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Fruit and Nut

University of California
Agriculture and Natural Resources

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PRACTICAL • CONNECTED • TRUSTED

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SACRAMENTO VALLEY REGIONAL PRUNE NEWSLETTER

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Orchard Considerations for Bloom and Beyond

Franz Niederholzer, UCCE Farm Advisor, Colusa, Sutter and Yuba Counties
Emily J. Symmes, UCCE Area IPM Advisor, Sacramento Valley
Katherine Jarvis-Shean, UCCE Farm Advisor Sacramento, Solano & Yolo Counties
Luke Milliron, UCCE Farm Advisor, Butte, Tehama and Glenn Counties

LATE FEBRUARY

- **Bees:** Order bees, generally at a rate of 1 hive/acre. Employ best management practices for maintaining hive health and actively communicate with your beekeeper about the fungicides you may use at bloom. Refer to the article in this issue for more information on bloom pest management activities and honey bee protection.
- **San Jose Scale (SJS):** Dormant to delayed-dormant is the preferred management timing for applying pesticides to treat damaging levels of San Jose Scale. Use spur monitoring to determine if treatment is needed. For detailed directions for taking a dormant spur sample, see: ipm.ucanr.edu/PMG/r606900511.html. Place pheromone traps by mid- to late-February to establish a biofix and begin accumulating degree days for crawler treatment timing (if dormant treatments were not applied) and to monitor parasitic wasp levels *More on SJS:* ipm.ucanr.edu/PMG/r606302111.html
- **Irrigation Maintenance:** Maintaining and checking the distribution uniformity of your irrigation system is key to preparing for possible heat at bloom, as well as the coming irrigation season.
- **Calibration:** Calibrating your spray equipment and replacing nozzles, checking spray filters and other worn parts is part of preparing for bloom disease sprays.
- **Protect new trees:** For both replants and new orchard plantings, protect trees from sunburn and herbicides with white interior latex paint diluted 2:1 water to paint, plus tree wraps. If tree wraps are used without painting trees, the boxes should be flattened (◇from the top, not □) to avoid "wrapper burn".

MARCH

- **Cold at bloom:** a closely mowed orchard floor is warmer than one with tall weeds/cover crop, while freshly disked soil is the coldest.
- **Heat at bloom:** If temperatures climb above 81-82°F during bloom, fruit set may be reduced and crop loss can occur. Crop failures have occurred with maximum temperatures above 83°F at full bloom in a fast bloom year. To cool the orchard as much as possible when hot weather at bloom is predicted, run sprinklers when temperatures reach 75°F and keep them on until they drop below 75°F. Evaporation of sprinkler water as it moves through the air provides some small temperature reduction (usually just one or two °F). If the weather is hot at bloom, taller weeds may keep the orchard cooler during the day.
- **Brown rot:** A single bloom spray for brown rot, applied at 25-40% bloom, is needed when skies are clear during bloom. Use locally systemic fungicide(s) (FRAC Group 3, 9, and/or 11) in a single-spray brown rot program. A scab material can be included with this single brown rot spray. Dew can wet the flowers long enough to allow infection, even if there is no rain, so treating at least once for brown rot is recommended. If the weather outlook changes and rain is forecast during bloom, spray 2x, once at white bud (5% bloom) and again at full bloom. The full bloom spray is the most critical. *See fungicide timing and efficacy data in this newsletter.*
- **Russet scab:** This disorder develops when there is significant rainfall during and/or immediately after bloom. The suggested full bloom timing of captan or chlorothanil (Bravo®/Echo®) can be risky for bee health. If a single bloom spray is applied for brown rot, before 50% bloom, scab material can be included in that spray. Once the fruit is through the jackets, the risk of scab is mostly gone.
- **Peach twig borer (PTB):** Monitor during and after bloom. Chewing damage on buds during bloom indicates PTB activity and may warrant treatment. To protect bees, avoid any insecticide in the spray tank at bloom, except Bt (*Bacillus thuringiensis* formulations such as Dipel®, Javelin®, etc.). *More on PTB at:* ipm.ucanr.edu/PMG/r606300211.html

- **Aphid**: If control measures were not taken during fall or winter, two oil sprays (4 gal/acre/spray) at bloom can be effective against mealy plum and leaf-curl plum aphids if applied slowly (for example 1.5 mph) 7-10 days apart. Oil has a level II precaution for bee safety, meaning it should only be sprayed between sunset and midnight, ideally when temperatures have dropped below 55°F to avoid foraging bees. **The safest option for bees is to consider utilizing an alternative management timing (spring, fall, or winter) for aphid control.** Finally, oil should ***not*** be applied with or shortly before/after captan, chlorothalonil, or sulfur because the combination can be phytotoxic.

  More leaf curl plum aphid info: ipm.ucanr.edu/PMG/r606301811.html

  More mealy plum aphid info: ipm.ucanr.edu/PMG/r606301711.html

APRIL

- **Got a crop?** If the weather stays dry and warm, we may have early bloom followed by early reference date. If bloom-time maximum temperatures stay between 60°-80°F, there is a strong chance the crop will be good to heavy and thinning needed once reference date arrives. Get ready to line up shakers if bloom weather is good. We are hearing reports of experienced thinning operations getting calls for thinning reservations before bloom even starts.Check for tip hardening earlier than usual. Reference date is usually 7-10 days after tip hardening. Thin early for best size results.
- **Irrigation:** In dry springs, special attention to orchard water status and irrigation is needed.
  - Monitor soil moisture sensors or pressure bomb readings to track orchard moisture status and determine when to apply first irrigation. Don't apply irrigation before the crop has used more water than the first irrigation will apply. Irrigating too early can saturate soils, leading to leaf yellowing from iron chlorosis. Yellow trees due to wet soils in the spring should "green up", but may not feed the growing crop as well as if they never became yellow at all. For more on diagnosing yellow prune trees see: sacvalleyorchards.com/blog/prunes-blog/why-are-some-prune-trees-yellow-in-the-spring-the-bicarbonate-blues/
  - If we continue to have a dry spring, irrigation may be needed much earlier than in previous years (last year?!). If the orchard is allowed to really dry out in the spring, rewetting can cause end cracking on fruit, especially in May and/or June. Don't let your orchards go into those months with water stress. The trick is to keep an eye on 1) crop needs and soil water levels and 2) the weather for the coming week plus. We have seen leaf yellowing ("iron chlorosis") when irrigation is applied and then the weather turns cool and tree water use is less than expected and the soil stays too wet. The most direct measure of water status is the pressure bomb, read more at: sacvalleyorchards.com/manuals/stem-water-potential/
- **Fertilization program starts:** With crop load being the major driver of nitrogen (N) and potassium (K) use, measure the crop in mid-April and use this information to plan your fertilizer applications. To optimize uptake and avoid leaching, apply multiple N applications, avoiding a single heavy spring application. Consider an N application before the end of April if there is a good crop set. If considering foliar potassium nitrate applications as your K program or to supplement soil applied K, begin spraying in late April and make additional applications every 2-3 weeks. More details at: apps1.cdfa.ca.gov/FertilizerResearch/docs/Prune_Plum.html
- **San Jose Scale (SJS):** If dormant treatments were not applied, efficacy not achieved, and/or spring SJS pressure appears high, consider treating at 600 to 700 degree days after pheromone trap biofix to target emerging crawlers. (Traps should be up in February.) Alternatively, SJS crawler activity can be monitored using double-sided sticky tape around limbs beginning in April to detect crawler emergence and time spring treatments if necessary.
- **Peach twig borer (PTB):** Begin post-bloom monitoring with pheromone traps (minimum 2 per block) no later than mid-March to determine biofix (moths caught on two consecutive trap checks) and begin accumulating degree days to inform when to begin fruit inspections. PTB biofix in prune orchards is often later than in almond orchards. Use prune PTB trap data to determine biofix in prune orchards.

- **Obliquebanded leafroller (OBLR):** Place pheromone traps (minimum 2 per block) at the beginning of April to establish a biofix (moths caught on two consecutive trap checks) and begin accumulating degree days to inform when to begin fruit inspections. *More on OBLR at* ipm.ucanr.edu/PMG/r606300511.html
- **Aphid:** Monitor for leaf curl plum aphid and mealy plum aphid since colonies can grow soon after bloom. Monitoring details at: ipm.ucanr.edu/PMG/r606900211.html. Oil sprays anytime from petal fall to May 15 can reduce mealy plum aphid to acceptable levels with good to excellent coverage. Oil is not effective against leaf curl aphid during this period as the spray can't reach inside the curled leaves. Other pesticides are effective in controlling aphids during the spring, but be careful to avoid flaring mites with pyrethroids (Asana®, Warrior®, etc). or neonics (Actara®, Provado®, etc.). Movento® and BeLeaf® can provide excellent aphid control when monitoring shows a need.

MAY

- **Rust:** Monitoring commences with the start of the month, surveying 40 trees every 1-2 weeks, paying close attention to non-bearing replants, exceptionally vigorous trees, and previous hot spots. Consider treating when the first leaf with rust is found. *For more on rust see:* ipm.ucanr.edu/PMG/r606100611.html
- **Peach twig borer (PTB) and Oblique-banded leaf roller (OBLR):** These worms feed on the fruit surface later in the season, "opening the door" for fruit brown rot infection as sugar increases in the fruit. Don't assume earlier sprays worked. Inspect fruit at 400 degree days after the first biofix. In the orchard, look for larval entry points on the fruit (ideally 15 fruit from 80 trees), especially where fruits contact each other or touch leaves. Treat if 2% or more (24+ of 1,200) of the fruit have damage. For OBLR, begin fruit inspections at 930 degree days after biofix for that pest, following the same sampling protocol and treatment threshold.
- **Aphids:** While monitoring for leaf curl plum aphid comes to an end in mid-May, continue monitoring for mealy plum aphid until mid-July.
- **Irrigation:** Continue monitoring soil and/or plants or tracking ETc to determine irrigation needed. May and June are the most critical months for end-cracking. Stay on top of orchard water status since irrigation is critical during the spring.
- **Fertility:** continue with nitrogen and potassium fertilization program if a good crop is set. More than 50% of annual N budget should be applied before June 1st.

Tehama Cooperative Extension is hosting an;

IRRIGATED PASTURE WORKSHOP

Saturday, April 4, 2020

9:00 AM

Los Molinos Veterans Hall — 7980 Sherwood Blvd. - Los Molinos, CA 96055

Topics being discussed: Water district goals and water user participation to achieve them, Grazing management variables affecting irrigation timing and production efficiency on irrigated pastures, How much water is delivered and what irrigation practices help shorten the delivery interval?, Need technical assistance? Arrange an on-site evaluation of your irrigation system, Looking for financial assistance? Completing an irrigation and nitrogen management plan, Demonstration of weed wiper and discussion of weed control in irrigated pastures, and Plant ID Jeopardy.

For more information contact the Tehama Cooperative Extension Office 527-3101

Young Orchard Weed Management

Drew Wolter, UC Davis Graduate Student, Weed Science Program

Weeds in young orchards compete with trees for orchard resources such as sunlight, water and nutrients. This can lead to reductions in growth and future yields. If weed stands are allowed to mature, not only are they harder to control via chemical and mechanical methods, but they can also create cover for voles and gophers, which can then damage tree trunks, root systems and irrigation systems.

Weed management can be particularly difficult in newly planted and young orchards because rapid weed growth is accelerated by frequent irrigation, necessary to establish trees, fertilizer inputs to grow the trees, and the abundant sunshine due to small tree size. In addition, control is challenging because tree trunks may still be green and sensitive to contact and systemic herbicides, which can cause severe trunk damage and canopy stress. For these reasons, weed control can be one of the most obstructive facets of establishing a new orchard. While weeds are present in every orchard, there is variation in the weed species composition and density from orchard to orchard, especially in young orchards. Scouting for weeds is the basis for a good Integrated Weed Management (IWM) plan. Post-harvest scouting should start early and be repeated once more before the start of the season in order to catch weeds when they are young. Herbicide applications targeting mature weeds are often minimally effective, resulting in a less successful program and increased management costs.

Post-emergent materials are often used for control of weeds in newly planted trees. Contact products (AKA burn-down herbicides) kill the leaves and green stems of plants that they come in contact with. Systemic herbicides enter the plant and move to the actively growing tips of the plants they come in contact with. Post-emergent herbicides require repeated treatment to control weeds throughout the season and careful timing of these short-lived products is necessary to control weeds in young orchards. Caution should be used when applying either form of post-emergent materials, because drift or direct spraying onto leaves or green tree trunks can lead to damage or even kill young trees (see figure 1). Crop safety is usually achieved by prudent application, being extra cautious with windy conditions, spray rig height, nozzle angles, and nozzle selection.

Figure. 1 Herbicide Damage in 2nd leaf almonds. Glufosinate + Glyphosate (1.5 + 2.75lbs/ac). Image on the left is trunk gummosis observed 5 weeks after treatment. Image on the right shows complete defoliation of the same tree 12 weeks after treatment.

Post-emergent Herbicides Registered for Young Orchards:

Herbicide	Example Trade Name	Notes from Labels
Carfentrazone	Shark	NOT OK on green bark
Clethodim	Select Max	Only for non-bearing
2, 4-D	Dri-Clean	OK to use after 1st leaf
Diquat	Diquat	Only for non-bearing
Fluazifop-p-butyl	Fusilade	
Glyphosate	RoundUp	NOT OK on green bark
Glufosinate	Rely 280	NOT OK on green bark
***Paraquat	Gramoxone	NOT OK on green bark
Pyraflufen	Venue	NOT OK on green bark
Saflufenacil	Treevix	
Sethoxydim	Poast	

*** *NEW EPA RESTRICTIONS- See article in this newsletter titled "New EPA Paraquat Restrictions"*

A pro-active yet often overlooked method to manage weeds in young orchards is the application of **pre-emergent** products. Pre-emergent herbicides control weed seedlings as they germinate halting the development of seedling shoots and roots, ultimately preventing emergence. These herbicides can provide residual control throughout the year if properly timed and applied. Applications can be made once in the winter or early spring going into summer and again in the fall to target warm and cool season species, respectively. Pre's bind to organic matter and soil to limit leaching and mobility once applied to provide residual control. Clearing berms of leaf litter and skeletal remains of any resident vegetation from last season will help evenly distribute and incorporate the pre-emergent for optimal control. The majority of these products require between 0.25-0.75 inches of rain/irrigation for proper incorporation and effectiveness. Plantings that were made in fall can take advantage of winter and spring rains.

Pre-emergent Herbicides Registered for Young Orchards:

Herbicide	Ex. Trade name	Notes from Labels (Time of first use)
EPTC	Eptam	Well-established
Flumioxazin	Chateau	Established for 1 season, needs carton
Indaziflam	Alion	Established for 1 season
Isoxaben	Trellis	
Norflurazon	Solicam	18 months
Oxyfluorfen	Goal	
Pendimethalin	**Prowl**	
Oryzalin	Surflan	
Penoxsulam	PindarGT	9 or 15 months (soil)
Rimsulfuron	Matrix	Established for 1 season

Cautionary note:
Many growers rely heavily on a single herbicide program on an annual basis. This might be because of affordability or the initial effectiveness of the program. However, by using the same products and mode of action to kill weeds, we are selecting for herbicide resistance. With the growing number of herbicide-resistant weeds in California orchards, control of escaped (resistant) weeds can considerably reduce the long-term cost of an annual orchard floor management program. For example, spot treating two acres of glyphosate-resistant palmer amaranth with a tank mix of glufosinate and paraquat is much more affordable than trying to control it over an entire 40-acre block. Remember to scout this winter so you can spot treat, rather than having an orchard full of herbicide-resistant weeds in the future.

For more information regarding the status of herbicide resistance in California visit:
ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=29069

More information regarding young orchard management can be found at:
UCCE/UCANR Young Orchard Handbook- ccfruitandnuts.ucanr.edu/files/238596.pdf
OR sacvalleyorchards.com/manuals/young-orchard-handbook/weed-management-for-young-orchards/

New EPA Paraquat Restrictions

Drew Wolter, UC Davis Graduate Student, Weed Science Program

As the 2020 growing season approaches, California growers, PCAs and handlers will have new regulations to take into consideration. The United States Environmental Protection Agency (EPA) recently announced the new requirements for handling paraquat (paraquat dichloride). The new EPA restrictions on paraquat aim to help protect Restricted Use Pesticide handlers, and others who may come into contact with these pesticides. However, these requirements will have a ripple effect on growers, distributors and the California agriculture community. Label changes emphasizing paraquat toxicity, restrictions and safe handling were completed November 2019. What changes did the EPA mandate?

Supplemental warning materials:

The containers of paraquat products will be required to include several supplemental warnings. These include a sticker with a, "one sip can kill", warning affixed near the dispensing valve and a product package safety requirements sticker affixed to the container. All of the supplemental warning materials will be in English, Spanish and pictogram format.

Restricting USE of all paraquat products to certified applicators. Two certifications will be required in order to use paraquat products:

A. Certified pesticide applicator's license/permit from your state or tribal authority.

- There are three main types of applicator certifications in California: Qualified Applicator License (**QAL**), Qualified Applicator Certificate (**QAC**) and Private Applicator Certification (**PAC**).

B. Paraquat-specific training certificate in your name, obtained via online training at www.usparaquattraining.com, currently hosted by the National Pesticide Safety Education Center (NPSEC).

How is paraquat use defined?

"Use" includes pre-application activities involving mixing and loading paraquat. Use also includes applying paraquat, transporting or storing opened containers, cleaning equipment, and disposing of excess product, spray mix, equipment wash waters, empty pesticide containers, and other paraquat-containing materials. **Non-certified applicators will no longer be allowed to use (see "use" definition above) paraquat, even under the supervision of certified applicators.**

Will existing paraquat products need to be relabeled?

No, retailers will be allowed to sell the "old" labeled products until supplies are exhausted.

For more information on the changes to Paraquat labeling and restrictions visit:

ifca.com/files/syng_4386_2_3_National_Paraquat_QA_FINAL.pdf

Navigating Irrigation Technology Overload

Allan Fulton, UC Irrigation and Water Resources Farm Advisor

Technology vs Confusion

"Technology" has different meanings for different people (Figure 1). In irrigated agriculture we look towards technology to meet our changing needs and sustain our industry in the long run. However, with technology, "confusion" and a sense of overload can hinder our ability to learn and apply it. This article considers the abundance of irrigation technology and the challenges with its adoption. Some ideas are offered to cope with the sense of confusion and overload.

"TECHNOLOGY" –

"The application of scientific knowledge for practical purposes"

"May be information, skills, techniques, machinery, or equipment"

"Sum of techniques, skills, methods, and processes to produce goods"

"CONFUSION"

"Lack of understanding, uncertainty

"Bewildered or unclear in one's mind"

Figure 1. Technology and confusion are often experienced together.

Why and Why Not Technology?

On one hand, there are many drivers that can cause us to look to technology for help with irrigation:

1. Acquiring sustainable irrigation water supplies;
2. Uniformly distributing water and nutrients to the crop;
3. Proper timing and amount of irrigation for optimal production;
4. Irrigating with limited labor yet improve execution and precision;
5. Optimizing water and energy costs in relation to crop revenues; and
6. Protecting groundwater and surface water from non-point source pollution.

On the other hand there can be a variety of constraints to adopt irrigation technology:

1) Technology is available from many origins and in many forms and with this comes a potentially steep learning curve to identify and understand whether a technology fits the need(s).
2) No two farms are the same. Each has its unique challenges depending upon the variables (size, crops, human resources, microclimate, soils, water source, etc…)

Where to Begin?

When considering new irrigation technology, it's probably best to start from the familiar "30,000 foot" perspective. An orchard irrigation system has several components (Figure 2) and it's necessary to determine what aspect may be the weakest link and provide the biggest return to investment in technology. It's helpful to recognize them all and not overlook something as you prioritize needs.

Water Well Technology

Well design and construction choices affect how efficiently water enters the well from the aquifer. The less efficiently water enters into the well the deeper the pumping water level and the greater the yearly energy bill.

If you are developing and securing a new groundwater supply, seek information on different techniques of well drilling, well design, construction and development. This can lead to a more reliable and affordable water supply and improve your understanding of the well you are buying. Some information resources include:

1) Water well design and construction, UC ANR Publication 8086 http://groundwater.ucdavis.edu/files/156563.pdf); and
2) Water well design, construction, and development: Important considerations before making the investment (https://ucanr.edu/sites/Tehama/files/20593.pdf).

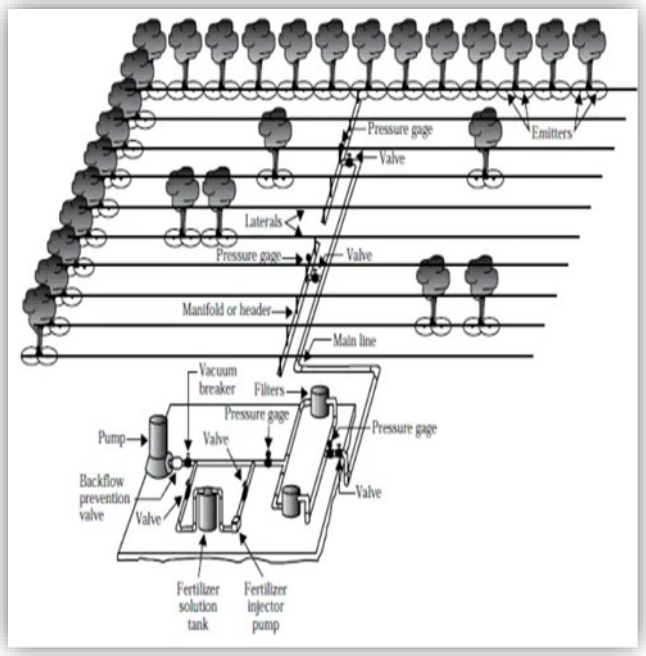

Figure 2. Schematic showing orchard irrigation system beginning with the well and pumping plant and extending out to the last lateral line and sprinkler or dripper.

Pumping Plant Technology

Overall pumping plant efficiency affects the cost of pumping water. The higher the efficiency the lower the cost of pumping an acre-foot of irrigation water. Efficiency and cost of pumping are affected by power demand, flow rate, irrigation system pressure, and fluctuating groundwater pumping levels. Flow meters to measure pump flow, pressure gauges or transducers that track irrigation system pressure, and well sounders or sensors to watch pumping levels are available to monitor pumping plant performance and costs. If used, they can notify the operator when the pumping plant performance is veering too far from optimal and in need of attention. They may also alert a manager of unexpected irrigation system failures such as a pump not turning on or off or a valve not opening or closing as expected. Other technologies such as solar arrays and variable frequency drives (VFD) are also becoming more common to manage the costs of pumping water. A solar system provides an alternative, renewable power source and a variable frequency drive (VFD) regulates the power to an electric motor to optimize demand and pumping plant performance. This is particularly valuable to manage irrigation sets of different sizes and flow needs. A VFD can also improve consistency of flow and pressure to an irrigation system during pump start-ups, back flushing, and when pumping water levels fluctuate.

Figure 3. Magnetic flow meter (upper left), pressure transducer (upper right), acoustic groundwater level sensor (lower left), and VFD digital control panel (lower right).

Irrigation system technology

A wide range of technology is available and all aim to grow uniform orchards that produce efficiently and at a high level for many years. This includes orchard site preparation schemes, choices among water filters, pressure regulators, drip emitters, microsprinklers, or minisprinklers, and tools to help monitor and maintain irrigation systems.

Figure 4. Layered orchard soil considered for soil modification and/or zone irrigation management.

Land assessments using backhoe pits (Figure 4) to guide soil modification with excavators or other deep tillage equipment is one technique used prior to planting trees and installing an irrigation system. Another approach uses non-invasive techniques to map and geo-reference the soil variability. This information is used to precisely design irrigation systems so that soils with distinctly different water infiltration and water holding characteristics can be irrigated in separate sets. This approach is referred to as variable rate irrigation (VRI) or zone irrigation. Refer to UC ANR Publication 3507, Prune Production Manual, Chapter 8 (https://www.youtube.com/watch?v=rz_ER49fZEA) and zone irrigation management articles found on the Sacramento Valley Orchard Source. (http://www.sacvalleyorchards.com/?s=zone+irrigation).

Figure 5. Pressure transducer on irrigation line (top) and flow meter on injection pump (bottom).

Pressure gauges or transducers (Figure 5) can be installed in drip or microsprinkler lines intermittently across an irrigation system to verify the system is operating as designed and according to schedule. Small flow meters can be installed on injection pumps to verify chemigation and fertilization efforts are going as planned. It is becoming easier to collect and analyze pressure and flow data from an irrigation system. This allows a quick response, if needed, or the option to save the historical data for management consideration at a later time.

Irrigation scheduling technology

Decisions on when to begin irrigating, how frequent and long to irrigate, and when to stop irrigating an orchard is often based on experience. However, there is growing interest in information and technology that enables a manager to adjust to site specific weather, soil, and crop conditions (Figure 6). The technology varies considerably ranging from manually operated, partially automated, or fully automated. The delivery of information can range from infrequent snapshots in time to hourly or more frequent delivery so that trends in crop water balances, soil moisture, or tree water status can be observed, evaluated, and used to guide the next irrigation scheduling decision.

Remote data and information acquisition

Remote implies "from afar" and not actually being there in person. Data acquisition is a process of collecting signals from various sensors that measure real-world physical conditions. "Telemetry" (Figure 7) is the means of gathering and transmitting the data to a collection point. After the signals are received they are then converted to useful numerical values that can be analyzed on a computer and interpreted to answer questions and guide management decisions.

Being able to collect quantitative data and information and respond based upon it while reducing labor and management time spurs interest in irrigation technology. It represents opportunity and hope as we strive to irrigate orchards as efficiently and productively as possible.

Find your place on the technology continuum

Irrigation technology is best viewed as a "continuum" … something that changes constantly but gradually without clear dividing points. It will continue to have a level of uncertainty and choosing to pursue technology is not always necessary, rather it is contingent on need.

When considering irrigation technology, it's probably best to step back and try to view the irrigation system in its entirety. By doing this, it will provide an opportunity to appreciate the improvements that have already been made and identify those parts of the system that are in greatest need of attention in the future. This should help ensure investments are focused on improvements with less risk and the largest opportunity for return.

Once some needs have been identified and prioritized, it may make sense to try the technology on a partial scale or even manually to establish proof of concept, robustness, and effectiveness on the way towards automation and broader adoption.

Figure 6. Irrigation scheduling technology. ET station (top left), plant water status sensor (top right), and soil moisture sensor (bottom).

Figure 7. Parts of a telemetry system. Cell tower and gateway next to pump controls (top left), gateway connection to internet (bottom left), orchard cell tower connected to sensors in the field (top right); and node connection to field sensors (bottom right).

PRUNE (DRIED PLUM): CONVENTIONAL FUNGICIDE EFFICACY

Fungicide	Resistance risk (FRAC#)[1]	Brown rot		Russet scab	Rust
		Blossom	Fruit[2]		
Bumper/Tilt[2]	high (3)	++++	++++	----	+++
Elite/Tebucon/Teb/Toledo[2,7]	high (3)	++++	++++	----	+++
Fervent	Medium (3/7)	++++	++++	----	+++
Fontelis	high (3)	++++	+++	----	+++
Indar[2]	high (3)	++++	++++	----	+++
Inspire Super	high (3/9)	++++	++++	----	+++
Luna Experience	medium (3/7)[4]	++++	++++	ND	++++
Luna Sensation[2]	medium (7/11)[4]	++++	++++	ND	++++
Merivon	medium (7/11)[4]	++++	++++	ND	ND
Pristine[2]	medium (7/11)[4]	++++	++++	ND	ND
Quash [2]	high (3)	++++	++++	----	+++
Quadris Top[2]	medium (3/11)[4]	++++	++++	ND	++++
Quilt Xcel/Avaris 2XS [2]	medium (3/11)[4]	++++	++++	ND	++++
Rovral[5] + oil	low (2)	++++	NR	----	NR
Scala[6]	high (9)[3,4]	++++	+++[6]	----	ND
Topsin-M/T-Methyl/Incognito/Cercobin+ oil[2,4]	high (1)[4]	++++	++++	----	----
Vangard[6]	high (9)[3,4]	++++	+++[6]	----	ND
Elevate[2,7]	high (17)[4]	+++	+++	ND	----
Rhyme/Topguard**	high (3)	+++	+++	----	+++
Rovral[5]/Iprodione /Nevado	low (2)	+++	NR	----	NR
Topsin-M/T-Methyl/Incognito [2,3]	high (1)[4]	+++	+/-	----	----
Abound	high (11)[4]	++	+	----	+++
Bravo/Chlorothalonil/Echo/Equus[8,9,10]	low (M5)	++	++	++	----[9]
Captan[7,8,10]	low (M4)	++	++	+++	----
Gem[7]	high (11)[4]	++	+	----	+++
Oso	high (19)	++	++	----	ND
Rally[2]	high (3)	++	++	----	----
Sulfur[10]	low (M2)	+/-	+/-	----	++

Rating: ++++= excellent and consistent, +++= good and reliable, ++= moderate and variable, += limited and erratic, +/- = often ineffective, ---- = ineffective, ? = insufficient data or unknown, NR=not registered after bloom, and ND=no data

*** Registration pending in California.**

[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.

[2] Fruit brown rot treatments for fungicides in FRAC Groups 1,2, 3, 17, 7/11 are improved with the addition of 1-2% light summer oil. The oil is "light" summer oil (1-2% vol/vol). If applied in summer, fruit will lose their waxy bloom and look red. They will dry to normal color. Use of a sticker such as NuFilm-P (8 to 16 fl oz/A) and high gallonage (120-150 gal/A) applications will provide effective control and fruit will retain their waxy bloom.

[3] Strains of *Monilinia fructicola* and *M. laxa* resistant to Topsin-M and T-Methyl have been reported in some California prune orchards. No more than two applications of Topsin-M or T-Methyl should be made each year. 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 prune with overuse of fungicides with similar chemistry. Subpopulations of both *Monilinia* spp. have been shown to be resistant to AP (FRAC 9) fungicides on prune in CA.

[4] 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.
[5] Blossom blight only; not registered for use after petal fall.
[6] High summer temperatures and relative humidity reduce efficacy.
[7] Registered for use on fresh prunes only.
[8] Do not use in combination with or shortly before or after oil treatment.
[9] Do not use after jacket (shuck) split.
[10] Do not use sulfur, captan, or chlorothalonil in combination with or shortly before or after oil treatment.

PRUNE (DRIED PLUM): ORGANIC FUNGICIDE EFFICACY

Fungicide	Resistance risk (FRAC#)[1]	Brown rot		Russet scab	Rust
		Blossom	Fruit[2]		
Dart	low	+++	++	----	+
EcoSwing	low	+++	++	----	+
Problad[1]	low	+++	----	----	----
Oso[1]	low	++	++	----	ND
Double Nickel 55[2], Serenade ASO/Opti, Serifel, Taegro, etc.	low	++	----	----	+
Aviv[3]	low	++	----	----	+
Sulfur[4]	low (M2)	+/-	+/-	----	++

Rating: ++++= excellent and consistent, +++= good and reliable, ++= moderate and variable, += limited and erratic, +/- = often ineffective, ---- = ineffective, ? = insufficient data or unknown, NR=not registered after bloom, and ND=no data

[1] Pending registration in CA.
[2] Strains of *Bacillus amyloliquefaciens*.
[3] Strains of *Bacillus subtilis.*
[4] Do not use sulfur, captan, or chlorothalonil in combination with or shortly before or after oil treatment.

PRUNE (DRIED PLUM): TREATMENT TIMING

Note: Timings listed are effective but not all may be required for disease control. Timings used will depend upon orchard history of disease, length of bloom, and weather conditions each year.

Disease	Green bud	White bud	Full bloom	May	June	July
Brown rot[1]	+++	+++	+++	----	+	++
Russet scab[2]	----	----	+++	----	----	----
Rust[3]	----	----	----	+	++	+++

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

[1] Flowers are susceptible beginning with the emergence of the sepals (green bud) until the petals fall but are most susceptible when open.
[2] A physiological disorder; no pathogens involved.
[3] More severe when late spring rains occur.