use in combination with or shortly before or after oil treatment.
[13] Efficacy is better in concentrate (80-100 gal/acre) than in dilute sprays.
[14] The low rates necessary to avoid phytotoxicity in spring reduce the efficacy of copper.
[15] "Burns out" scab twig lesions when applied at delayed dormant. (Chlorothalonil can be applied with dormant oil during tree dormancy).
[16] Hull rot ratings are for the disease caused by *Rhizopus stolonifer*. Ratings for the disease caused by *Monilinia* spp. will be provided in the future.

ALMOND: TREATMENT TIMING

Note: Not all indicated timings may be necessary for disease control.

Disease	Dormant	Bloom			Spring[1]		Summer	
		Pink bud	Full bloom	Petal fall	2 weeks	5 weeks	May	June
Alternaria	----	----	----	----	----	++	+++	+++
Anthracnose[2]	----	++	+++	+++	+++	+++	+++	++
Brown rot	----	++	+++	+	----	----	----	----
Green fruit rot	----	----	+++	----	----	----	----	----
Hull rot[7]	—	—	—	—	—	—	—	+++
Leaf blight	----	----	+++	++	+	----	----	----
Scab[3]	++	---	---	++	+++	+++	+	---
Shot hole[4]	+[5]	+	++	+++	+++	++	----	----
Rust	----	----	----	----	----	+++	+++	+[6]

Rating: +++ = most effective, ++ = moderately effective, + = least effective, and ---- = ineffective

[1] Two and five weeks after petal fall are general timings to represent early postbloom and the latest time that most fungicides can be applied. The exact timing is not critical but depends on the occurrence of rainfall.

[2] If anthracnose was damaging in previous years and temperatures are moderate (63°F or higher) during bloom, make the first application at pink bud. Otherwise treatment can begin at or shortly after petal fall. In all cases, application should be repeated at 7- to 10-day intervals when rains occur during periods of moderate temperatures. Treatment should, if possible, precede any late spring and early summer rains. Rotate fungicides, using different fungicide classes, as a resistance management strategy.

[3] Early treatments (during bloom) have minimal effect on scab; the 5-week treatment usually is most effective. Treatments after 5 weeks are useful in northern areas where late spring and early summer rains occur. Dormant treatment with liquid lime sulfur improves efficacy of spring control programs.

[4] If pathogen spores were found during fall leaf monitoring, apply a shot hole fungicide during bloom, preferably at petal fall or when young leaves first appear. Re-apply when spores are found on new leaves or if heavy, persistent spring rains occur. If pathogen spores were not present the previous fall, shot hole control may be delayed until spores are seen on new leaves in spring.

[5] Dormant copper treatment seldom reduces shot hole infection but may be useful in severely affected orchards and must be followed by a good spring program.

[6] Treatment in June is important only if late spring and early summer rains occur.

[7] Make application at 1-5% hull split to manage hull rot caused by *Rhizopus stolonifer*.

ALMOND: SUGGESTED DISEASE MANAGEMENT PROGRAMS BY FUNGICIDE FRAC[1] GROUPS

Note: Not all indicated timings may be necessary for disease control (*see* Treatment Timing Table). If treatments are needed based on host phenology, weather monitoring, inoculum models, or environmental-disease forecasting models, suggested fungicide groups are listed for each timing.

How to use this table:

1) Identify disease(s) that need(s) to be managed. Know disease history of the orchard especially from the previous season.
2) Select one of the suggested fungicide groups. *Numbers separated by slashes are pre-mixtures, whereas numbers grouped by pluses are tank mixtures.* If several diseases need to be managed, select a group that is effective against all diseases. Refer to the fungicide efficacy table for fungicides belonging to each FRAC group. Group numbers are listed in numerical order within the suggested disease management program.

Continued on next page

3) Rotate groups for each application within a season and, if possible, use each group only once per season, except for multi-site mode of action materials (e.g., M2) or natural products/biological controls (NP/BC).

Disease	Dormant	Bloom			Spring		Summer	
		Pink bud	Full bloom	Petal fall	2 weeks	5 weeks	May	June
Alternaria	----	----	----	----	----	2	3, 7, 3/9, 3/7, 3/11, 7/11 11 19	3, 7, 3/7, 3/9, 3/11, 7/11 11, 19
Anthracnose	----	3, 7, 3/7, 3/9, 3/11	3, 7, 3/7, 3/9, 3/11 7/11 11	3, 3/9, 3/7, 3/11 11 M3 M4	3, 7, 3/9, 3/11, 3/7 7/11 11 M3 M4	3, 7, 3/7, 3/9, 3/11 7/11 11 M3 M4	3, 7, 3/7, 3/9, 3/11 7/11 11 M3 M4	3, 7, 3/7, 3/9, 3/11 7/11 11 M3 M4
Brown rot	----	1[2] 2 (+oil) 3, 3/7, 3/9, 3/11 9	1[2] 2 (+oil) 3, 7, 3/9, 3/11, 9 3/7, 7/11 11	1[2] 2 (+oil) 7, 9, 3/11 7/11	----	----	----	----
Green fruit rot	----	----	1[2] 2 (+oil) 3/7, 3/9, 7, 9 3/11, 7/11	----	----	----	----	----
Leaf blight	----	----	1[2] 2 3, 3/7, 3/9, 3/11 11	1[2] 2 3, 3/7, 3/9, 3/11 11 M3 M4	3, 3/7, 3/9, 3/11 11 M3 M4	----	----	----
Scab[4]	M1+oil, M2[3]	----	----	1[2], 3/7, 3/9, 7, 7/11[2] 3/11, 11[2] M3 M4, M5	1[2], 3/7, 3/9, 7, 7/11[2] 3/11, 11[2] M3 M4, M5	3, 3/7, 3/9, 3/11 7, 7/11[2], 3/11, 11[2] M2[3] M3, M4	M2[3] M4	----
Shot hole	M1	2 3, 3/7, 3/9, 3/11, 7, 9, 11	2 3, 3/7, 3/9, 3/11 7, 7/11 9, 11	2 3, 3/7, 3/9, 3/11 7, 7/11 9 11	7, 7/11 11 M3 M4 M5	7, 7/11 11 M3 M4 M5	----	----
Rust	----	----	----	----	----	3, 7, 3/7, 3/11 7/11 11, 19 M3	3, 7, 3/7, 3/11 7/11 11, 19	3, 7, 3/7, 3/11 7/11 11, 19

[1] Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see http://www.frac.info/). Group numbers are listed in numerical order within the suggested disease management program. Fungicides with a different group number are suitable to alternate in a resistance management program. Refer to the fungicide efficacy table for fungicides belonging to each FRAC group.

[2] Strains of *Monilinia fructicola* and *M. laxa* resistant to Topsin-M, and T-Methyl are present in some California almond orchards. Resistant strains of the jacket rot fungus, *Botrytis cinerea*, and powdery mildew fungi have been reported in California on crops other than almond and stone fruits and may have the potential to develop in almond with overuse of fungicides with similar chemistry.

[3] Use liquid lime sulfur in dormant applications and wettable sulfur at and after pre-bloom.

[4] Apply petal fall treatments based on twig-infection sporulation model.

UC CE | University of California
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Annual Almond Production Meeting
Wednesday, February 3, 2016
8 a.m. - Noon
Norton Hall, 70 Cottonwood Street, Woodland

Meeting Program - DRAFT

7:45 a.m.	Registration Coffee and Donuts
8:00 a.m.	Welcome
8:05 a.m.	Weed Management *Brad Hanson, UCCE Weed Specialist* 0.5 CCA CEUs (Integrated Pest Management)
8:35 a.m.	Almond Board updates
9:00 a.m.	Reading a Water Report *Allan Fulton, UCCE Irrigation and Water Resources Advisor* 0.5 CCA CEUs (Soil & Water Management)
9:30 a.m.	Break
9:45 a.m.	Wet Spring Diseases *Jim Adaskaveg, UCCE Plant Pathology Specialist* 0.5 CCA CEUs (Integrated Pest Management)
10:15 a.m.	Canker Diseases *Florent Trouillas, UCCE Plant Pathology Specialist* 0.5 CCA CEUs (Integrated Pest Management)
10:45 a.m.	Break
11:00 a.m.	Laws and Regulations Update *Solano Ag Commissioner's Office*
11:30 a.m.	Rootstock Options *Katherine Pope, UCCE Orchard Systems Advisor, Sacramento, Solano, & Yolo*
12:00 p.m.	Adjourn

Meeting Announcement

January 2016

UC CE | University of California
Agriculture and Natural Resources | Cooperative Extension

Colusa/Sutter/Yuba Winter Almond Meeting

St. Bernadette's Hall; Colusa, CA (Just E of the Colusa Fairgrounds, directions below)

FEBRUARY 3, 2016

2.0 hours of PCA CE and **3.0 hours** of CCA CE *requested*

Thanks to:
Farm Credit Services of Colusa-Glenn, ACA
for room sponsorship

Spend the morning at the Colusa Farm Show, then cross the street to the meeting…

12:30 Sign-in

1:00 Weed management
Dr. Brad Hanson, UCCE Specialist, UC Davis

1:30 Canker diseases of almond
Dr. Florent Trouillas, UCCE Specialist, UC Davis

2:00 Spring/summer diseases of almond
Dr. Jim Adaskeveg, Professor, Department of Plant Pathology and Microbiology, UC Riverside

2:30 Almond Board Update

2:45 Break

3:00 Reading irrigation water analysis reports
Allan Fulton, UCCE Irrigation and Water Resources Advisor, Tehama, Glenn and Colusa Counties

3:30 Laws and Regulations Update
Colusa County Ag Commissioner's office

4:00 Almond Rootstock Options
Katherine Pope, UCCE Farm Advisor, Sacramento, Solano and Yolo Counties

4:30 Nickels Review: Comparing Yield between Non-pareil/Pollinizer combinations
Franz Niederholzer, UCCE Farm Advisor, Colusa and Sutter/Yuba Counties

5:00 Adjourn

UCCE Colusa County • 100 Sunrise Blvd. Suite E • Colusa, CA 95932
Office 530-458-0570 • Fax 530-458-4625 • Website http://cecolusa.ucanr.edu

The Colusa Farm Show runs Feb 2-4 at the Colusa County Fairgrounds.
For program details, see: http://www.thefarmshow.com/

The meeting will be in St. Bernadette's Hall, just east of the Colusa County Fairgrounds.

Directions to St. Bernadette's Hall:

From East:

- **Take Hwy 20 into Colusa**
- **Turn left on Sioc St at the first light (Sav Mor shopping center on right)**
- **Go eight blocks to 8th St**
- **Turn left, go south on 8th for 0.2 mile, past the school on your left, turn left into parking lot (look for yellow meeting sign to show entrance to parking lot)**
- **St. Bernadette's Hall is the large hall on the right, north of parking lot.**

From West:

- **Take Hwy 20 into Colusa, past the Colusa Fairgrounds**
- **Turn right on Sioc St (second right past Colusa Fairgrounds)**
- **Go two blocks to 8th St**
- **Turn right, go south on 8th for 0.2 mile, past the school on your left, turn left into parking lot (look for yellow meeting sign to show entrance to parking lot)**
- **St. Bernadette's Hall is the large hall on the right, north of parking lot.**