Field Notes
San Joaquin County
August 2020

University of California
Agriculture and Natural Resources

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Soil Health in Alfalfa Receiving Full and Deficit Irrigation

Soil health has been described as the ability of soil to function and is characterized by biological, chemical, and physical soil properties that are sensitive to changes in management. Studies have shown that reducing tillage, increasing rotational crop diversity, and employing cover crops during the fallow season can improve soil health characteristics. In turn, improvements in soil health may enhance various soil functions, like improving crop productivity, reducing input costs, and buffering plant health from living and non-living stresses.

Over the last year and a half, I have been working on a project to characterize a suite of soil health properties in alfalfa receiving full and deficit irrigation. When I was developing the project, I had two hunches. The first was that alfalfa production may improve certain soil health characteristics. Alfalfa provides soil coverage for several years. Alfalfa is also a deep-rooted crop that can scavenge water and nutrients deep in the soil profile. Additionally, alfalfa has been shown to provide a nitrogen benefit to subsequent crops. For reasons like these, I hypothesized that certain soil health characteristics might improve over the years of an alfalfa stand.

My second hunch, however, was that deficit irrigation could negatively impact soil health properties. In recent years, California alfalfa production has received negative press for water usage that exceeds that of other crops. Alfalfa does represent an important footprint in California's agricultural water use. Alfalfa has a high water demand (i.e. crop evapotranspiration, ETc) that is directly related to yield. All else being equal, as ETc increases, alfalfa yield also increases up to maximum ETc. Studies conducted by UC Alfalfa and Forage Specialist, Dan Putnam, have demonstrated, however, that alfalfa is resilient under water deficit conditions. While alfalfa may be resilient under deficit irrigation, water facilitates soil microbe functioning and nutrient availability. Therefore, I also hypothesize that soil health may degrade under deficit irrigation. This is critical knowledge to develop not only for deficit irrigation strategies but also in the event of drought, where growers may be asked to sacrifice crop irrigation for water transfers to other uses. Such knowledge could demonstrate how prioritization of water uses may impact soil conservation outcomes.

This project is being conducted at UC Davis on a Yolo silt loam and was initiated in Spring 2019. The treatments, which are replicated four times, are: 1) full irrigation (100 percent ETc), 2) full irrigation at the beginning of the season with a sudden cutoff toward the end of the season (60 percent ETc), 3) gradual deficit where each irrigation imposes restriction (60 percent ETc), and 4) more-severe gradual deficit (40 percent ETc). The treatments are applied using overhead irrigation – an 8000 series Valley 500 feet, four span linear-move system. The site allows us to observe soil characteristics under different levels of deficit, imposed at different stages of the cropping season. Soil sampling occurs twice each year – in the spring before irrigation begins and in the fall after the last irrigation. We are testing a comprehensive nutrient analysis, organic matter, total carbon and nitrogen, salinity, compaction, bulk density, N mineralization, and particulate organic carbon.

This project is ongoing, but we have interesting preliminary results. One example is with particulate organic carbon. Particulate organic carbon (POC) is a biological indicator of soil health because it is the fraction of soil organic matter that is readily available as an energy source for soil microorganisms. Though not statistically significant (Fig. 1, P = 0.066), there is a trend for the higher irrigation rates – and sustained irrigation throughout the season – to have higher POC. Between the two irrigation treatments providing approximately 60 percent of ETc, the third treatment which provides a sustained deficit throughout the season tends to have higher POC than the 60 percent ETc treatment that has a sudden cut-off of water about two-thirds of the way through the season. These results suggest the importance of water in sustaining soil biological activity.

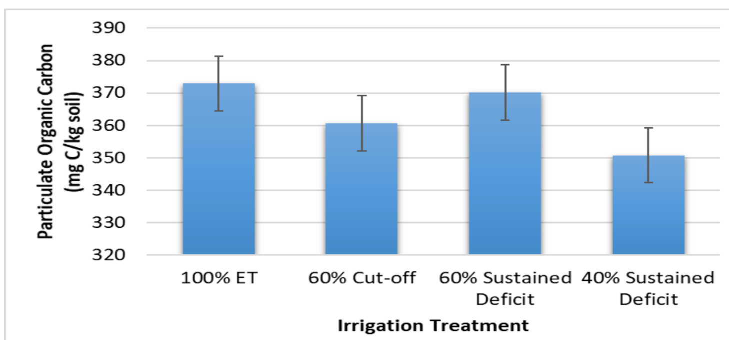

Figure 1. Average particulate organic carbon (top 12 inches) across four irrigation treatments and three seasonal readings (Spring 2019, Fall 2019, Spring 2020).

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Likewise, there is a similar trend for higher irrigation rates and sustained irrigation through the season to result in lower soil compaction readings (Fig. 2, P = 0.2691). At the 6-inch depth, the full irrigation rate trended toward having the lowest compaction, followed by the 60 percent sustained deficit treatment. All treatments, however, had average readings below 300 psi, which is the pressure above which root growth is believed to be constrained.

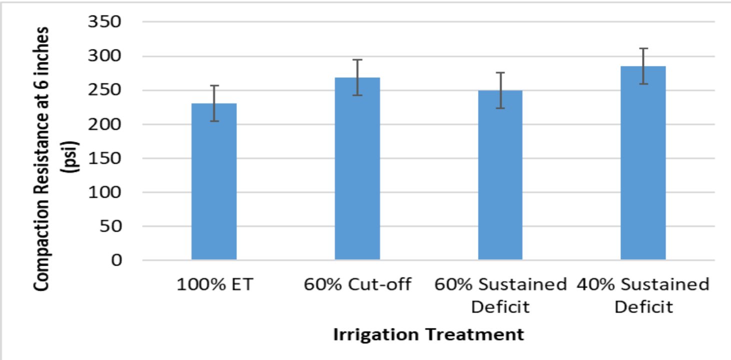

Figure 2. Average soil compaction at 6-inch depth across four irrigation treatments and three seasonal readings (Spring 2019, Spring 2020, Summer 2020).

These are preliminary results. We will soil sample again this fall, and hopefully again next spring and fall, to see if these trends continue. I want to acknowledge my UC Davis collaborators on this project: Dan Putnam, Isaya Kisekka, Daniel Geisseler, Umair Gull, and Veronica Romero. I also want to acknowledge the South Delta Water Agency for funding support

Michelle Leinfelder-Miles, Delta Farm Advisor

Livestock Update

Range Camp 2020 Goes Virtual

What should have been our 36th Range and Natural Resource Camp held in Half Moon Bay had to be canceled due to Coronavirus, as did most things this spring and summer. Sharing our love of rangelands was something important for the Camp staff to do, so we organized a virtual camp. We have almost 30 videos on a handful of topics, with activities that can be done anywhere. The Camp (and the virtual camp) is for High School students (14-18 years of age) since the educational component is geared towards high school standards. The videos include a very diverse career panel, with a dozen range professionals discussing how they came to work in rangelands, short sessions on range ecology, monitoring, fire, wildlife, grazing, and much more. Most of the videos are under 5 minutes. If you know any high schooler who has any interest in rangelands and natural resources, please share our registration link: http://ucanr.edu/rangecamp2020. This is a FREE camp! We will have a live, interactive session on August 31st at 3 pm to round out the virtual Camp. Hope to see some local San Joaquin "campers" there!

Forage Production

For over a dozen years, I have been clipping on ranches in the area to determine forage production. The last few years, we have had a very non-normal rainy season. Most of the rain came late in the spring when soil temperatures had warmed, so we had ideal conditions for grass to grow. Annual forages are very hardy and will produce a lot of forage in a very short time frame if there is enough soil moisture. The west side this year ranged between 60% below to 60% above average. The majority of the plots were between 50-60% below average. It is important to note that this is comparing forage production from the same site over the years. My data set is now long enough to use this local data instead of the Soil Survey forage production data. So, this year one site was 60% below what the running average for that site is. The east side is a little more consistent in the pattern of storms, so we see consistency in forage production. Plots on the east side ranged from 41% below to 12% above average, with most in the 20% below to 10% above average production. Without the late spring rains, forage production would have been closer to 70-80% below average for the west side and 30-50% below average for the east side. Our local production plots are conservative. Looking back through the past 13 years, we have experienced more drought years than above normal or normal years. UCCE Livestock Advisors have been clipping for local averages in some areas for over 50 years. We use this information to help us determine local carrying capacity when we are asked, for research on forage production, as well as providing Farm Services Agency with local data for their drought programs. We are starting a project this fall where we will be attempting to see if remote sensing can accurately determine forage production on grasslands with limited tree cover. As technology continues to improve, we hope that we will also be able to use remote sensing when there is greater tree canopy cover.

Weed Mapping

Our local Northern San Joaquin Valley Weed Management Area is back to meeting regularly, looking for grants for weed management, and working on projects. In 2020, California Department of Food and Agriculture awarded most Agricultural Commissioners small grants to map weeds of interest. In San Joaquin, the Resource Conservation District is taking the lead on the project.

The goal is to find A and Q rated weeds. If you think you have an A or Q rated weed, contact the RCD and they will come identify the weed and map it. They have more information on their website at: http://www.sjcrcd.com/programs/noxious-weed/. (Also see the attached flyer.) This program is county-wide and for all commodities. Be sure to keep an eye on roads, where we typically see noxious weeds first.

Theresa Becchetti, Livestock and Natural Resources Advisor, Stanislaus and San Joaquin counties

Report of Cherry X-Disease Phytoplasma in the Northern San Joaquin Valley

Survey

In June of 2020, we visited a large cherry orchard in the Courtland

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area of Sacramento County with a severe outbreak of cherry buckskin disease, also known as Western X disease phytoplasma. The orchard is 20 years old and roughly 50 percent of the trees appeared to be infected. This is a reminder of how devastating this disease is and how quickly it spreads if growers are not on the lookout for the early symptoms. It seems like a good time to review the details of this disease, which is also very likely still present in San Joaquin County (SJC). Infected cherry trees are the most important source of inoculum for the spread of the disease in California. We are working closely with the grower, and providing information on symptoms, scouting, sampling, and best management practices (see below) to slow the spread of the disease. We have also informed other neighboring cherry growers and PCAs about the disease because this problem requires community-wide monitoring and management for successful long-term suppression.

<u>Background</u>

Western X disease is caused by a phytoplasma that is spread by leafhoppers. There were major outbreaks in SJC as early as the 1970s. It was brought slowly under control, thanks to a joint research and outreach effort by UC and the cherry industry to identify the causal agent, vectors, and successful management strategies. Today, we can see the results of diligent management efforts over the past few decades. Though still present and the threat of re-infection is still present, it is rarely encountered and no longer the threat it once was to the cherry industry. In Pacific northwest cherry orchards, there is now a significant outbreak of what they are calling "little cherry" due partly to X-disease as well as to two other viruses that frequently occur together.

<u>Cherry X Disease Symptoms</u>

Symptoms of X-disease phytoplasma on sweet cherry trees depend on the rootstock. Cherries on Mahaleb rootstock develop different symptoms than cherries on Colt and Mazzard. On Mazzard or Colt, infection reduces fruit size and quality. Fruits from X-disease infected trees generally have a bitter taste, are small, and color up later (if at all) than fruit on healthy limbs and trees. The fruits are also more pointed and have a shorter stem than normal fruits (Fig. 1A and B). They are unmarketable. Fruit symptoms of buckskin disease can be confused with those of cherry crinkle leaf and deep suture (Fig. 2).

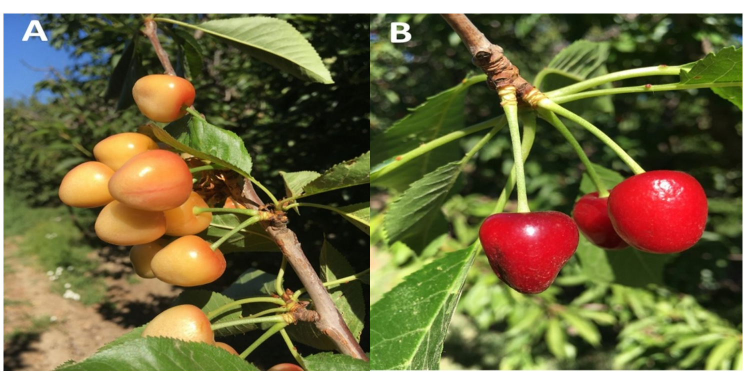

Figure 1. Symptoms of X-disease phytoplasma in sweet cherry, **A** and **B.** Small, light colored and misshapen fruit with short stems.

Figure 2. Symptoms of cherry crinkle and deep suture: Small, pointed fruit and distorted leaves

The best time to scout for trees with symptoms is in the week or two prior to harvest. Leaves are often smaller than normal with "wavy" margins (Fig. 1C), but these symptoms have other causes and are not a good diagnostic indicator. Foliage symptoms are not obvious in the early infection years. Only a single branch may show symptoms the first year after infection with more branches exhibiting symptoms in subsequent years, which can make disease diagnosis difficult at an early stage of the infection.

Figure 1. **C.** Small, pale-green leaves with "wavy" margins.

Trees decline over a period of several years. Symptoms may progress as follow:

- Early infection (Year 1): small fruit may be restricted to one branch or cluster, fruit color may develop normally, or individual pale fruit may be observed.
- Middle infection (Years 2-3): small fruit observed on multiple or all limbs, and poor color development is pronounced.
- Terminal infection (Years 3-5): characterized by reduced fruit yield, and dieback of limbs. Until trees die, they are a potential source of infection for other trees.

On Mahaleb rootstock, tree will die late in the season that they become infected, or early in the following season. Symptoms similar to Phytophthora crown and root rot, Armillaria root rot, or rodent damage can be seen - leaves are normal size but develop a yellow hue, turning bronze to dead as the season progresses. Trees exhibit a sudden decline as a result of a hypersensitive reaction at the graft union. Fruit symptoms do not develop on Mahaleb -rooted trees. In high-worked trees on Mahaleb, only infected scaffold branches develop these symptoms. Another diagnostic feature that can sometimes be seen is a pitting and grooving of wood – somewhat resembling a zipper – under the bark at the graft union. This symptom is different from pits, which develop in the wood of cherry stem pitting infected trees (Fig. 3).

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Figure. 3. Symptoms of pits and grooves at the graft union in cherry wood on Mahaleb rootstock caused by X-disease phytoplasma.

Causal Organism: Western X Phytoplasma

Western X is not a virus. It is a special type of bacteria called a phytoplasma. The Western X phytoplasma lives and multiplies in phloem cells in the tree's vascular system, affecting movement of nutrients. Once a tree is infected, the pathogen multiplies and spreads through the phloem to other parts of the tree. The phytoplasma may cease to replicate or dies in the aerial parts of the tree as it goes dormant in winter; surviving phytoplasma overwinter in the roots (except for Mahaleb rootstock). The aerial portions of the tree become re-infected in the spring, as the phytoplasma moves up through the phloem of the tree. On Mazzard and Colt, removing symptomatic branches does not eliminate the phytoplasma since it is already in the root system.

Transmission

The most significant source of infection in cherry orchards is the tree-to-tree spread of the phytoplasma by insect vectors. The only known vectors of the X-disease phytoplasma are phloem-feeding species of leafhoppers. The most important vectors of cherry buckskin in California are:

- The cherry leafhopper (Flor's leafhopper, *Fieberiella florii*). It thrives on cherries (favored host) and some other woody plants. This leafhopper is considered to be mainly responsible for spreading the phytoplasma from tree to tree within orchards.
- The mountain leafhopper, *Colladonus montanus,* lives mainly on herbaceous plants and weeds and occasionally feeds on cherries. Mountain leafhopper flies long distances and is thought to be mainly responsible for introducing buckskin disease into cherry orchards from outside, rather than spreading it among trees within the orchards.
- In Sierra foothill orchards, the leafhopper, *Scaphytopius acutus*, also appears to be an important vector.

Management Guidelines

Until it dies, a cherry tree that contracts the phytoplasma will remain infected for the rest of its life. Control of this disease requires a community effort because leafhoppers spread it from orchard to orchard. X-disease phytoplasma is still present but generally at low levels in local cherry orchards. Successful management requires a multi-pronged approach. Research in the 1980s and 1990s showed that these must be in combination for effective long-term suppression:

- Annual surveys: Each year prior to harvest, systematically inspect orchards on Colt, Mazzard, Gisela, Krymsk or Maxma rootstock for fruit symptoms. For orchards on Mahaleb rootstock, be vigilant throughout the growing season for trees showing leaf symptoms. Examine the graft union of suspect trees for zipper-like grooving and pitting. If X-disease is suspected on any trees, it is possible to confirm a diagnosis further by collecting and submitting samples to a laboratory for a test. Feel free to contact me, your local farm advisor, or your PCA for help.
- Identify and remove diseased trees: Remove infected trees following postharvest treatment for leafhoppers. Infected cherry trees are the most important source of inoculum for the spread of the disease. On high grafted Mahaleb rootstocks, remove the diseased scaffold branches by sawing off below the graft union and then top-work if desired with clean scion wood. Low-grafted trees on Mahaleb or other susceptible cherry rootstocks should be completely removed.
- Monitor and manage leafhopper vectors: If you have the disease in your own or a nearby orchard, implement a spray program. Between harvest time and leaf fall, leafhopper populations and X-disease phytoplasma concentration in the tree are higher than at other times. See sections of UC IPM on Cherry Leafhopper (http://ipm.ucanr.edu/PMG/r105301811.html) and Mountain Leafhopper (http://ipm.ucanr.edu/PMG/r105301711.html) for more information about postharvest treatment of the orchard for leafhopper vectors. Rotate leafhopper products when populations are present, and try to maintain an effective insecticide residue in the orchard from July through October. A spray schedule could be every three to four weeks starting after harvest through late October.
- Control alternative hosts for phytoplasma and the leafhoppers: Several weed species act as an alternative host for phytoplasmas and leafhoppers; these are mainly clovers, dandelion and curly dock, and they should be removed from the orchard floor.

Mohamed T. Nouri, Orchard Systems Advisor
Cristian Olaya, Postdoctoral Researcher, Department of Plant Pathology, UC Davis
Mysore R. Sudarshana, Research Biologist, USDA-ARS, Department of Plant Pathology, UC Davis

"How To" Reminders for Summer Silage Harvest

Buying or selling corn silage this summer? Do you want to adjust price for dry matter?

Traditionally, corn silage is purchased on a 70/30 basis; that is 70% moisture and 30% DM. Let's assume we're buying a field for \$60/ton. What happens when the corn silage is delivered at 28% DM, is the value still \$60/ton? What if it's delivered at 32% DM? Below is an equation that can be used to correct the purchase price for DM:

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Actual DM % x $/ton = *Corrected* $/ton
30% DM

Examples:
So, at 28% DM, the purchase price would be: 28/30 x $60/ton = $56/ton
And, at 32% DM, the purchase price would be: 32/30 x $60/ton = $64/ton

A note of advice: Have these discussions ahead of time, so both parties agree to price corrections before trucks start delivering forage. See this previous *California Dairy Newsletter* issue for more information on silage DM% price correction, including suggestions for collecting a representative field sample: https://ucanr.edu/sites/Dairy/newsletters/California_Dairy_Newsletter52328.pdf

How do I evaluate kernel processing during harvest?

Here's a fast (less than 10 minutes per sample), yet effective, way to evaluate kernel processing during harvest. Kernel processing breaks up corn kernels, allowing the starch to be digested. If whole kernels pass through the animal, the starch is lost in feces rather than used as energy for milk production. By evaluating kernel processing during harvest, adjustments to harvest equipment can be made to ensure kernel processing is effective. The following are six easy steps to evaluate kernel processing:

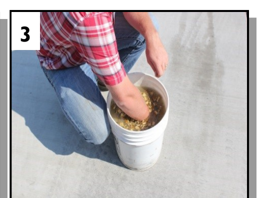
Materials needed:

1. 5-gallon bucket
2. Water source
3. Silage sample; fill a gallon sized plastic bag about half way, or collect equivalent amount, after it is unloaded at the silage structure.

Procedure:

Fill the 5-gallon bucket ¾ to the top with water.

Add the silage sample to the water in the 5 gallon



Stir the sample in the water for several seconds or until it all gets wet.

Let the sample settle in the bucket.

Slowly and carefully pour off the water with the floating sample material.

Kernels (and other dense material) sink to the bottom of the bucket; examine the kernels to ensure most are broken or crushed. If you find too many in-tact kernels, communicate with the custom harvester, chopper, etc. in order to make the necessary adjustments at the field to achieve the desired end product.

Jennifer Heguy, Dairy advisor, San Joaquin, Stanislaus, and Merced counties

Salt Burn Injury or Almond Leaf Scorch

Several growers have called me this year concerned that Almond Leaf Scorch, a disease caused by the bacterium *Xylella fastidiosa*, was spreading rapidly through their almond orchards. In most cases, I believe growers are observing salt burn symptoms on the leaves of their almond trees. I recommend that symptomatic leaves be tested for sodium and chloride first before sending samples to a laboratory to test for the bacterium. One grower I spoke with this year, however, had trees test positive for both almond leaf scorch and salinity.

Years of drought, ground water pumping, and lower than average rainfall have allowed salt levels to accumulate, especially in the Southern San Joaquin Valley, where drip and micro-sprinklers are commonly used because of heavier soils and the need to maximize water use efficiency. Less leaching of salts has led to gradual increases in sodium and chloride levels observed in leaf petiole and soil analysis. The accumulation of salt can result in poor growth, reduced yield, and observed leaf burn.

Salt injury may occur at any time but often worsens as the growing season progresses. Ordinarily it is a result of excess salinity in soil or water. Unlike almond leaf scorch, salt injury affects numerous trees in one concentrated area rather than individual trees widely scattered throughout an orchard. Salt burn is generally more concentrated at the leaf tips than along margins (Fig. 1) and it usually lacks the yellow band between the burned brown and green areas of the leaf that is characteristic of almond leaf scorch.

Figure 1. Typical Salt Burn

Affected leaves with almond leaf scorch develop a tan marginal scorch with a characteristic yellow band between the scorched and green portions of the leaf (Fig. 2). Almond leaf scorch usually develops slowly over several years, infecting more of the tree with each successive year. It may be easily overlooked when only a few leaves on one branch are affected. Almond leaf scorch is known as Golden Death because of the striking yellow color of a fully infected tree canopy.

Salt injury, particularly chloride, may be mistaken for almond leaf scorch. Sometimes the two are indistinguishable, as leaves with chloride burn can also have a yellow band between the brown burned and green tissues (Fig. 3).

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If sodium and chloride leaf levels are normal, and salinity has been eliminated as a possible cause of the problem, then have the tree tested for almond leaf scorch (the same test for Pierce's Disease of grapevine). CSP Laboratory in Pleasant Grove tests for *Xylella* (3556 Sankey Road, Pleasant Grove, CA 95668, 916-655-1582).

Figure 2. Almond Leaf Scorch

Figure 3. Chloride Burn with Yellow Band

Almond leaf scorch infections should start with once branch or scaffold. If you can detect that one branch or scaffold before the whole trees becomes infected, then I would remove that scaffold as a means of preventing the spread of the bacterium. I used to recommend removing whole trees after the whole tree becomes infected, but the evidence for tree to tree spread seems lacking, and I have observed infected trees continue to produce quite well. Cold winters appear to reduce inoculum levels of the bacterium, slowing the advance of the disease. We expect that by the time symptoms engulf the entire tree canopy, the tree may have been infected with leaf scorch bacteria for 3 to 5 years.

Xylella is spread by sharpshooter leafhoppers, which feed in the water conducting xylem. These insects carry the pathogen from plant to plant, and common annual weeds in the orchard can be sources of infection.

There is no good evidence that infected trees are the source of bacteria to infect other trees, but sharpshooters feeding on infected trees can infect annual weeds, and sharpshooters feeding on the infected annual weeds can infect additional trees in the orchard. Irrigated pasture, weedy grasses, alfalfa, and permanent cover crops are the most common habitat for sharpshooters in almond growing regions.

The green sharpshooter (*Draeculacephala minerva*), and the red-headed sharpshooter (*Carneocephala fulgida*), are the most common vectors of the pathogen found in almond orchards. The glassy-winged sharpshooter (*Homalodisca coagulata*), could also successfully spread the pathogen in almond orchards because, unlike other known vectors, it prefers to feed on trees.

The small, green potato leafhopper (*Empoasca* spp.), prune leafhopper (*Edwardsiana prunicola*), and the white apple leaf hopper (*Typhlocyba pomaria*) that commonly feed on almond leaves are not vectors of the bacteria.

Brent Holtz, Farm Advisor and County Director

Calendar of Events

Rice Virtual Field Day
Wednesday, August 26, 2020
1:00-3:00pm
Agenda: https://ucanr.edu/sites/PSU/files/331035.pdf.
Registration: https://ucanr.edu/survey/survey.cfm?surveynumber=31700.
Contact: Michelle Leinfelder-Miles, mmleinfeldermiles@ucanr.edu

Alfalfa and Forage Virtual Field Day
Wednesday, September 23, 2020
8:30am-12:00pm
Agenda: TBA
Registration: https://ucanr.edu/survey/survey.cfm?surveynumber=31830
Contact: Michelle Leinfelder-Miles, mmleinfeldermiles@ucanr.edu

San Joaquin County

Noxious Weed Mapping Program

To eradicate Noxious Weeds of San Joaquin County, San Joaquin County Resource Conservation District and the San Joaquin County Ag Commissioner's office are teaming up to map where larger populations are located. Please join in the effort and report weed populations to the SJCRCD.

Noxious Weeds that are being targeted are...

European Frogbit

Mexican Pokeweed

Slender Russian Thistle

and many more.

SJC Resource Conservation District
SJCRCD@outlook.com or
(209)337-2124

Visit the ***SJCRCD.com/Programs*** *for the full list of San Joaquin County Weeds.*

SAN JOAQUIN COUNTY
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