Sacramento Valley Prune News
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In This Issue

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Prune Management Considerations: Late Spring through Summer

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Late April – May

Crop load

- Check crop load in late April or early May and decide whether to shaker thin. See article in this newsletter for more information.

Nutrition

- Plan fertilizer applications for the season based on crop load. See articles in this newsletter for more information.

Irrigation

- Plan initiation of irrigation based on soil moisture monitoring, ETc water use, and/or stem water potential. See article in this newsletter for more information.

Insects & Mites: *With rainfall limiting orchard access this winter, pay close attention to potential spring and summer applications (especially for aphids, scale, and worms) if dormant treatments were not applied.*

- Monitor aphids this spring and summer to determine whether applications are needed. Visually sample a minimum of 40 trees in each block, using a timed search method. Spend approximately 10 minutes (15 seconds/tree) looking for significant populations of mealy plum and leaf curl plum aphid. According to UC IPM guidelines, a 'significant' aphid population is one where 10% or more of the tree canopy is occupied by live aphid populations, and the treatment threshold is more than 30% of trees having a significant aphid population in the visual search. More information on spring monitoring is available at http://ipm.ucanr.edu/PMG/r611900811.html.
- Monitor San Jose scale for crawler treatment timing. If dormant monitoring indicated economically-damaging levels AND dormant applications were not applied, consider treating the spring crawlers. If adult San Jose scales were caught in pheromone traps this year, treatments at 600 to 700 degree-days from first trap catch are effective at targeting the crawler stage. Alternatively, limbs can be wrapped with double-sided sticky tape to monitor crawler emergence and time treatments accordingly. For degree-day calculations and treatment options, see http://ipm.ucanr.edu/PMG/r606302111.html.
- Peach twig borer (PTB) and obliquebanded leafroller (OBLR) pheromone traps should have been placed in prunes by early April in the Sacramento Valley. We are observing higher than usual leaforller activity in certain areas this season, and winter conditions may have set us up for a high PTB pressure year. For both pests, set your biofix when moths are consistently caught in traps on two consectutive checks, and begin accumulating degree days (DD). For PTB, fruit sampling should begin when 400 DD have accumulated from the biofix. For OBLR, begin fruit sampling at 930 DD from biofix. More information on fruit sampling below.

Diseases

- Stay ahead of brown rot. Research indicates that late April to early May (pit hardening) is a time of potential latent brown rot infections in prune. In addition, the recent hail storm may have exacerbated the potential for infection – injuries can result in ideal conditions for brown rot infection. This can also set the stage for secondary inoculum to infect fruit later in the season. To minimize this potential, consider a fungicide application, especially if rain continues into May. For more on brown rot, visit http://ipm.ucanr.edu/PMG/r611100211.html.
- Monitor for rust potential by looking for bright, angular spots on leaves. Check low branches, replants, vigorous growth, and previous hot spots.
- Dead limbs are apparent after leaf-out. Once the bulk of spring rains have passed, prune out branches that are dead or damaged by *Cytospora*. Cut several inches below canker margins to remove all of the infected tissue. If there is rain in the forecast (within the next two weeks), postpone pruning activities. Spores from dead wood become airborne, so make sure to remove prunings and dead wood from the orchard.

Weeds

- Survey weeds after summer annuals have germinated to identify 'the ones that got away' and how future weed management could be improved. Mow or cultivate as required. A weed survey sheet and weed ID photos can be found at http://ipm.ucanr.edu/PMG/C606/m606fcweeds.html.

JUNE

- Continue monitoring for aphids and rust.
- PTB and OBLR: Begin scouting for PTB and OBLR at 400 and 930 DD from biofix, respectively. Visual inspections of fruit for larvae or damage will indicate whether treatments may be warranted (1200 total; 15 fruit each from 80 trees). Pay particular attention to leafrolls, fruit-to-fruit, and fruit-to-leaf contact points. UC IPM suggests a treatment threshold of greater than 2% of fruit with larvae and/or damage present for dried fruit (use a lower threshold for fresh market). More information is available at http://ipm.ucanr.edu/PMG/r606300511.html and http://ipm.ucanr.edu/PMG/r606300211.html#MONITORING.
- Begin scouting for spider mites. Check two different sections of the orchard each week. Spend about five minutes in each section checking 2-3 leaves (some inside and outside of the canopy) on 10 trees. Look for spider mites and predators (predaceous mites and sixspotted thrips). Treatment decisions should be based on population levels of both mites and predators. If more than 20% of leaves have mites, but less than 50% of the leaves have predators, treat for mites. If more than 60% of leaves have mites, treat even if most leaves have predators. For more on mites, see http://ipm.ucanr.edu/PMG/r606400411.html.

JULY

- Continue monitoring for aphids, rust, and spider mites.
- Consider preharvest treatments for brown rot according to UC IPM guidelines (link above).
- Begin measuring fruit pressure once fruit begin to color. Typically, there are approximately 30 days from first color to fruit maturity. Warmer weather results in slower fruit maturity; cooler weather results in faster fruit maturity. Pressure readings will indicate when to cease irrigation prior to harvest. Fruit is mature between 3 to 4 lbs internal pressure. Fruit lose 1 to 2 lbs fruit pressure per week.
- Obtain leaf samples in mid-July to measure nitrogen and potassium levels. Collect leaves from four non-fruiting spurs spread throughout the canopy of 30 trees. If local concerns dictate, include other nutrients in your leaf sample analyses (e.g., include chloride analysis of there are groundwater issues or if potassium chloride was used as a K source).
- Fruit damage samples in mid-July will give you an indication of the efficacy of your IPM program for PTB, OBLR, San Jose Scale, and brown rot. Randomly examine 1000 fruit (40 from 25 trees) looking for larvae, worm damage, and halo spots caused by San Jose scale. More information is available at http://ipm.ucanr.edu/PMG/r606900711.html.

Thinning Prunes

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

Many prune orchards this year may have set enough fruit that thinning will need to be done to maintain a large fruit size and good pricing. The earlier the thinning is done, the greater effect it will have on final fruit size at harvest. However, if you try to shake too early, you may damage the trees without getting the desired number of fruit removed. Thinning should occur roughly around the same time as 'reference date', or the point at which 80-90% of the fruit have a visible endosperm. The endosperm, a clear gel-like glob, will be found in the seed on the blossom end of the prune (Figure 1) and is solid enough to be removed with a knife point. Typically, reference date occurs in late April or early May, approximately one week after the pit tip begins to harden.

Figure 1. Extraction of the endosperm from a developing prune.

To decide whether to thin, estimate the number of fruit per tree needed to produce your desired crop, and compare that to the actual number of fruit on your trees. These numbers will then be used to help determine how much fruit to remove from the tree if thinning is needed. Below I walk through the math, step by step.

1. Calculate a targeted tonnage from a given block by considering orchard history, age, etc. Let's assume a target of 4 tons/ac, and shoot for 60 dry count/lb. From there, we calculate a targeted number of fruit per tree:

(Dry pounds per ac x Dry count per lb) ÷ Trees per ac = Target number fruit per tree

$$8{,}000\frac{lbs}{ac} \times 60\frac{count}{lb} \div 150\frac{trees}{ac} = 3{,}200\ fruit/tree \text{ (target)}$$

2. Estimate the actual number of fruit per tree and compare that number to the target of 3,200 fruit. Ideally, you would repeat this procedure on 3 trees to ensure accuracy. Place a tarp under a tree and mechanically shake off as much fruit as possible, then hand strip any remaining fruit. Collect all the sound fruit from the tarp and weigh them (we'll assume for this example math it weighs 100 lbs). Take a 1-lb subsample of the fruit and count how many sound fruit are in a pound (we'll assume 90 fruit/lb). Don't count fruits that look like they will not stay on the tree; these fruit are light green or otherwise look slightly "off" compared to the strong fruit that will "make" a prune. Then use those numbers to estimate the total number of fruit per tree:

Total tree fruit weight x Number of prunes per lb = Total number of fruit per tree

$$100lbs \times 90\frac{fruit}{lb} = 9{,}000\ fruit/tree \text{ (actual)}$$

In this case, you have approximately 2.8 times the number of fruit on the tree as desired to hit the target of 60 dry count/lb, and you may consider thinning the orchard. You don't want to simply remove all those fruit though, because you need to account for natural fruit drop. Estimates of natural fruit drop range from 10%-40% - again, this is an area where you need to account for orchard history, as well as your own risk threshold.

It is much safer to under thin than to over thin! Because of that risk, many growers prefer to leave approximately 50% more fruit on the tree than the target amount. This means that we need 50% more fruit on the tree after mechanical thinning than we want remaining on the tree at harvest:

Target number prunes per tree X (1.5% fruit drop buffer) = Adjusted number fruit per tree

$$3{,}200 \text{ X } 1.5 = 4{,}800\ fruit/tree \text{ (adjusted target)}$$

And finally, you can calculate how many fruit to remove by subtracting the adjusted target number from the actual number of prunes on the tree:

Actual fruit per tree – Adjusted target fruit per tree = Number fruit to remove

$$9{,}000\frac{fruit}{tree} - 4{,}800\frac{fruit}{tree} = 4{,}200\ fruit/tree\ to\ remove$$

From here, you can use harvest machinery to remove the approximately 2,600 fruit desired. Shake a tree for one second, and following the steps above, calculate how many fruit were removed. Adjust the shaking time until the desired number are removed. Typical shaking time is 2-4 seconds at full throttle; avoid shaking for longer than 6-7 seconds to prevent unnecessary damage. Once you've calibrated your shaking time, go through and thin the block.

Techniques to Time First Irrigation Dates for Prune

Allan E. Fulton, UCCE Farm Advisor Tehama, Glenn, Colusa and Shasta counties
Richard P. Buchner, UCCE Farm Advisor Tehama, Glenn and Butte counties

Overly aggressive, early irrigation can saturate soils and deprive roots of necessary oxygen. Without oxygen, roots often suffocate and die compromising tree performance. In addition, soil fungal pathogens such as *Phytophthora* are favored in saturated soils increasing the risk of infection and tree damage or death. On the dry side, delaying the start of irrigation too long can result in tree water stress also compromising tree and crop performance. Impacts may include smaller fruit and reduced yield. Water stress during the season can reduce flower quality, influence carbohydrate reserves and increase fruit drop, sunburn and limb dieback.

Monitoring Tree water use (ET) and Rainfall

One relatively simple technique to help decide when to begin irrigating is to estimate soil moisture depletion by comparing estimates of evapotranspiration (ET) to effective rainfall received since leaf out. Not all in-season rainfall is effective. In longer, more intensive storms some water runs off, some may infiltrate into an already full soil profile and cause earlier stored water to drain out of the primary root zone. Short, intermittent showers may evaporate quickly if followed by sunshine and not add to stored moisture in the root zone. 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. The first irrigation is suggested when the cumulative ET exceeds the amount of spring rainfall received since leaf out by at least the amount of water that will be applied in a typical irrigation event. This requires knowledge of the hourly water application rate of the drip or microsprinker system. If there is concern about tree damage from root pathogens and/or poor aeration, the first irrigation can be delayed even more. Shovels or soil augers are useful for visual soil evaluation and/or soil moisture monitoring can confirm any decisions to delay the first irrigation. To acquire real-time ET reports email aefulton@ucanr.edu or dmlightle@ucanr.edu for northern Sacramento Valley counties and fjniederholzer@ucanr.edu or kspope@ucanr.edu for southern Sacramento Valley counties or go to www.sacvalleyorchards.com/et-reports and click on "Subscribe".

Measuring Soil Moisture

There are numerous manufacturers and providers of soil moisture sensing equipment. Some detect volumetric soil moisture content and some measure soil moisture tension. Soil moisture levels can be measured manually or automatically with data loggers and delivered on demand via cellular and internet services. An important aspect of monitoring soil moisture depletion is placement of the soil sensors to achieve good representation of the root zone and soil variability. The decision to begin the irrigation season can be determined by comparing the amount of soil moisture depletion to the amount of irrigation that will be applied and balancing them.

Measuring Orchard Water Status

The pressure chamber and midday stem water potential (MSWP) has been the state of the art for monitoring tree water stress for some time. Pressure chambers are used to measure actual tree water status usually midday when trees are experiencing the most amount of water stress. Low to mild stress levels in the -8 to -10 bar range would be reasonable threshold to begin irrigation for prune. A free on-line UC ANR Publication 8503 describes in detail how to use the pressure chamber to guide water management decisions in prune, almond and walnut. Publication 8503 can be found at *http://ucanr.edu/datastoreFiles/391-761.pdf*.

Prune orchard nutrition: thoughts for 2017

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

It looks to be at least a decent prune crop in many orchards around the Yuba City area. Now begins the important work of supporting current crop growth and canopy health and return bloom for future production. Adequate orchard nutrition is critical to both these goals. With soils still very wet in many orchards and rain continuing as of mid-April, special care in soil and nutrient management should be taken to maintain profitable crop development and canopy health.

Saturated/wet, cold soils slow root activity. All nutrients absorbed from the soil are absorbed from the soil solution, so some soil moisture is necessary for nutrient uptake. But too much soil water interferes with nutrient uptake, as oxygen is rapidly depleted in saturated soil by plant root and microbe activity and "restocking" of soil oxygen from above ground atmosphere is blocked by water-filled soil pores. Wet soils are also slow to warm, and warmer soils mean warmer roots. Active biological processes move faster in warm compared to cool soils.

Inputs of three essential mineral nutrients are needed in most prune orchards in most years – nitrogen (N), potassium (K) and zinc (Zn). In wet springs, tree N, K, and Zn availability may be limited by cold, saturated soils. Iron (Fe), and occasionally manganese (Mn), availability can also be limited under those conditions. Before getting into specifics about how this spring may impact N, K and Zn management, let's review some basics regarding these key elements.

Nitrogen:

- Is primarily absorbed as nitrate (NO_3^-) by roots, but uptake also occurs as ammonium (NH_4^+). All N in fertilizer and/or organic matter inputs are eventually transformed to nitrate in warm, well aerated soils by microbes.
- Is readily lost from the soil solution in ways other than being absorbed by crop.
  - Nitrate leaching with excessive soil moisture –rain or irrigation—as negatively charged nitrate is not held on the negatively charged soil.
  - Ammonia volatilization from ammonium or urea fertilizer left on the soil surface and not incorporated with irrigation water or cultivation
  - Immobilization by soil microbes or weeds. Immobilization refers to the absorption and use of mineral N by microbes or weeds.
  - Denitrification by soil organisms in saturated, low/no oxygen soil conditions. Nitrate is transformed into N_xO and N_2, that can't be readily used by plants.
- Is most efficiently managed on a "feed the need" basis in most crops including prunes, as excess soil nitrate is readily lost by the mechanisms listed above. "The need" is made up of mostly crop and shoot growth as well as some storage in woody tissue in roots, trunk and branches. A dry ton of prunes contains 12-13 lbs. of N.

Potassium:

- Is readily held on the cation exchange phase of soil, especially on the heavier soils commonly used to grow prunes in the Sacramento Valley.
- Is managed by 1) applying banded soil applied K fertilizer (400-500 lbs 0-0-50 or 0-0-60) in winter, 2) fertigated K in-season at roughly half the winter rates, 3) some combination of soil and foliar applied K fertilizer in-season or 4) foliar fertilization, only. Foliar applied potassium nitrate effectively replaced winter banded K fertilizer in a four year UC research project, but at least 4 to 5 sprays (20-25 lbs KNO_3/acre for each spray) were applied from April to early August. Banded, soil applied K fertilizer is more slowly available to the tree than in-season fertigated K.
- Is required by a prune crop in the highest amount of any mineral nutrient – 23-25 lbs K_2O/dry ton.

Zinc:

- Is tightly held on the cation exchange phase of soil, especially on the heavier soils commonly used to grow prunes in the Sacramento Valley.
- Is much less available to prune roots when soil pH is above 7 (soil is alkaline).
- Is required in relatively small amounts by a healthy prune orchard. An entire, mature prune orchard contained roughly 8 oz/acre in a UC study in Glenn County in the 1990's.
- Is primarily needed in growing points of plants, so tree Zn requirement is highest at bloom when the largest number of growing points are present in prune trees (and other tree crops).
- Is commonly managed using a single foliar application, postharvest. Traditionally high Zn rates (20 lbs zinc sulfate/acre) applied at the beginning of natural leaf drop can be replaced by much lower rates (for example, 5 lbs zinc sulfate/acre) in early October although leaf drop will not occur with lower rates. A spring foliar Zn spray can also effectively manage Zn in prune orchards.

In a wet spring with a good to heavy crop in many orchards, consider the following suggestions:

1. N and K are the most expensive nutrients to apply and the costliest to be deficient in a prune orchard. Since cropload drives N and K demand, thinning the crop -- where needed -- should reduce nutrient demand/acre while maximizing production of large, high value fruit. The first step is to count fruit just before the reference date is reached and thin, if needed, once reference date is reached. The more time that passes between reference date and thinning, the smaller the improvement in size of thinned compared to unthinned fruit. (See the article on shaker thinning of prunes in this newsletter.)

2. Delay first irrigation until 1) the soil will hold all the water applied by micro-irrigation or 2) the soil is depleted of 50% plant available water under flood irrigation conditions (see article on timing of first irrigation in this newsletter). If irrigation is applied too early and weather remains cool, tree water use is limited and the soil water content will remain high. Under saturated or near saturated conditions, root function is reduced and bicarbonate levels can build in the soil, reducing Fe availability and producing Fe deficiency symptoms (see picture below). This is a particular problem where irrigation water contains elevated levels of bicarbonate (see article in this newsletter about yellow prune trees).

Why are some prune trees yellow in the spring? The Bicarbonate Blues.

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

Wet springs often means more yellow, iron (Fe) deficient prune trees than in dry years. Iron deficient prune trees show yellow leaves with green veins and limited vigor. If the deficiency continues, the leaf between the veins bleaches to almost white. The symptoms usually appear first at shoot tips, because iron is not mobile in plants. Tree growth and production can suffer under extended Fe deficiency.

Iron deficiency symptoms in French prune.

The problem is actually not soil Fe deficiency, but a lack of iron in the right form within trees. Researchers believe Fe deficiency in tree crops is related to soil bicarbonate levels. To further complicate troubleshooting of yellow leafed prune trees, leaf analyses results may not show low leaf Fe levels, but Fe deficiency symptoms will be present. This is because, while prune trees absorb Fe as Fe^{2+}, it must be oxidized to Fe^{3+} in the tree to be biologically useful. If the shift from Fe^{2+} to Fe^{3+} doesn't occur, Fe can be in the leaf and measureable by lab equipment but not active in chlorophyll molecules and other important functions, resulting in yellow leaves.

While foliar sprays containing Fe^{3+} can correct symptoms in the short-run, the root cause of the problem of yellow prune trees is elevated soil bicarbonate and that is the condition to be managed in the long term. Soil bicarbonate levels can be elevated by several conditions; some are more easily managed than others.

Alkaline soils ($pH > 7.0$) are high in carbonates and bicarbonates. The further above pH 7, the greater the level of carbonates and bicarbonates in soil. Areas in an orchard can show high pH and iron deficiency symptoms. Yellow leaves from iron deficiency are often called iron chlorosis or lime induced iron chlorosis. Reducing the soil pH with soil sulfur or sulfuric acid applications is a method of correcting lime induced iron chlorosis. Adding sulfur is a slower, longer lasting effect, while adding sulfuric acid is a quick, short-lived fix. In some orchards with very high pH and excessive yellowing in trees, shanking sulfur into the ground gives the best results. If not treated, Fe deficiency symptoms will continue through the season as the source of bicarbonate is permanent.

Irrigation water high in bicarbonates can produce yellow trees (see photo below). This can be corrected with sulfuric acid or urea/sulfuric acid treatment of the irrigation water or by sulfur application to the soil to reduce soil pH to neutralize the bicarbonate. Unless treated, this condition can continue through the season, especially in areas of the orchard where pH is above 7.

Saturated soils after bloom, which can result from premature irrigation in wet springs, can accumulate bicarbonate from the carbon dioxide produced by respiring roots and trapped in the soil by excessive moisture. The best correction for this condition is timely irrigation. In this scenario, the yellow leaves should fade as the soil dries and allow to "breathe out" the carbon dioxide.

Finally, the best long-term fix for iron deficiency in prunes and other stone fruit is the use of rootstocks that perform well under high bicarbonate soil conditions. Rootpac-R is a rootstock that is reported to do well under high pH soils in Europe and may have a fit under similar conditions in California prune orchards. This rootstock is included in the Yuba County prune rootstock trial planted by UC in 2011. So far, the trees are performing well. Stay tuned…

Two prune orchards, farmed by the same operation.
The orchard on the right is irrigated with high bicarbonate water.