Topics in Subtropics Newsletter

University of California Cooperative Extension

Fresno, Kern, Madera, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara,Tulare,&Ventura Counties

News from the Subtropical Tree Crop Farm Advisors in California

Volume 25, Summer 2024

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Cherimoya Growers Handbook Available On-Line

Ben Faber

Judge Robert B. Ord of Santa Barbara in 1871 planted the first avocado tree in California which he had obtained as a small seedling from Mexico. He established a collection of other exotic fruit trees in the downtown area. At the same time, Mr. Albert Packard had 18 cherimoya trees growing on his property at 510 West Canon Perdido Street in Santa Barbara in 1870-71. While Judge Ord pursued gardening and horticulture somewhat as a hobby, it was Mr. Packard who maintained a vineyard and a small silkworm farm in addition to practicing law as the city attorney.

In the years following, other cherimoya trees were planted in the Santa Barbara area as direct imports from Mexico or as offspring seedlings from the Ord or Packard trees. Joseph Sexton, who settled in the Goleta area near Santa Barbara in 1867, became a recognized gardening expert and horticulturist. He eventually introduced and established many subtropical fruit species, including the Santa Barbara soft shelled walnut. In 1890 his collection was reported to have many fruiting specimens of avocado and cherimoya. However, none of the original trees planted by Packard, Ord, or Sexton have survived the subdivisions and other developments in this area.

The California cherimoya industry grew from these humble beginnings to comprise about 800 acres in the state and the formation of the California Cherimoya Association (CCA). Back in the early 1990s, the CCA decided to put together all their knowledge about the fruit and plant - from history to pollination and costs of production in the Cherimoya Growers Handbook. There are numerous authors who contributed. It took several years to bring the handbook all together, finalizing in 1995. It was only available to members of the Association, but now it's available on-line.

If you make citation to this work, please recognize the CCA for all the effort that went into it, as well as the individual authors. This is the definitive work on California cherimoyas.

https://ceventura.ucanr.edu/Com_Ag/Subtropical/Minor_Subtropicals/Cherimoya_Manual_/

Book 1: CCA Cherimoya Growers Handbook - Digital Version (PDF)

Optimizing avocado irrigation management practices using soil moisture sensing

Ali Montazar, UCCE Irrigation and Water Management Advisor in San Diego, Riverside, and Imperial Counties

Ben Faber, UCCE Subtropical Crops Advisor in UCCE Ventura and Santa Barbara Counties

Introduction. Irrigation scheduling is one of the most critical management decisions that affects avocado tree growth, fruit yields and profitability. It is an effective tool to enhance water use efficiency and productivity which not only may result in water and cost savings but also may assist in sustainable future expansion of the avocado industry. Importantly, avocados are very sensitive to overwatering and underwatering and long-term tree health is affected by proper irrigation management. Avocados for the most part are grown in coastal California where weather patterns are erratic, and a fixed irrigation schedule can easily lead to improper irrigation management.

Understanding the effects of irrigation events on soil water content provides critical insight for farmers about the present growing environment, the frequency and duration of irrigation events needed, and to maintain adequate soil moisture for avocado trees. There are instances where irrigation events occur too often and for far longer periods than required to reach field capacity (the amount of soil water content held in the soil after excess water has drained away following an irrigation event) in avocado orchards. There are also instances where irrigation events occur improperly, and more frequent irrigations or greater amount of water in some events could improve soil water conditions for healthy tree growth. Soil moisture sensors are proven and useful irrigation tools that can provide answers to the following critical questions:

- What is the water status of the soil early in the irrigation season?
- When is the right time for the first and subsequent irrigation events?
- Is the soil profile full after each irrigation event?
- What is the length of irrigation time?
- Should the irrigation practice be changed?

Soil moisture sensors appear to be the most adopted irrigation scheduling tool in California avocados. Nearly 46% of growers who responded to our recent avocado irrigation management survey reported using soil moisture sensors as the key decision-making irrigation tool (Fig. 1). It needs to be noted that avocado growers will also use plant observation and calendars in combination with other irrigation tools including soil moisture, CIMIS (California Irrigation Management Information System; https://cimis.water.ca.gov/), and the avocado irrigation scheduling calculator (http://avocadosource.com/tools/irrigationcalculator.asp).

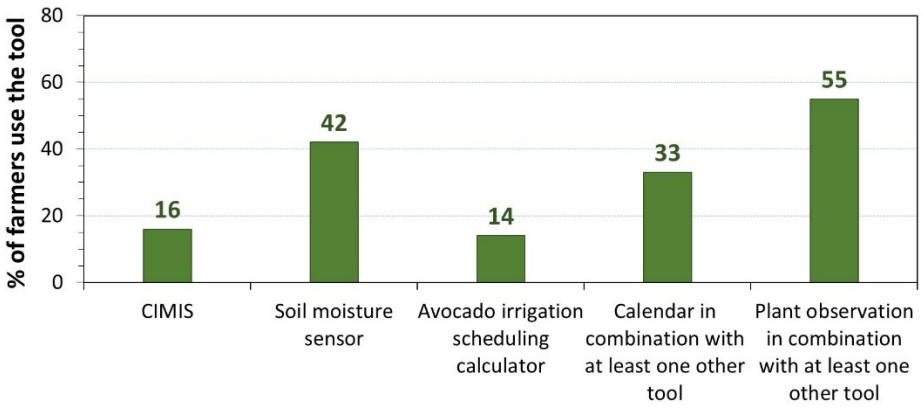


Fig. 1. The percentage of farmers who use different irrigation scheduling tools in their avocado orchards. Results are obtained from our recent avocado irrigation management survey completed by 62 CA avocado farmers.

Soil moisture sensor selection. An extensive range of soil moisture sensors/probes have already been commercialized and are available to use in avocado orchards. They determine the real-time soil water potential (tension) or volumetric water content and are dominated by a small number of technologies including granular matrix or gypsum block sensors, tensiometers, time domain reflectometry (TDR) sensors, and Frequency Domain Reflectometry (FDR) or capacitance sensors (Table 1 and Fig. 2). Some commonly used soil moisture sensors can be combined with various telemetry devices to access the data through cloud-based data storage applications. Data is automatically uploaded by radio or cell phone communications to cloud-based computer servers and is accessible through apps on smartphones and tablets. These communication advancements greatly improve the convenience of accessing data and can be configured to provide timely alerts when trees require irrigation.

The results of our avocado irrigation management survey demonstrated that avocado farmers dominantly adopted tensiometer and watermark soil moisture sensors, however, some other sensors such as AquaSpy, Sentek, CropX, Hortau, Meter, and GroundWorx are also used in avocados (Fig. 3). Different types of soil moisture sensors have different accuracies, depending on the sensing technology used and the property of the soil. For instance, the readings of electromagnetic sensors tend to have larger errors in soil with higher clay content. The salinity of soil and/or irrigation water is another factor that can increase sensor error.

Table 1. A summary of commercialized soil moisture sensors.

Technology	Measurement (key parameters)	Manufacture
Granular matrix	Soil water potential	Metergroup, Irrometer
Tensiometer	Soil water potential	Hortau, Irrometer, Metergroup
TDR	Volumetric moisture content (and soil temperature and salinity)	Acclima, Campbell Scientific, Metergroup, Environmental Sensors, Spectrum Technologies
FDR or Capacitance	Volumetric moisture content (and soil temperature and salinity)	AquaCheck, AquaSpy, Metergroup, Sentek Technologies, Spectrum Technologies, CropX

Fig. 2. A demonstration of commercialized soil moisture sensors.

Fig. 3. Various soil moisture sensors used in California avocado orchards (Acclima, Watermark, and tensiometer soil moisture sensors and telemetry devices (a & b), CropX soil moisture probe (c), and Metergroup Teros 54 soil moisture probe (d)).

While considering the sensors that might work best for your own orchard depending on soil properties and cost (a wide range of less than $100 to more than $300 per sensor plus datalogger/telemetry components and yearly data subscription costs), it is also critical to learn where and how to install and maintain the sensors, and how to interpret and use the data of soil moisture sensors for irrigation management. Most soil moisture sensors have sufficient accuracy, and if properly installed in the right place, they may provide high quality useful data to answer the critical questions mentioned before.

Location of soil moisture sensors. The proper location of the soil moisture instrument within the active root zone is quite important. Given the high spatial variability of soils in avocado orchards on hillsides and seasonal changes in root distribution and frequency, both within the orchard and around the trees, the accuracy and representativeness of soil water measurements can be strongly affected.

In selecting the best location for placing a soil moisture instrument, one must consider at least two factors: first, the representativeness of its placement within the orchard, and second, the location around the avocado tree itself. Within the avocado orchard, the ideal situation for instruments is in a homogeneous area that is representative of the orchard as a whole, considering both trees and soil (use soil sampling and/or soil survey tools such as http://websoilsurvey.sc.egov.usda.gov to map you soils on the orchard). Having one soil moisture probe per irrigation block could be very beneficial for the effective monitoring of the entire avocado orchard. In addition, around the selected trees, the sensor should be placed at a soil depth and distance from the tree trunk where the highest concentration of root activity is located. The direction, as in the-row or between-the-rows, should also be considered, particularly as it relates to the irrigation method being used. Drip irrigation tends to concentrate roots within as many soil wet bulbsas there are emitters, and micro-sprinklers (usually one per avocado tree) concentrate roots in a larger wet bulb, often located between the trees and within the row. The soil moisture sensor should be set up somewhere between the tree and micro-sprinkler, not very close to the tree nor very close to micro-sprinkler.

Soil moisture data triggers irrigation events. The major pitfall of the soil-based irrigation norms using soil moisture probes is that irrigation scheduling is carried out according to the properties of the soil, while the water status of the plant is not taken into consideration. An assumption is made that the plant would not stress if soil water content at the effective root zone is kept within the recommended ranges of soil water content, usually field capacity and 50% depletion of easily available water. If the sensor is not in the right place or the avocado root system is not healthy, the measured soil moisture will not truly assess the tree moisture status.

Avocado growers who schedule irrigation based on soil water balance could use a depth of up to 24 in. (called irrigation depth and is recommended to monitor water drained below effective crop root zone of avocado trees), where more than 70 % of roots are found. Data from the sensor installed at 8 - 12 in. depths could be considered as good indication for irrigation management. For instance, those who read the in-field soil water potential from tensiometer and/or watermark sensors may trigger irrigation when soil water potential reaches between − 20 (20 if it is called soil water tension) and − 40 cb at the shallow depth. In order to provide adequate water, irrigation is normally started when the soil dries to -25 cb for sandy soils, or to 40 cb for clay soils. Greater tension thresholds can be allowed in late fall through winter when temperature is low, and the water and heat stress are not likely potential issues. This provides optimal water availability that does not restrict plant growth. The amount of available water remaining in the soil profile at this given time determines the need for irrigation.

An interpretation of soil moisture data from avocado orchard case studies.
Half-hourly soil water tension (potential) at 12 in. depth was measured using watermark sensors in two avocado sites, site A with a sandy loam soil texture and site B with a silty loam soil texture (Fig. 4). The data demonstrates that the soil water was maintained within the optimal range in both sites A and B due to the frequent irrigation events, while there was room to optimize irrigation management practices in these avocado sites. For instance, a moderate water

stress could have occurred in mid-June 2022 at site A, when the soil water tension exceeded 70 cb, due to a late irrigation event. Also, scheduling a light irrigation event in mid-February 2023 at site A could benefit avocado trees. Even though considerable precipitation occurred in winter 2023, there was no rain event between late January through February 20, 2023, at this site, and consequently, the soil water tension exceeded 100 cb for a short period of time until new precipitation occurred in the late February.

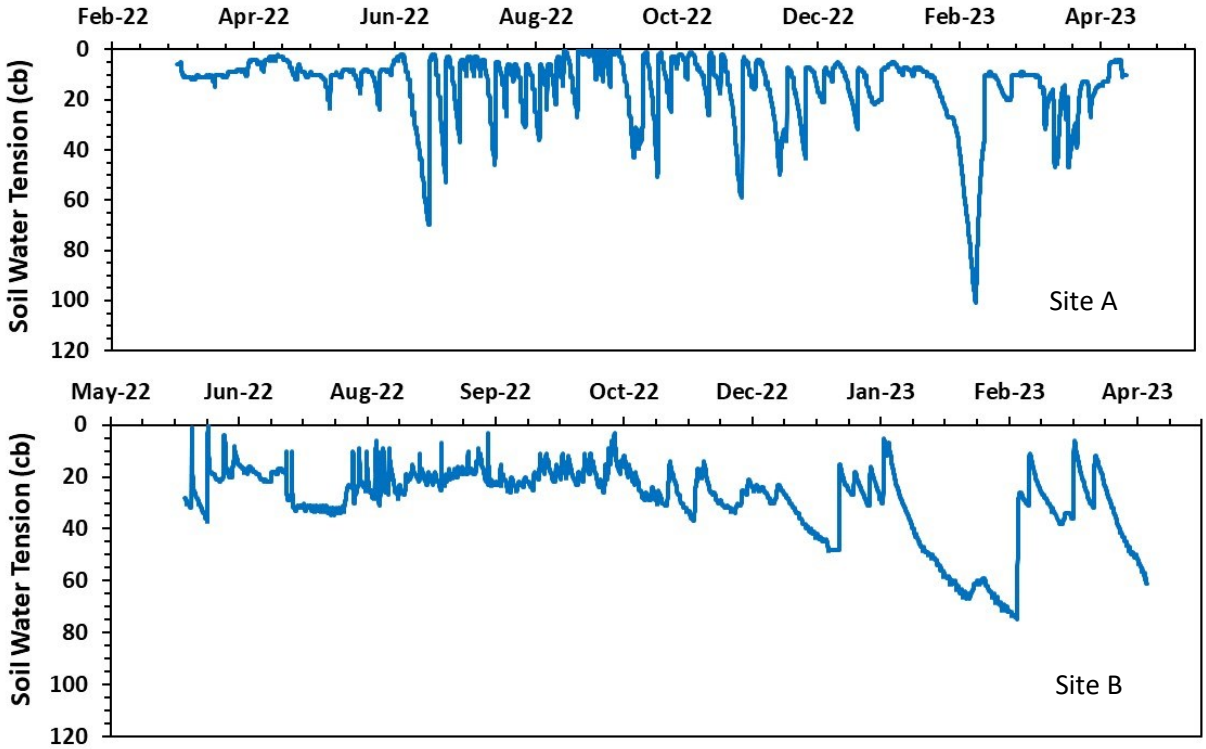


Fig. 4. Half-hourly soil water tension (centibar) measured using watermarks at 12 in. depth in two different avocado orchards over nearly a 12-month period. Sites A and B have sandy loam and silty loam soli textures, respectively. Soil water tension at field capacity (FC) at site A and B is approximately 12 and 20 cb, respectively. Both sites have micro-sprinkler irrigation systems with a flowrate of 9.5 and 7.4 gallons per hour (per tree).

Site B was occasionally overirrigated during the summer but again one irrigation event in mid-February 2023 could have been recommended for this avocado site as well, to maintain soil water status at a desired level in the late flower bud development growing phase. The soil moisture data indicates that less frequent irrigation events at site B and shorter irrigation runs at site A could be considered in the summer period to improve irrigation efficiency.

A good example of proper irrigation scheduling in avocado orchards is what happened in a 6-month period at site C (Fig. 5). The loamy soil of this site has high water holding capacity and the grower scheduled 10 irrigation events between mid-July and mid-December in the 2023 season. As a result of proper irrigation management at this site, the volumetric soil water content at the effective root zone was maintained at an average of 23.5% over the period. No considerable overirrigation or potential water stress was observed, as soil moisture was adequately maintained throughout the study period.

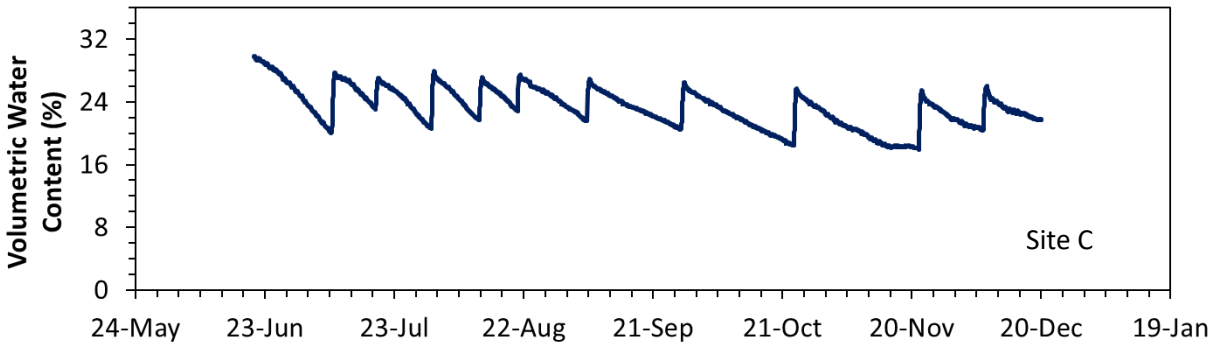


Fig. 5. Half-hourly soil volumetric water content (%) measured using CropX soil moisture sensor at 8 in. depth in an avocado orchard over a six-month period. The site has a loamy soil texture. Soil water content at field capacity (FC) at site C is approximately 28%. The site has a micro-sprinkler irrigation system with a flowrate of 7.9 gallons per hour (per tree).

A few last comments. We need to keep in mind that adopting soil moisture sensors and effectively using them to fully obtain the benefits and optimize irrigation scheduling in avocado groves could be time consuming. Making a habit of having them in avocado grove and looking at their data is likely the most critical step of the adoption process. One might be disappointed about the accuracy and the effectiveness of this tool in the beginning, or even find soil moisture data redundant. A learning curve and good approach to effectively adopt soil moisture sensing in avocados could be to: track the data for good quality over a period with several irrigations and/or rain events; accurately interpret the data for the period; implement changes needed in the irrigation practice accordingly and track the impact for a following short period. Ensure good quality data, learn to interpret the data, and take action/s for improving irrigation practices if needed!

Learning from the Rain

Ben Faber

Rain is wonderful stuff. If it comes and washes the accumulated salts of the last several years out of the root zones of citrus and avocado, that's a good thing. But what happens if there is a little too much rain? In the winter of 2005, Ventura got over 40” of rain, which is 100% more of what is normal. The last time big rains occurred prior to that was in the winter of 1997-98. That year the rains were evenly spaced on almost a weekly basis through the winter and into the late spring and over 50" fell. That year we had major problems with both citrus and avocados collapsing from asphyxiation. The same occurred in 2005, but not so pronounced.

Most rainfall years are not average, usually it is more or less than average. And sometimes the rains come, and flooding happens throughout California. The winter of 1861/62 saw such flooding that the harbor at Goleta was filled in.

In 2023, we had a lot more rain than we normally see and in Carpinteria it rained 4 inches in July!!!!!! And with the rain we saw mudslides and buried orchards, and with wet soil and winds we saw avocado trees being blown over.

And then came the winter of 2023/24, and there was more rain and more devastation (mudslides, buried orchards, etc.). But in general, trees look good. The consequences of low rainfall and the resulting greater application of salty irrigation water is leaf burn and often Botryosphaerias. After two wet rainy winters, we see much less of this kind of damage.

But there's been more subtle damage going on, especially avocados. It's been particularly hard on young trees with poorly developed root systems and orchards on flat ground. Asphyxiation has happened with the soils being too wet. Excluding air reduces root function, especially in the uptake of iron. It also allows ethylene to accumulate. Ethylene is a plant growth regulator that accelerates maturity. When roots sense ethylene, it causes leaf and fruit drop. The combined lack of oxygen and accumulation of ethylene leads to iron chlorosis and leaf drop. These are characteristic symptoms of asphyxiation and wet soils.

The way to avoid this problem is to plant on berms, but that is not an option with trees in the ground. The best thing to do is to pull back mulch to expose the soil so that soil moisture can evaporate faster. If there is extensive leaf drop, it might be necessary to whitewash the branches to prevent sunburn. Without leaves, there is no water movement through the tree and the sun can heat up the exposed branches causing irreparable damage. Without leaves to transpire, the irrigation regimen will need to be adjusted. With asphyxiation, think frost damage and treat the tree accordingly. It might even be prudent to treat trees for incipient root rot, since they are now vulnerable.

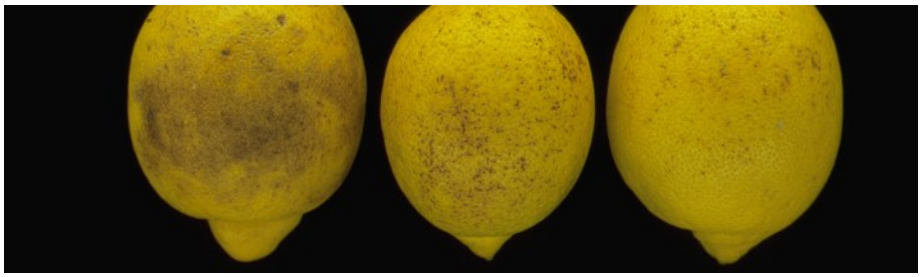
Mulched trees on flat ground are especially prone to asphyxiation.

In avocado, there has been more anthracnose (*Colletotrichum gloeosporioides)* in the canopies and presumably in the fruit. The fruit infection often doesn't show up until the consumer cuts into it and finds rot.

Anthracnose can occur on stems, leaves and fruit.

In citrus, if growers let their copper guard down, there have been problems with brown rot (Phytophthora Sophia.), Septoria, and Alternaria on fruit, and gummosis (Phytophthora sp.) on trunks. The "standard" practice in the past has been a whole or skirt canopy spray to control the disease. But somehow growers got out of the habit and when the rains came, these disease start popping up again. A mistaken management decision that many growers regret after all the rain.

Brown Rot



Septoria

Alternaria Rot

Gummosis

Also in citrus, especially noticeable in lemons along the coast has been “Cell burst” or mesophyll collapse. – Edema.

Edema spotting on leaves and fruit

This physiological condition can be brought on by a lot of situations - wind-blown sand wounds, high light intensity, chemical damage, but the most common is the presence of abundant, warm soil water and a cool, moist atmosphere. Under these conditions the roots absorb water at a rate faster than is lost through transpiration. Excess water accumulates in the leaf and fruit. If this condition persists, cells enlarge and can rupture, leading to spotting on the leaves and fruit.

So what's a grower to do? Avoid irrigating to exacerbate the situation. And it seems reducing nitrogen fertilization can reduce the occurrence.

And when it rains, it snails. There has been a major period of snail activity and they have been throughout the canopies of both avocado and citrus, especially if no snail treatments have been applied.

Harvesting avocados and snails

Long range weather forecasts are not always accurate, but it's important to be ready for rain with copper on the citrus, snail bait in the orchard and a ready rake to pull mulch back if the rains are persistent.

Pest Alert: Fig Wax Scale

Bodil N. Cass – Department of Entomology, University of California, Riverside
Tyler Tkachuk – Department of Agriculture, Weights & Measures, County of San Diego

Fig wax scale, *Ceroplastes rusci* (Hemiptera:Coccidae), has recently been detected in the environment in the San Diego County. This insect is commonly intercepted at ports of entry, especially on shipments of palms, but has not previously established a reproductive population in California to our knowledge.

Fig wax scale is an A-rated, actionable invasive pest by CDFA[1], due to its high potential to damage fresh fruit production through lowering yield, increased production costs, disruption of export markets, and vectoring of plant viruses including *grapevine leaf-roll virus*[2]. It is a polyphagous phloem feeder and a potentially devastating pest of many high-value crops including almond, grape, citrus, pistachio, avocado, cotton, fig, palms, pear, and ornamentals. In the USA it is currently only found in Florida, although it is distributed throughout much of the

[1] Leathers, J (2016) *California Pest Rating for Ceroplastes rusci (L.): Fig wax scale.* Pest Rating Proposals and Findings, California Department of Food and Agriculture. https://blogs.cdfa.ca.gov/Section3162/?p=3010
[2] Ben-Dov, Y (1993) *A systematic catalogue of the soft scale insects of the world*. Flora and Fauna Handbook No. 9. Sandhill Crane Press: Gainesville, FL.

rest of the world and frequently affects citrus and fig production in Europe[3]. The environmental conditions throughout much of California are considered favorable for this scale to establish if it is not eradicated and prevented from re-entering.

Fig wax scale adult females are oval-shaped, approximately 4 - 5 mm (0.16 - 0.2 in.) in length. The winged males are small (~1mm; 0.1 in.) and hard to find. Adult females have a thick, waxy, pinkish-gray covering of plates, and nymphs have star-like waxy projections. Hundreds of eggs are laid underneath the female and are protected there until they hatch as crawlers. Scale insects disperse locally in this first instar nymphal stage by wind or walking. Over longer distances they are moved primarily as accidental passengers on shipments of plant material. The adults are sessile, remaining with their long, straw-like mouthparts inserted in the plant leaves, branches, trunk or fruit to feed and reproduce. Scales excrete honeydew, which is often tended by ants, and serves as a substrate for sooty mold growth (Fig. 1-6).

There are other wax scales in the environment in California and they are not easily distinguished from fig wax scale[4]. These include irregular wax scale (*C. irregularis*), tortoise wax scale (*C. cistudiformis*), barnacle scale (*C. cirripediformis*) and Chinese wax scale (*C. sinensis*). These are occasionally found on fruit trees including citrus, but only reach pest status on ornamentals such as gardenia, Australian willow, mayten, California bay, coyote brush, holly, and pepper tree. Accurate identification of *Ceroplastes* spp. requires slide mounting of adult females to identify key characters under a microscope. Therefore, the best way to determine if you have found a suspect sample of fig wax scale in the field is by host plant and severity of the infestation. If you find wax scale insects on fruit trees or palms, or a heavy infestation on any plants, it should be considered a suspect invasive species.

The find site in San Diego is being treated and will be monitored to ensure eradication of this population. The scale was found infesting multiple fig trees throughout a small orchard. Despite the polyphagous nature of fig wax scale, it has only been detected on fig trees thus far. Multiple nearby sites in the area have been surveyed as well as other fig-growing sites throughout San Diego County and it has not yet been found elsewhere. The Department of Agriculture, Weights and Measures continues to monitor for this pest to determine if it is established elsewhere in San Diego County. Early detection is critical for preventing the establishment of invasive pests. Please report potential sightings to the CDFA Pest Hotline (1-800-491-1899) or your local County office.

Please report potential sightings to the
CDFA Pest Hotline
1-800-491-1899
https://www.cdfa.ca.gov/plant/reportapest/

[3] CABI PlantwisePlus Knowledge Bank (2023) *Ceroplastes rusci* (fig wax scale) Technical Factsheet https://doi.org/10.1079/pwkb.species.12352
[4]UC IPM (2017) *Wax scales—Ceroplastes spp.* How to Manage Pests - Pests in Gardens and Landscapes. https://ipm.ucanr.edu/PMG/GARDEN/PLANTS/INVERT/waxsc.html

1. Fig wax scale adult females and crawlers. *Image: Tyler Tkachuk.*

2. Fig wax scale adult females and crawlers. *Image: Tyler Tkachuk.*

3. Ants feeding on honeydew produced by the scale insects. Ants protect scales from natural enemies. *Image: Tyler Tkachuk.*

4. Fig wax scales reproduce rapidly and can heavily infest a susceptible tree. *Image: Tyler Tkachuk.*

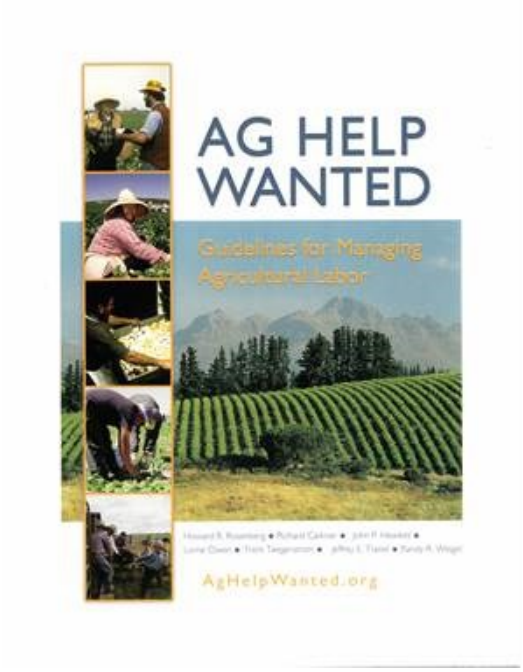
5. Fig wax scale adult females. *Image: Jeffrey W. Lotz, Florida Department of Agriculture and Consumer Services, Bugwood.org*

6. *Fig wax scale nymphs.* *Image: Florida Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Bugwood.org*

Ag Labor Management Resources

Eta Takele

Adopted from e-mail of John P. Hewlett
Farm/Ranch Management Specialist, University of Wyoming



Ag Help Wanted is an educational guidebook designed to assist every person who currently manages or expects to manage human resources on farms, ranches, nurseries, dairies, and other agricultural operations.

The book can be used as a source of ideas for improving management policies or practices, an occasional reference in coping with problems that arise, or a base for systematic study of human resource management in agriculture.

It presents principles, practical examples, regulatory considerations, and leads to more references that all help equip managers to make choices that are reasonable, legal, and ultimately effective for both their businesses and the people they employ.

Click here to access *Ag Help Wanted Highlights* covering the book content in *English* and *Spanish*.

Click here to access *Ag Help Wanted Updates* with recent material updating chapter content in both *English* and *Spanish* versions.

Ag Help Wanted is published by the Western Farm Management Extension Committee. Land-grant university educators from seven states and one Canadian province contributed to its development.

For more information or to access many of these materials online see: https://aghelpwanted.org/.

Upcoming Meetings

Avocado Irrigation Workshops
University of California Cooperative Extension (UCCE)

September 3 (Tuesday), 2024
1:00 – 4:00 P.M
San Diego Farm Bureau 420 S Broadway, Escondido, CA 92025
Registration link: https://surveys.ucanr.edu/survey.cfm?surveynumber=43213

October 16 (Wednesday), 2024
2:00 – 5:00 P.M.
UC Cooperative Extension Ventura County (California Room)
669 County Square Dr, Ventura, CA 93003
Registration link: Registration

For more information about the workshop, please contact
Ali Montazar, amontazar@ucanr.edu, or Ben Faber, bafaber@ucanr.edu.

Pending CEU CREDITS: CCA (2.5 hrs.); VCAILG (2.0 hrs.)

Avocado Sunblotch Viroid (ASBVd) Workshops
Unlock the Secrets to Healthy Avocados: Learn about Avocado Sunblotch Viroid
California Avocado Commission CAC) and University of California Riverside (UCR)

September 20, 2024
9 am-12:30 pm
United Water, Oxnard
Registration link: https://forms.gle/12LxUUdkPb8DmNdm8
Fatemeh Khodadadi
fatemehk@ucr.edu
(845) 901-3046
Ben Faber bafaber@ucanr.ed

September 13, 2024
9am - 12:30pm
The Farm Bureau, Escondido
420 S Broadway, Escondido, CA 92025
Registration link: https://forms.gle/12LxUUdkPb8DmNdm8

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Topics in Subtropics

Newsletter by Tree Crops Farm Advisors

UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

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