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Submitted by:

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Waterlogged Orchards

Joseph Connell, UCCE Farm Advisor Emeritus, Butte County

Despite last fall's prediction of La Nina or dry conditions, this past winter is likely to be the wettest winter on record for the Northern Sierra Precipitation 8-Station Index, currently on April 12th standing at 204% of average. We are only 0.3 inches behind the wettest 1982-1983 season and it's still raining. I've recorded 38.0 inches of rain in north east Chico; which is 13.0 inches above Chico's long term average at the end of April and we still have two weeks to go. The statewide snow water content is at 167% of the April 1st average suggesting much more runoff is to come.

A year like this is when having an orchard planted on a deep, well-drained soil, or planting on berms, islands, or mounds can pay off. Some orchards on soils that are not well-drained or have been flooded can face difficulties when their root zones are saturated. Orchards planted in low areas or on heavy textured soils are the most affected. Maintaining drains and keeping ditches clear is most important when facing these difficult conditions. The water level standing in a ditch will be at the same level or higher in the soil profile in the adjacent orchard.

Tree roots require oxygen for respiration. Respiration fuels growth and energy reactions leading to water and nutrient uptake. During cool winter conditions trees can withstand longer periods of saturation since respiration rates are lower when trees are dormant. Flowing water is less damaging than standing water most likely due to greater amounts of dissolved oxygen. Reduced root activity and nutrient uptake can produce pale leaf color or interveinal chlorosis. When tree roots are surrounded by saturated soil they can die from lack of oxygen even without any major pathogens present. This may be a transient problem in some cases, affecting only small feeder roots followed by tree recovery as new feeder roots grow out of the problem. In more severe cases, larger roots die and trees begin a gradual decline producing small, off color leaves, little new growth with a thinning canopy, display leaf burning, wilting and defoliation, followed by tree death.

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Waterlogging also provides ideal conditions for the development of *Phytophthora* water molds. These pathogens are stimulated under saturated conditions to produce swimming spores (zoospores) which orient towards root exudates. These compounds include amino acids, organic acids and simple sugars, as well as polysaccharides, proteins and organic substances. Zoospores may have greater difficulty orienting toward tree roots, crowns, or trunks and penetrating when water is flowing. Flooded conditions are favorable because *Phytophthora* can propagate more rapidly and spores are moved about by water.



Figure 1. *Phytophthora* crown rot on older tree showing zonate canker margins (left). Aerial trunk or limb cankers (right) occur at the depth of flooding or around pruning wounds most likely caused by *P. syringae*, a cold weather species. Photo: UC IPM.

Phytophthora is often thought of as a root disease, but in years where there is standing water above the soil line, it can infect up to the depth of standing flood water. Once zoospores penetrate the bark under saturated or flooded conditions, they germinate; causing root, crown, or aerial infections that kill roots, scaffolds, or the entire tree (Fig. 1). *Phytophthora* species are known to be present in flooded areas and in orchards irrigated by surface water.

Young trees are more vulnerable because their bark is thinner and more easily penetrated, and they are smaller and more easily girdled and killed. As temperatures warm, young trees are at greatest risk if they are actively growing and are faced with standing in stagnant flood water or are on soils whose profile remains saturated. You may also observe differences in susceptibility between varieties on the same root-

stock. Aldrich on Lovell rootstock can die from crown rot when Nonpareil rows in the same orchard are less affected. Young Price trees may develop more aerial *Phytophthora* cankers than adjacent Nonpareil rows. Once tree root systems are injured by extended periods of saturated soil, it's easy for weak areas to be overwatered when irrigating since a compromised root system results in lower water uptake. Over-irrigation then compounds the problem making it difficult to overcome. Such trees can stress easily between normal irrigations, and may display lower limb dieback. The severity of these problems will become apparent when temperatures heat up later this spring. Reducing nozzle/emitter sizes in weak areas in an orchard may help mitigate over-irrigation.

If root system health is compromised, it's important to limit irrigation sets to 24 hours or less to avoid further root system stress. In addition to keeping ditches and drains clear, allowing orchard weeds to grow taller in the middles will increase water use helping to extract excess water from the soil. Phosphonate spray applications provide some protection from *Phytophthora* infections but are ineffective in combating waterlogging.

Correction: When to Apply the First Irrigation?

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

In the last almond newsletter, I wrote an article on first irrigation timing. Since then, I talked to Allan Fulton, UCCE Water Resources Advisor in the northern Sacramento Valley, and learned that he uses only 50% of actual rainfall as the “effective rainfall” value to determining when to first irrigate – NOT the total amount of precipitation.

Not all in-season rainfall is effective. In longer, more intensive storms some water may runoff and some may infiltrate into an already full soil profile and cause earlier stored water to drain out the bottom of the root zone. Short, intermittent showers may evaporate quickly if followed by sunshine and not add to stored moisture at all. Anecdotal experience suggests

that about 50 percent of the total in-season rainfall might, on average, effectively be stored in the soil to supply ET.

Allan told me whenever he has used total rainfall for in-season irrigation calculations; he has fallen behind in soil moisture and had to apply more water to “catch up”. Since first irrigation timing is very important to root health and water management – especially in a wet year like this –this correction article is needed.

The basic idea of first irrigation timing is to wait to irrigate until the trees in the orchard have used enough soil water to make room for all the irrigation water applied. For a quick review, here is an example scenario, ***with the effective rainfall correction***.

- An orchard starts the season with the root zone at field capacity (as much water as the soil can hold after natural drainage).
- The root zone soil in the orchard holds 2.75” of plant available water.
- The irrigation system delivers 1.35” of water to the soil in an 18 hour set.
- It is a micro-irrigation system with 90% efficiency, so 1.215” water is actually delivered to the soil in an 18 hour set.
- Since first leaf out, the orchard used 1.5” of water based on ET estimates (see actual data for this year at: <http://www.sacvalleyorchards.com/et-reports/>).
- Rainfall since leaf out = 1.5”. **Use 0.75” as the amount of rain that actually recharges the root zone (assume the rest is lost from the orchard as runoff).**
- It’s not time to irrigate. Why? 1.5” of water lost (ET) + 0.75” effective rainfall as soil recharge means that the soil has only a net water loss of 0.75” since leaf out. Since the irrigation system will deliver 1.215” of water to the soil in an 18 hour set, you need to wait to apply a full set until an additional 0.465” of net water loss occurs (or shorten your set time to deliver just 0.75” of irrigation water).

If you have questions about this correction to first irrigation timing calculations, please e-mail me

(Franz) at fjnieiderholzer@ucanr.edu or talk with your local UCCE farm advisor.

Note: The full corrected article can be viewed at: <http://www.sacvalleyorchards.com/walnuts/irrigation-walnuts/when-should-you-apply-the-first-irrigation-of-the-season/>

Potassium, Zinc, Manganese, and Iron Deficiencies in a Wet Spring

Joseph Connell, UCCE Farm Advisor Emeritus, Butte County

Potassium, zinc, iron, and manganese nutrient deficiency symptoms are more prevalent where soils are wet, cold, and saturated. Reduced root activity and nutrient uptake can produce pale leaf color or interveinal chlorosis (pale or yellowing between the veins in the leaf). Micronutrient deficiencies often show symptoms in only a small part of an orchard, or, if due to saturated soil or flooding, may only appear during part of the season. Foliar nutrient sprays can provide quick correction of symptoms and improve tree color and vigor if indeed that is the reason trees were performing poorly in the first place.

When thinking about fertility in your orchard, the first step is to review tree nutrient status by re-examining your leaf tissue analysis from last July to determine if any nutrients are borderline or deficient. Root activity increases when soils warm and dry out, hence, deficiency symptoms may correct themselves as spring progresses. For every 1000 pounds of almond kernels hauled to the huller (hulls, shells and kernels), 60-80 lbs. of potassium, 1.1 oz. of zinc, 3.0 oz. of iron, and 0.7 oz. of manganese are exported with the crop. Fertilizing with potassium and zinc is often required but most soils normally supply the tiny amounts of iron and manganese necessary to meet tree needs unless soils are cold and wet. If truly deficient, symptoms will persist and will be reflected in this year’s July leaf analysis.

Potassium (K). When first leafing out, trees displaying K deficiency symptoms appear pale in color and have small leaves with little new growth. Later, trees show rolled leaves with marginal leaf burning. This symptom is classic when it occurs in the tree top on leaves in the middle of new shoot growth. The

Butte variety is a good indicator of this deficiency because it is likely to exhibit leaf scorching before other varieties show symptoms. K is deficient if July leaf analysis is below 1.0%.

A true K deficiency can be corrected now by foliar sprays of potassium nitrate when sufficient material is applied. The standard approach that corrected K deficiency for the season in the past applied 40 pounds of potassium nitrate per acre with each of the three 400 gallon dilute applications for a total of 120 pounds of potassium nitrate per acre. In a typical concentrate spray applied at 100 gal/ac, rates of 20-30 pounds of potassium nitrate per acre can be safely applied to almonds to provide the boost needed in a wet spring.

Zinc (Zn). Zinc is part of the enzyme system that regulates terminal growth and plant cell expansion. Trees with severe deficiency may experience dormant flower bud drop and decreased fruit set, will have shortened internodes and small ‘little leaf’ symptoms, and have chlorotic leaves with wavy margins (Fig. 1). With mild deficiency, leaves may be slightly smaller than normal with areas of interveinal chlorosis. Young trees can be deficient without showing any visual symptoms so it is important to get a July tissue analysis even in young orchards. Zinc is deficient if a July leaf analysis is below 15 ppm.

Foliar sprays to correct Zn deficiency are effective and inexpensive. A spring foliar treatment can be timed once leaves have attained nearly full size. On spring foliage, basic zinc sulfate or zinc oxide sprays



Figure 1. Zinc deficiency.
Photo: UC IPM

are normally safe and effective. Either form can be applied at 5 pounds per 100 gallons of water or at 15 pounds per acre when sprayed at 100 gallons water per acre. Rain within 48 hours of zinc foliar applications can reactivate the zinc and produce phytotoxic “shot-hole” symptoms on leaves.

Iron (Fe) and Manganese (Mn). Both iron and manganese are important in chlorophyll formation so a deficiency of either show as interveinal chlorosis in young leaves. Deficiencies in iron and manganese although rare in the Sacramento Valley, are occasionally seen in orchards with soil pH above 7.5, on calcareous soils, or on heavy or poorly drained soils.

Iron deficiency causes interveinal yellowing with the small leaf veins remaining green. When severe, leaves will be uniformly yellow throughout the leaf (Fig. 2). Iron deficiency may show early in the season and continue until leaves yellow and drop or it may show in the spring and then gradually disappear as soils warm up and dry out.

Leaf analysis is not a reliable indicator of iron deficiency so learn to recognize leaf symptoms. Trees will green up if foliar sprays of Sequestrene® 138 Iron Chelate or other similar iron materials are applied following label instructions.



Figure 2. Mild (left) and severe (right) iron deficiency symptoms. Photo: J.H. Connell

Manganese chlorosis appears as a herring bone pattern with major veins green between yellow interveinal areas. Manganese is adequate when July leaf analysis is over 20 ppm. Manganese deficiency can be corrected with foliar sprays of manganese sulfate at 2 pounds per 100 gallons water sprayed at 100 gallons per acre. If you have a small problem area, banded soil applications of manganese sulfate at 10 pounds per tree have been effective for longer term correction.

April Showers bring Yellowing Krymsk?

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

The cold and wet seems like it just won't quit this year. The continued saturation of tree root zones may lead to nutrient deficiency symptoms (see article, this issue) from reduced root activity. Sometimes these deficiencies are transient and symptoms resolve as the soil dries out and warms up.



Figure 1. The “yellowing Krymsk” symptoms include pale foliage, wilting canopy with curling leaves, and poor shoot growth. *Photo: J.H. Connell.*

However, if the season progresses and the soils warm up but *stay oversaturated*, the symptoms may persist or trees may show the “yellowing Krymsk” problem (Fig. 1). Symptoms include yellowing of the canopy, leaf rolling, and “stalling out” (trees that stop growing). Typically these symptoms show up on younger (1st -3rd leaf) almonds on rootstocks with plum genetics, namely Krymsk 86 or Marianna 2624. For those familiar with the Union Mild Etch disorder on Marianna 2624, the yellowing Krymsk 86 problems look similar, though there is typically no etching or pitting under the bark at the graft union.

What should you do if these symptoms are observed? First and foremost, make sure you're not over-irrigating! Roots need oxygen through good aeration of the soil 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 (see article, this issue). 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 well into 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.

Bloom review: 2017

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

The almond nut set appears, so far this year, to be a mixed bag in the Sacramento Valley. A review of the many steps involved in successful nut set may provide a better understanding of just what went wrong (or right) for different varieties across the region at bloom this year.

- Anthers (see Fig. 1) open as relative humidity drops in the late morning, exposing dry pollen grains (containing male sperm cells). Not all anthers in a flower open on the same day, so fresh pollen is produced by the same flower for several days. Rain can rupture pollen grains after anthers open and before pollen grains germinate. Temperature does not affect pollen viability, but it does influence pollen germination and pollen tube growth rate.
- Bees move pollen from the anthers of one flower to the stigma of a compatible variety's flower. Bees are more active when temperatures are above 55°F, winds are less than 15 mph and it is not raining. When these conditions are met for an hour, we count that as a “bee hour” – a rough metric of good or bad conditions for pollination. See the daily bee hours graph (Fig. 2) from one location in the Sacramento Valley at the bottom of this article. Strong hives (8 frames or more) collect 3x more pollen than a 4frame hive.
- Stigma (the pollen landing pad) and style (the passageway to the ovule) are receptive for 4-5 days (see Fig. 1). If the stigma is receptive, the pollen grain hydrates from stigmatic secretions, germinates and begins to grow down the style towards the ovule, which contains female germ cells. If the pollen tube reaches and enters the ovule while the ovule is still viable, a nut will be set. Multiple pollen tubes grow down the style

simultaneously preparing the ovule for fertilization, but only one pollen tube's contents fertilize the ovule. Multiple pollen tubes growing down a single style, including both compatible and incompatible pollens will improve the chances for successful fertilization of the ovule.

- Rate of pollen germination and pollen tube growth towards the ovule is temperature sensitive. At temperatures between 50-70°F, pollen grains germinate rapidly. Optimum pollen tube growth rate occurs between 60-85°F.
- Pollen tube growth from germination to ovule fertilization can take 5-8 days, depending on temperature. An ovule remains viable for 5-7 days. The effective pollination period is the time “window” between flower opening and the last day a pollen grain can land on the stigma and still grow down the style to fertilize a viable ovule.
- The sooner after opening a flower is pollinated, the better the chances that it will set a nut. In UC research, flowers pollinated on the day they opened had 30% nut set, flowers pollinated 3 days after opening had 21% set, and flowers pollinated 5 days after opening had only a 1% chance of setting a nut. This is why it is so important to have viable, compatible pollen in the orchard (and good bee activity) when Nonpareil flowers begin to open. This is also why it is good that all flowers don't open on the same day.

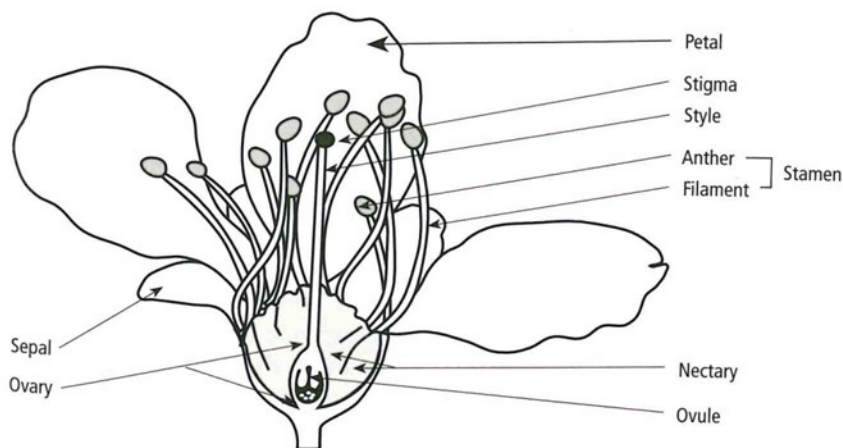


Figure 1. Drawing of a ‘Mission’ variety almond flower.

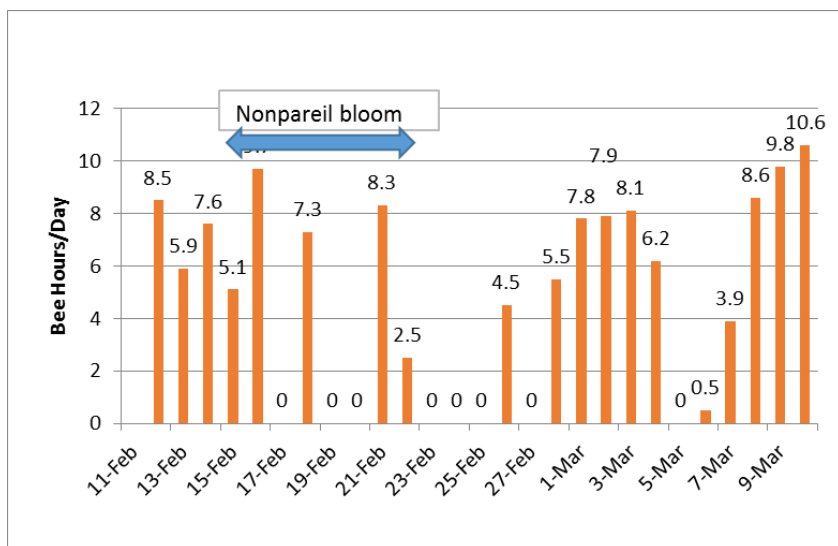


Figure 2. Daily “bee hours” at Nickels Soil Lab, Arbuckle, CA (Colusa County). 2017. A “bee hour” is an hour in during which temperatures are above 55°F, winds are less than 15 mph and it is not raining.

Tentative take home from the 2017 bloom season:

- This was not a year to skimp on bees, with less than 25 bee hours from February 17-28. This corresponded to mid to late Nonpareil bloom in the Arbuckle district, where strong hives would have made the most of that limited flying time.
- Good bee flight on February 18 and February 21 may have been extremely important to the crop this year.
- The cold weather from February 17 to 28 contributed to delaying bloom for the later blooming varieties into a time of good bee weather the first week of March, when later varieties could still be successfully pollinated.

Almond Management Considerations: Spring & Early Summer

Katherine Pope, UCCE Orchard Advisor, Sacramento, Solano and Yolo Counties

APRIL

- Monitor for signs of **Altemaria** through June, looking on exposed leaves for large, brown spots which then turn black, watching the most susceptible varieties (Carmel, Sonora, Monterey, Winters and Butte). You can also use the Disease Severity Value model to time fungicide applications, based on temperature and leaf wetness. See more at <http://ipm.ucanr.edu/PMG/r3101611.html>.
- Keep an eye out for **scab** development on leaves, fruit and twigs. Once twig lesions have sporulated and rain occurs, watch for initial leaf lesions appearing as small yellow specks on the leaves in late spring to early summer. Some shot hole sprays will also control scab. Be aware that in some orchards scab resistance to FRAC Group 11 fungicides has been documented. Treat following UC IPM guidelines at <http://ipm.ucanr.edu/PMG/r3100411.html>.
- Consider continuing treating for **anthracnose** if warm, rainy weather persists through April, especially in orchards with a history of the disease. Anthracnose infects nuts and causes marginal leaf necrosis and branch dieback to the point where an infected nut is attached. Be sure to alternate fungicides to avoid resistance development. More on treatment options at <http://ipm.ucanr.edu/PMG/r3101111.html>.
- Watch for **shoot strikes caused by PTB or OFM** starting in mid-April, primarily in first leaf orchards, where you're encouraging shoot elongation to establish tree structure. There's no consensus threshold of how much damage warrants treatment in young trees, but keep in mind that damage at the tip of a primary scaffold will stop that branch from growing longer and shift growth into side branching, impacting the structure of that tree for the life of the orchard. See pictures and more on management at <http://ipm.ucanr.edu/PMG/C003/m003fshootstrik.html>.
- **NOW egg traps** should have gone out by first week of April, if not sooner. Check traps twice weekly to determine biofix. Many experienced practitioners in the Sacramento Valley use the first NOW eggs found in traps as the biofix. This differs from common practices in the San Joaquin Valley because our population pressure is often lower. Find more on NOW management at <http://ipm.ucanr.edu/PMG/r3300311.html>.
- Monitor leaves for **shot hole** fruiting structure development (a small dark speck in the middle of the leaf lesions). UC guidelines suggest applying treatment prior to additional rain as soon as fruiting structures are evident since that's when the disease can become epidemic. Additional treatment may be necessary if rainy, wet conditions persist through spring. See more at <http://ipm.ucanr.edu/PMG/r3100211.html>.
- Manage **gophers** before their reproductive pulse – usually between March and May. While flooding may have increased winter mortality, increased rain fed vegetation could increase reproduction this spring. See more on gopher control at <http://www.sacvalleyorchards.com/blog/almonds-blog/options-for-gopher-management/>.
- Apply 30% of the **nitrogen** needs of your crop in April. With all the rain, this is a tricky year for keeping nitrogen in the root zone where trees can use it. Avoid applying nitrate-containing fertilizer before rainstorms predicted to deliver more than about an inch of rain if the soil profile is near-full. Nitrate leaches easily with excessive rainfall or irrigation. Remember that ammonium based fertilizers will not leach through the soil during and immediately after a rain or irrigation event. This is not a perfect solution to avoid leaching if heavy rain continues through April, because about half of the ammonium will be transformed to nitrate by soil bacteria after two weeks in the soil.

MAY

- Continue **leaf monitoring** for Alternaria Leaf Spot, Shot Hole, Rust, Scab and Anthracnose if rainy weather persists. Consider a follow up rust treatment *before* symptoms are visible if orchard history and conditions indicate high vulnerability. Rotate the material's site of action (FRAC Group) to avoid development of pesticide resistance.
- Continue watching for **shoot strikes** in first leaf orchards. Once sufficient growth for primary scaffold extension has occurred, this is no longer a concern.
- Monitor for **spider mites** at least weekly, watching hot spot areas that are often dusty or water-stressed. Find more on treatment decisions at <http://ipm.ucanr.edu/PMG/r3400211.html>.

JUNE

- Continue monitoring for spider mites.
- Assess your crop set, consider last year's July leaf sample results and adjust the amount of nitrogen application needed. Of the total crop N use, trees use 30% in June. For the whole season, mature trees use 68 lbs of N for every 1,000 kernel lbs produced. In orchards with high July leaf N and a history of hull rot, under-shooting this rate will help decrease hull rot risk (see below).
- In orchards with a history of **hull rot**, regulated deficit irrigation and maintaining July leaf nitrogen levels below 2.6% will decrease orchard susceptibility. If you've had problems with *Rhizopus* which produces black spores inside the hull after hull split, fungicide treatment at early hull split can significantly reduce hull rot. For best control of *Monilinia* hull rot, present as a tan lesion on the outside of the hull, spray in early June as hull split timing does not effectively control this hull rot source. For orchards with a history of hull rot, Dr. Jim Adaskaveg recommends an integrated program combining targeted irrigation reduction in early hull split, early N cut off (May) and 1-2 fungicides (depending on the hull rot infection source). See more at <http://ipm.ucanr.edu/PMG/r3101811.html>.

Upcoming 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 are held the second Tuesday of each month, February through November, and cover a wide range of timely pest and orchard management topics. Locations will be rotated each month. Please contact Emily Symmes to request topics or bring your questions to the meeting! **DPR and CCA Continuing Education hours requested**

Upcoming meetings:

Glenn: May 9th, 7:30-9:00am, No-host breakfast

Berry Patch Restaurant, 900 Newville Rd, Orland CA

Space is limited, please RSVP to Emily Symmes (contact information below) by May 7th.

Butte: June 13th and November 14th (Location TBA)

Colusa: July 11th (Location TBA)

Yuba-Sutter: August 8th (Perko's Restaurant)

Tehama: September 12th (Rockin R Restaurant)

Glenn: October 10th (Berry Patch Restaurant)

Additional information for each meeting will be available on the events page at sacvalleyorchards.com or by contacting UC IPM Advisor Emily Symmes at (530) 538-7201 or ejsymmes@ucanr.edu.

NICKELS SOIL LAB ANNUAL FIELD DAY

Wednesday, May 10, 2017
Green Bay Rd., Arbuckle, CA

1.0 hour PCA CE credits requested

2.5 hours CCA CE credit requests

8:30 a.m. — **Registration**

Coffee and Donuts provided by Farm Credit Services of Colusa-Glenn, ACA

9:00 a.m. — **Field Topics:**

Site specific irrigation in almonds: update

Shrini Upadhyaya, Professor, UC Davis Biological & Agricultural Engineering Dept.

Botryosphaeria in walnuts

Themis Michailides, UCCE Plant Pathology Specialist, UC Davis/UC Kearney Ag Center

Janine Hasey, UCCE Farm Advisor & County Director, Sutter/Yuba Counties

Hedging walnuts

Bruce Lampinen, UCCE Extension Specialist, UC Davis Plant Sciences Department

Thousand cankers disease in walnuts

Steve Seybold, UC Davis Department of Entomology and Nematology

Almond variety selection

Dani Lightle, UCCE Farm Advisor, Glenn, Tehama and Butte Counties

Canker disease in almonds

Leslie Holland, UC Davis Plant Pathology Department

Foliar and bloom disease management in almonds

Jim Adaskaveg, UC Riverside Department of Plant Pathology

Nitrogen and potassium nutrition in almond.

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

12:15 pm – **BBQ Tri-Tip Lunch** by reservation.

RSVP to the UCCE Colusa Office at (530) 458-0570 \$15 prepaid, \$20 at the door

Prepared by and proceeds to the Pierce High School (Arbuckle, CA) FFA Program

Program organized by Franz Niederholzer, Farm Advisor,
University of California Cooperative Extension, Colusa and Sutter/Yuba Counties

NICKELS SOIL LAB ANNUAL FIELD DAY LUNCHEON RESERVATION FORM

Name:		
Address:		
City:	State:	Zip:
Phone:		
Name(s) of Attendees(s):		<div style="border: 1px solid black; padding: 5px;"> <p>Please return this form & your check by May 5 to receive the discounted price.</p> </div>
Total Amount Enclosed:		

Make checks payable to: Pierce High School
Lunch benefits Pierce High School FFA Program

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