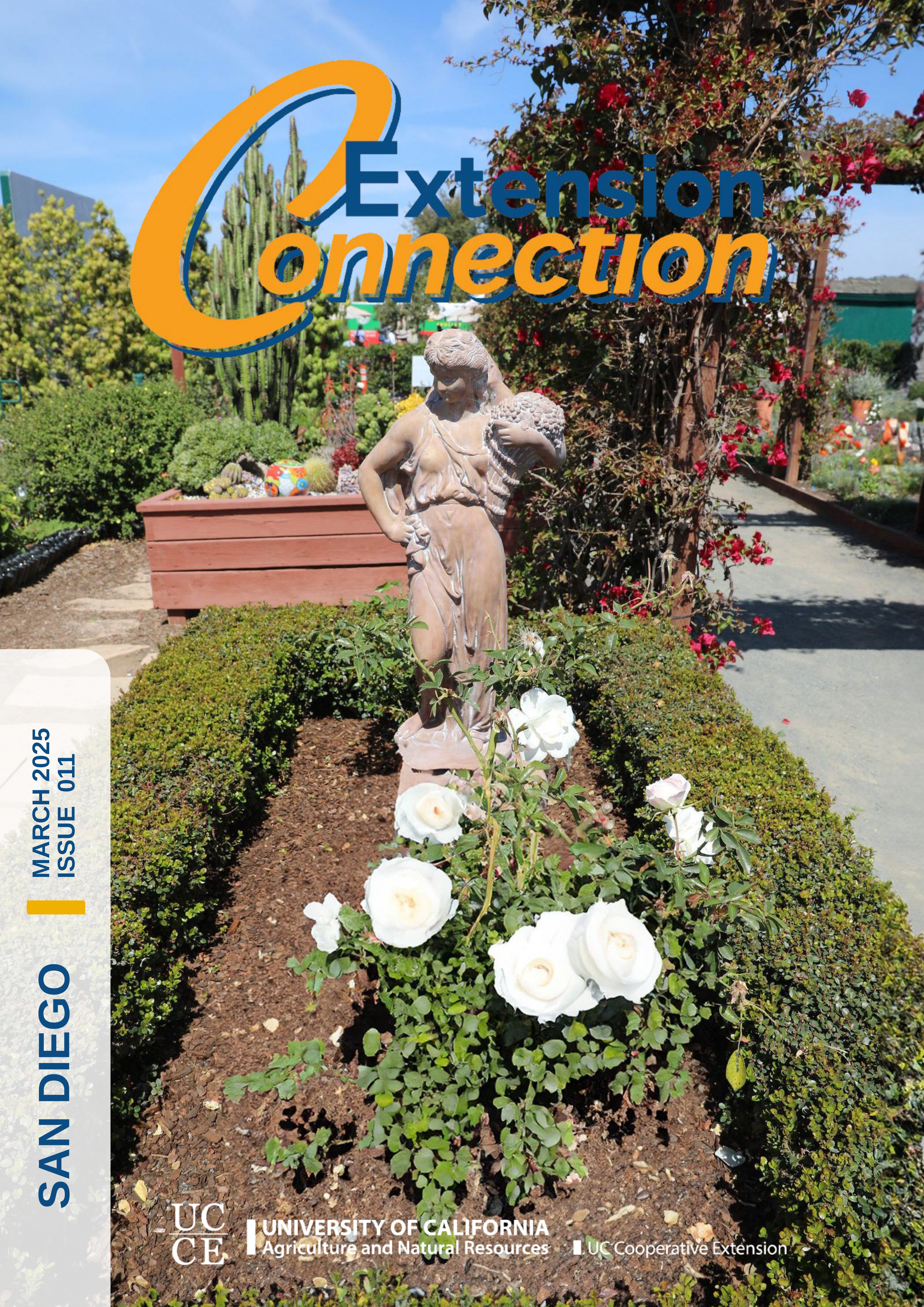


Extension Connection

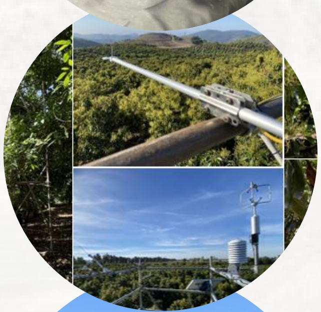
MARCH 2025
ISSUE 011

SAN DIEGO

UC CE
UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources
UC Cooperative Extension

Contents

MARCH 2025



ARTICLES

ARTICLES

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Introduction from our
County Directors

Dear Readers:

Spring is here again, and we are making plans for programs and activities to meet the needs of our community in San Diego County. Along with the Master Gardeners and Master Food Preservers, our advisors and staff members will be participating in the San Diego County Fair. We will be located in the O'Brien Hall From June 11th through July 6th. Please come by and say hello, ask questions, and listen to presentations from advisors and staff. In addition, we will be participating at the "Graze" event, hosted by the San Diego County Farm Bureau on April 24th as the Carlsbad Flower Fields. Feel free to come by and pick up materials, chat with advisors and enjoy the evening.

We are excited to announce the organization will be welcoming two new Advisors to our ranks. This summer, Maricela Chaves and Matt Fatino will join our staff. Maricela is coming from Minnesota, via the University of Montana where she completed her Ph.D. and will be the Indigenous Food Systems Advisor. She brings years of experience working in this discipline. Matt Fatino, originally from San Diego, has completed his undergrad work at Cal Poly San Luis Obispo, and his Ph.D. at UC Davis. He will be the Subtropical Horticulture Advisor and will focus on Avocado and Citrus production in San Diego and Riverside Counties. We are happy to have these positions filled in our area and look forward to working with these new Advisors.

Thank you for you continued support and we look forward to connecting with you this spring and summer!

Val and Ramiro
UC Cooperative Extension
San Diego County

Watch out for Thrips parvispinus in San Diego County

Written By: Eric Middleton, PhD, IPM Advisor, University of California Statewide IPM Program and Cooperative Extension, San Diego, Orange, and Los Angeles Counties

Figure 1. a) Adult female Thrips parvispinus on a Dipladenia flower. b) Size comparison between T. parvispinus (left) and Western flower thrips (right).

San Diego is a hub for nursery and floriculture production in the United States, with a mild climate that allows many kinds of plants and flowers to grow. Unfortunately, this also makes the area vulnerable to a wide range of invasive pest species, including Thrips parvispinus (Figure 1).

Thrips parvispinus is a small thrips species that feeds on numerous ornamentals and even food crops. Their main hosts include Dipladenias, Mandevillas, Gardenias, Anthuriums, and peppers of all kinds. Adults and larvae feed on flowers and young leaves causing distortions, scarring, and sometimes even killing the plant. This damage, combined with a high reproductive rate, makes T. parvipinus a serious pest of ornamentals and peppers.

While T. parvispinus was not known to be present in California, it can arrive undetected and become established before growers are aware of the threat. With this in mind, I hired two students to help me visit commercial garden centers around San Diego County and check known host plants to see if T. parvispinus had entered California undetected.

Unfortunately, at the very first garden center we visited, we found T. parvispinus present on multiple host plants. We continued our survey through December 2024 and ended up finding T. parvispinus at almost every store we visited throughout San Diego County, and even up into Orange County (Figure 2). They were found feeding on Dipladenias, Mandevillas, Gardenias, and pepper plants.

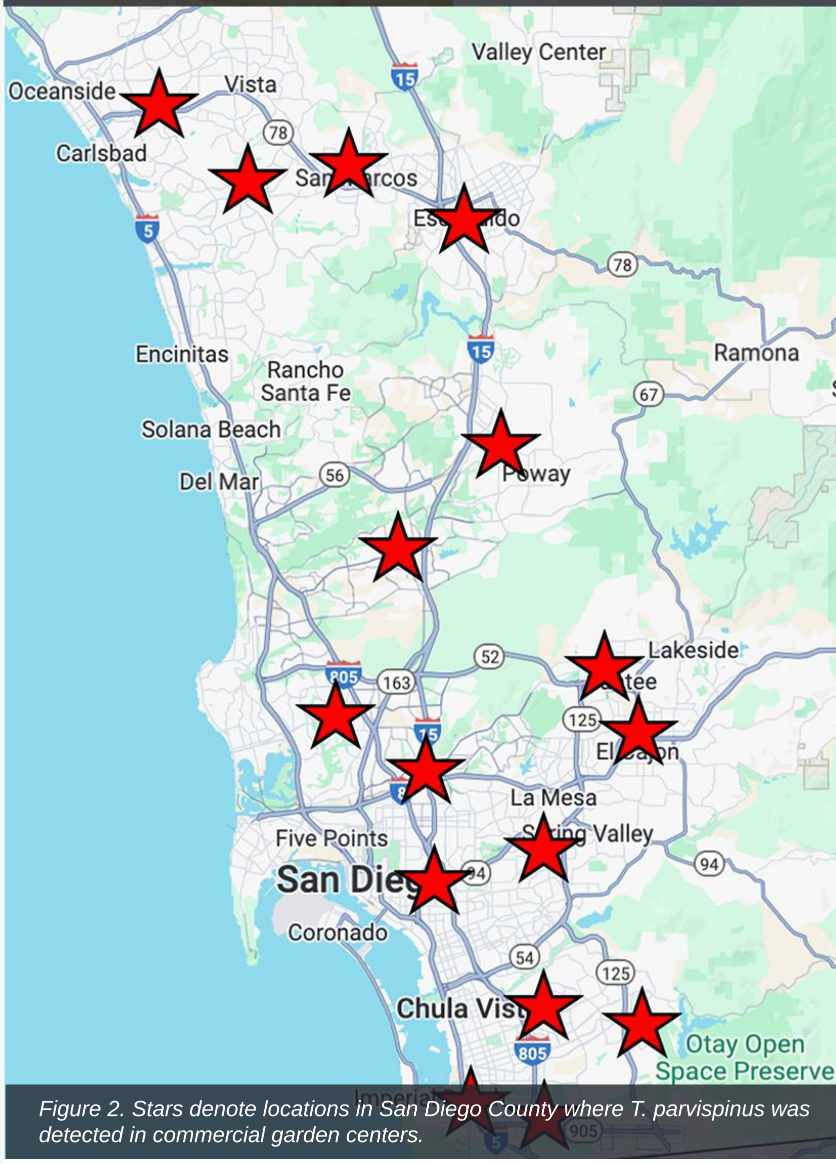

Figure 2. Stars denote locations in San Diego County where T. parvispinus was detected in commercial garden centers.

In collaboration with the Pest Exclusion team at San Diego County Ag Weights and Measures, we identified a single grower from whom almost all the plants were coming. As a result, the plants were placed on hold, several thousand were destroyed both at the growers' operation and at garden centers, and the sale of host plants from the grower was temporarily blocked.

Continued Pg. 4

T. parvispinus damage on Dipladenia and Mandevilla shoots.

Following these actions, we surveyed the garden centers again, and while we did see plants that showed signs of T. parvispinus feeding, we have not yet found any new T. parvispinus during our second round of surveys. Additionally, working with the UC Master Gardeners from San Diego to Santa Barbara, we checked host plants out in the landscape and so far, have found no T. parvispinus outside of commercial garden centers.

However, there is still a good chance T. parvispinus has already become established in Southern California judging by the scale and spread of infested plants in garden centers. While we continue to look for it, growers, landscape managers, and residents should also keep an eye out for T. parvispinus and recognize the damage it causes to common hosts.

After T. parvispinus feeding, Dipladenias and Mandevillas will develop notched leaves, have stunted growing terminals, and show signs of scarring on leaves and flowers (Figure 3). Gardenias will have scarred and stunted new leaves with some distortions. Pepper leaves will become distorted and take on a crinkled appearance with some visible scarring.

Figure 3. Thrips parvispinus damage on Dipladenia/Mandevilla shoots.

While it will be difficult to positively ID T. parvispinus on your own, watch for small, dark, and active thrips. Adult female T. parvispinus are smaller and darker than adult females of common species like Western Flower Thrips. If you see one under magnification, adult female T. parvispinus have a brownish head and thorax with a dark abdomen and wings that appear light close to the body and darker further out.

"Keep an eye out for this damaging invasive thrips species and reach out to me or another UC Cooperative Extension advisor if you have questions or think you have found it!"

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ACFA and 4-H: A Purr-fect Partnership for Animal Welfare

Written By: Rebeca Manzo, Community Education Specialist 2, San Diego 4-H Program and UC Cooperative Extension, San Diego County

Cat Fanciers' Association, Inc. (CFA) is a nonprofit corporation founded in the late 1940's by a group of people with a great love for cats. The organization is funded through corporate and individual donations; additional income is derived from education events produced by CFA. Administrative and operation costs are 100% covered by CFA so all contributions are used to benefit cats.

Every year this non-profit organization sponsors over 400 cats shows throughout the world to raise money that benefits our feline companions. The CFA Cat Show attracts around 12,000 visitors over the two days it's held in our area, San Diego County. The important work of this organization is responsible for providing shelter, food, animal welfare and breeding assistance, from rescue to adoption needs, and so much more.

Robin Philips works with the San Dieguito/Olivenhain 4-H club as a club leader, she recently shared this fantastic information and opportunity with our county and encouraged the involvement of other 4-H program clubs. The response of our 4-H clubs was overwhelming and so many were eager to volunteer at the CFA Cat Show at the Del Mar Fairgrounds this year. The 4-H program had an information booth set up at the fairgrounds meanwhile volunteer club members with their parents helped to hand out flyers, provided program and enrollment information. They were highly engaged while answering questions about the club locations and club activities. Additionally, youth were able to receive important lessons and skill building practice on the importance of animal sanitation safety as they helped to keep animal crates clean throughout the event.

Additionally, 4-H members and their parents assisted with tasks such as processing admissions, stamping hands at the entrance, cleaning out various areas where cat were held prior to and after demonstration times, and, of course, getting plenty of opportunities to interact with all sorts of fancy, exotic, adorable, furry and friendly cats.

One of the biggest takeaways from the day for our 4-H youth and families was the interaction with CFA members, community and various surrounding state visitors. They stopped by to greet our 4-H members, parents, volunteers and took the time to share how impactful 4-H had been for them when they were young. Consequently, this provided club members with a vital opportunity to practice community outreach skills. The group did a wonderful job to reintroduce the current 4-H curriculum, new and favorite activities, and discussed the hope of launching some new cat projects with the help of CFA. It was an exciting event for 4-H members, overall and we enjoyed the introduction to this non-profit corporation, affiliates, and the cat show culture.

Many expressed with enthusiasm the eagerness to continue our partnership with CFA for additional opportunities that will help benefit the cats during upcoming events.

A very special Thank You to Robin Philips for the invitation to 4-H clubs and for getting them involved in this important effort. Robin went the extra mile and offered to provide an exclusive 'Cat Show Training' to all 4-H youth members and clubs that were interested in continuing to further their education, skills-set and knowledge towards cat show presentations. Thank you to all the youth, parents and volunteers who came out to help our feline friends!

University *of* California
Agriculture and Natural Resources | 4-H Youth Development Program

"I believe change thrives with the right opportunities and environment. My goal is to create a safe space for learning, offer high quality programs, and encourage the growth of more clubs."

ABOUT THE AUTHOR

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Fig. 1. A demonstration of one flux tower monitoring station and some of the instrumentation set up.

Hass Avocado Crop Water Use: An analysis for California Production Systems

Written By: 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

In California, avocado is primarily grown in southern and central parts of the state along the coast where 88% (USDA-NASS, 2023) of the avocados are grown in the United States. These regions have semi-arid Mediterranean climates with winter-dominant rainfall, and currently face uncertain water supplies, mandatory reductions of water use, and rising cost of water. Consequently, efficient use of irrigation water is one of the highest conservation priorities. Moreover, due to increasing salinity in water sources and the fact that avocado trees are sensitive to salinity, effective irrigation is more critical to ensure optimal yield and high-quality avocado fruits. Many avocado growers have developed irrigation practices that enable good profitability, however, the continuing increase in water costs and water restrictions due to drought and climate change have placed pressure on the industry to further enhance water use efficiency.

Accurate information on crop water use along with irrigation best management practices are the immediate needs of the avocado industry under the current fluctuations in water availability, reliability, and quality to sustain the profitability and sustainability of production in California.

This article presents some results from our irrigation study, quantifying crop water consumption of California Hass avocados. More comprehensive data and information will be available in the near future.

Experimental sites and measurements

The data used in this analysis are from the research conducted at "Hass" avocado orchards in four avocado sites in southern California, here referred to site A (the San Pasqual Valley, Escondido), site B (the Via Vaquero, Temecula), site C (the Orchard Hills, Irvine), and site D (the West Saticoy, Ventura) (Table 1, pg. 7). The sites consisted of a wide range of climates, slopes and elevations, soil texture and conditions, tree spacings, and water sources; therefore they offer a good representation of the Hass avocado production systems in California.

A combination of surface renewal and eddy covariance equipment (flux tower, Fig. 1) was utilized to measure actual crop water consumption at each avocado site over a three-year period. Several other sensors and equipment were used to monitor soil and plant water status, soil salinity and chloride, and high-resolution images were captured by unmanned aerial systems to evaluate canopy features.

Experimental site	Age of trees (in 2024)	Tree spacings (ft × ft)	Elevation of the monitoring station (ft)	Row aspect & slope (%)	Dominant soil texture (0-2 ft)	Water source
Site A	13-year	19×19	758	South, 44%	Coarse sandy loam	District water
Site B	10-year	15×18	1490	Southeast, 20%	Rocky loam	District water
Site C	7-year	15×19	450	Southwest, 12%	Loam	Reclaimed water
Site D	7-year	12×14	164	Southwest, 3%	Loam	District water and groundwater

Elevation of the monitoring station is expressed as the distance above mean sea level. District water has surface water source.

Table 1. General information about experimental avocado sites.

Daily crop water use

While a similar crop water use pattern was found over the course of the measurement seasons in experimental sites, daily crop water consumption was generally greatest at site A. Variable daily crop water use was observed on each site over the season/s. For instance, it varied from 0.03 in d−1 to 0.18 in d−1 with an average of 0.11 in d−1 in the 2023 season at site A (Fig. 2). Considering the tree spacings at this site, the crop water use ranged between 6.7 and 40.5 gallons per tree with an average crop water needs of 24.6 gallons per tree in 2023. The values were, as expected from the weather data, lower in late fall and winter when conditions were cooler, and the days were shorter. Uniform daily crop water consumption over the summer months occurred more frequently than other months, specifically during the winter and part of the spring when the weather conditions were more unstable.

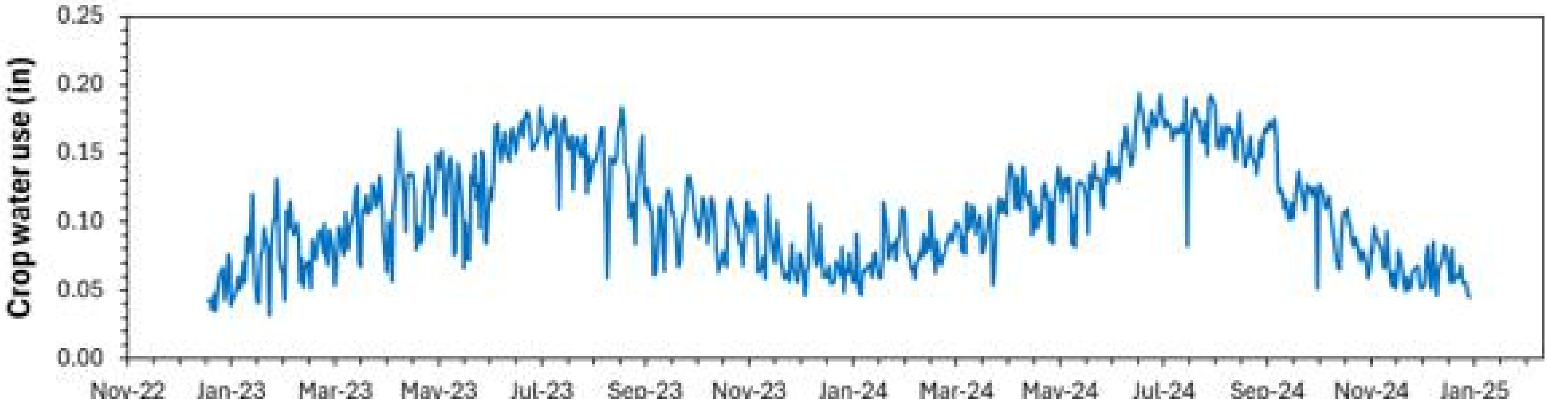

Fig. 2. Daily actual crop water uses at site A over the 2023 and 2024 seasons.

Seasonal crop water use

Our analysis demonstrates that all the regions associated with the avocado sites A through D had a dry 2022 winter, a wet 2023 winter, and a near normal 2024 winter (in comparison with the 10-year average data of 2015-2024). Considerable differences were found in the seasonal crop water use measured across experimental sites and seasons. The largest difference was 11.4 in. between site A and site D during 2024. However, the seasonal crop water use difference between avocado sites C and D was 2.1 and 2.4 in., in 2023 and 2024, respectively. Overall, greater crop water consumption was observed in each of the avocado sites in 2024.

Fig. 3., pg. 8, Seasonal crop water use measured at the avocado sites in 2023 and 2024. The comparison demonstrates that the seasonal consumptive water uses at avocado sites varied from 28.1 in. (affected by coastal climate) to 40.4 in. (an inland valley) over the two growing seasons of 2023 and 2024. Considering the tree spacings at the avocado sites, the seasonal crop water requirements may vary from about 3,000 gallons per tree (high density orchard affected by coastal climate) to about 9,000 gallons per tree (low density orchard under growing conditions of inland valley).

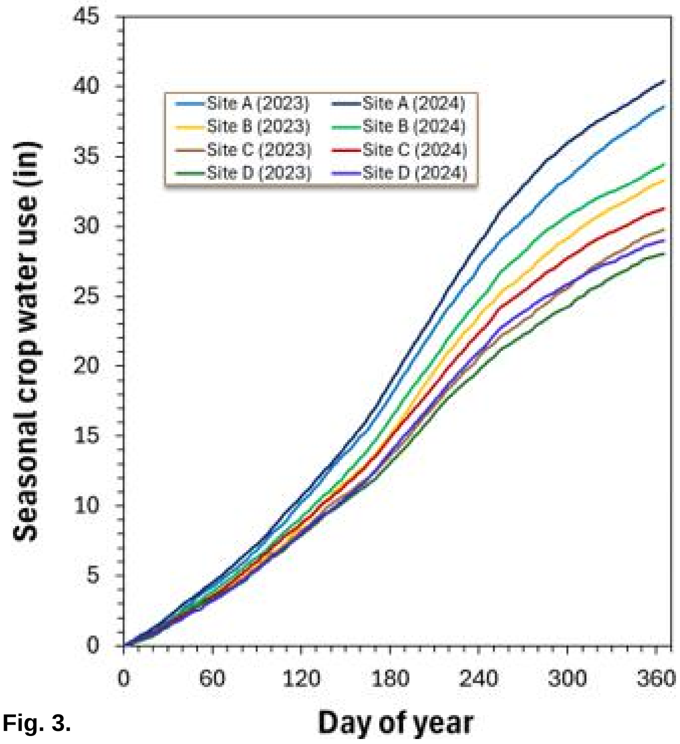

Fig. 3.

The results of this study clearly showed that avocado crop water use varies spatially and temporally (discussed also in Montazar and Faber, 2023). The greatest seasonal crop water consumption was determined at an avocado site (site A) with the features of coarse sandy loam soil texture, 44% south facing slope, average elevation of 758 ft. above mean sea level, plant density of 120 trees per acre, mean canopy coverage of 88.7% and tree height of 23.2 ft. In contrast, the least seasonal crop water use was observed at an avocado site (site D) affected by coastal climate with the features of loamy soil texture, 3% southwest facing slope, average elevation of 164 ft. above mean sea level, plant density of 254 trees per acre, mean canopy coverage of 75.9% and tree height of 12.5 ft.

Conclusions

A mean daily crop water use of 0.13 and 0.15 in d−1 was found forspring and summer (over the three study seasons), respectively, whilst the value for winter and fall was similar (0.08 in d−1) at avocado site A with maximum values. Considering the tree spacings at this avocado site, the average daily crop water requirements are estimated 29.2 and 33.7 gallons per tree in spring and summer, and 17.7 gallons per tree in fall and winter. In a winter with normal or wet rainfall conditions, precipitation most likely provides sufficient water to compensate for avocado tree water needs. Our data verifies this for 2023 and 2024 at all avocado sites.

Several factors impact the variability of crop water use in avocado orchards including irrigation management practices, salinity and/or soil differences, slope and row orientation, elevation, height of trees, and trees canopy coverage that provides a good indication of canopy size and the amount of light interception.

If avocado groves are located in similar climatic regions, it appears that slope and row orientation along with canopy coverage percentage are likely the most influential drivers on avocado crop water use. It needs to be noted that in the Northern Hemisphere, midday and daily total solar radiation is mostly greater on southern slopes than on northern slopes and the slope aspect influences incoming light intensity and as a result consumptive water use.

The seasonal crop water uses provided in this article are the seasonal water use measured for avocado orchards across avocado experimental sites. Excess irrigation can be considered beneficial water use for salinity and choloride management in avocado groves. The amount of additional irrigation water to effectively drain salt from the crop root zone depends on the soil conditions, effective rainfall, and quality of irrigation water. However, the total irrigation water that needs to be applied in an individual orchard over the season depends on seasonal crop water requirements, effective rainfall, water distribution uniformity, and salt leaching requirements. Heat waves are another driver that may impact the total applied water in avocado orchards.

NOTE. A journal article from the findings of this study is under review. This journal article may provide more comprehensive analysis and information on avocado crop water use and irrigation management.

Acknowledgements

This research was jointly supported by the U.S. Department of Agriculture's (USDA) Agricultural Marketing Service and the California Avocado Commission. The first author would like to sincerely thank the California Avocado Commission for providing continuous support and thoughts, and gratefully acknowledge McMillan Farms, Barr Ranch, Grangetto Farms, Irvine Ranch, Lloyd-Butler Ranch, Pine Tree Ranch, and Rancho Simpatico for allowing us to implement this study on their avocado orchards.

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Join Us for the 2025 California Agritourism Summit – May 14 & 15

Written By: Darlene Ruiz, Staff Research Associate

Agritourism is thriving in California, providing farmers, ranchers, and tourism professionals with unique opportunities to build sustainable businesses while connecting consumers to the state's rich agricultural heritage. To support industry growth and collaboration, we invite you to the **California Agritourism Summit** on **May 14-15 2025**, in **San Diego County**.

A Gathering of Agritourism Leaders

This two-day event will bring together agritourism stakeholders from across the state to exchange ideas, share best practices, and gain valuable insights into expanding agritourism enterprises. The Summit will feature a dynamic lineup of expert panels, roundtable discussions, hands-on workshops, and guided tours of successful agritourism operations.

Key Highlights

Keynote Address by Secretary Ross – We are honored to welcome California's Secretary of Agriculture **Karen Ross**, as our keynote speaker. Her leadership and vision for the future of California agriculture will set the tone for an inspiring and insightful event.

Exclusive Agritourism Tours – Attendees will have the chance to explore **thriving agritourism operations** in San Diego County, learning directly from farmers and ranchers who have successfully integrated tourism into their businesses.

CA Grown Sponsored Reception – After a full day of learning and networking, join us for an evening reception on **May 14**, generously sponsored by **CA Grown**. This is an opportunity to connect with industry leaders, share ideas, and celebrate the vibrant agritourism community.

Why Agritourism Matters

Agritourism is on the rise as farmers diversify, boost income, and adapt to market challenges, while the public seeks authentic outdoor experiences and local food connections. In San Diego, agritourism strengthens local and regional economies by attracting visitors and supporting rural businesses.

Who Should Attend?

Agritourism's success depends on the collaboration of a diverse range of stakeholders, including:

- **Farmers and Ranchers** looking to develop or expand agritourism offerings
- **Community and Producer Organizations** supporting local agricultural businesses
- **State and Local Government Representatives** involved in policy and economic development
- **Destination Marketing Organizations & Tourism Professionals** promoting agritourism experiences
- **Economic Development Professionals** working to strengthen rural economies

Be Part of the Future of Agritourism

Your participation and support are essential in shaping the future of agritourism in California. Don't miss this incredible opportunity to learn, connect, and contribute to a thriving agritourism sector. **Reserve your spot today** and join a community dedicated to fostering sustainable agritourism enterprises and enriching California's agricultural landscape.

For more details and registration information, visit: https://bit.ly/2025CAAgTourismSummit

Growing Climate Action Connections Across Southern California

Written By: Chandra Richards, PhD, Land Use Academic Coordinator II, UC Cooperative Extension San Diego County

One of the newer programs within UCCE San Diego is the Climate Action and Land Equity Project (CALE). CALE is funded through the Department of Conservation's Climate Smart Land Management Program, which aims to build capacity and technical assistance on California's agricultural lands toward a resilient future. CALE specifically seeks to address agricultural land access, tenure, and profitability barriers in the Southern California region. Southern California hosts over 22.1 million people across 46,245 square miles. The region leads the state in agriculture, with over 11,800 farms, 18% of California agricultural sales, and $10.8 billion in products sold.

Throughout the region and statewide, high costs of land, water, and resources, high rates of urbanization, and intense climatic impacts are driving many growers to halt agricultural operations and sell their lands and/or shift away from agriculture. Since 1984, San Diego County has ranked in the top 8 counties in the state with the largest net loss of irrigated farmland, specifically over 36,300 acres.

Drought, flooding, pests, and wildfire also continue to impact agricultural land use conversion to non-agricultural uses: for example, the Lilac and Border 2 fires burned over 6,700 acres and damaged 4 structures in January. These combined barriers make it difficult for many growers to maintain their livelihood, scale their operations, and ensure profitability toward long-term resilience.

To ensure agricultural land use resilience in the greater area, we will actively continue to plan, prepare, and strengthen connections and opportunities. We are actively engaging with organizations and land stewards in each of the counties in Southern California region. In January, we hosted our first event, Growing CALE Connections, in Orange County. Alongside staff and academics at the South Coast Research and Extension Center, in attendance were farmers, liaisons, local policy advocates, state agency representatives, school district coordinators and educators, resource conservationists, and students.

Farmers Mark Lopez and A.G. Kawamura shared their candid experiences of agricultural land access, tenure, and management struggles within Irvine. They urged attendees to continue supporting growers across a range of agricultural operation sizes, specialty crops and varietals, and backgrounds. All attendees indicated that they would adopt climate action lessons learned in their work and efforts.

In addition to elevating the voices of local growers, the CALE team is partnering with the Community Alliance with Family Farmers (CAFF), California Farm Bureau Federation (CFBF), and California Association of Resource Conservation Districts (CARCD). CAFF continues to build a sustainable food system and offers programs spanning small farm hubs, policy, climate action, food safety, and wildfire resilience. They also organize the Small Farms Conference annually, each February.

CFBF hosts a Beginning Farmer and Rancher Mentorship Program, Expanding our Roots, to link experienced farmers and ranchers with newer growers operating a production agriculture business in California. Their program has multiple benefits that ensure knowledge sharing, improving business methods, and scaling of production and distribution opportunities. CARCD has several areas of focus aligning agriculture, watersheds, forest and fire resilience, and community engagement and collaboration. Alongside the local resource conservation districts, they continue to scale climate-beneficial agriculture throughout the state for historically underserved and underrepresented communities.

The CALE team continues to think critically about how to support growers and agricultural lands and specifically make a collection of recommendations toward long-term resilience over the course of the three-year grant. Alongside these three partners, we urge farmers, ranchers, and land stewards to join California Farmlink's Land Match Program to build and sustain community relationships and opportunities to access agricultural land. It also provides a pathway to navigate the complexities of finding affordable land, succession planning, land lease agreements, and financial management.

If you would like us to feature your farm at one of our upcoming events, please contact:

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"Chandra is the Principal Investigator for the Climate Smart Land Management Program grant to elevate voices and opportunities for historically underrepresented communities"

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Why You Need to Know the Application Rate of Your Nursery or Greenhouse Sprinkler Irrigation System

Written By: Gerardo (Gerry) Spinelli, Production Horticulture Advisor, and
Valerie Mellano, Co-County Director,
UC Cooperative Extension, San Diego County

The application rate is a number that tells you how much water your irrigation system applies to your containers (or field) over time, expressed in units of inches per hour. This concept is widely used in irrigation to calculate irrigation run time (i.e. how long you run your irrigation system when you apply water). The application rate represents an inherent characteristic of the irrigation system, determined by sprinkler (or emitter) spacing on the lateral, spacing between the laterals (or drip lines) and the flow rate of each nozzle (or emitter). In sprinkler irrigation, the application rate is also called precipitation rate and truly represents the quantity of water applied to the surface of the irrigation block, since sprinklers apply water uniformly to the whole block. In drip irrigation, it represents a somewhat artificial quantity, since water is not really applied to the whole field.

Think about a vineyard, for example: water is applied to a narrow strip where the vines are planted and the space in between rows is left dry. Similarly, in open- field cut flower production, drip irrigation applies water only to beds, and the furrows between beds remain dry. Nevertheless, even in these systems, the concept of application rate is widely used to calculate irrigation run times and represents the average amount of water applied to irrigated and non-irrigated areas.

Why depth and not volume?

Yesterday I was listening to the news. “We are going to get two inches of rain overnight,” the weather reporter said. “Why inches?” I wondered. Why do we use depth to measure rain and not volume, like gallons or acre-feet? It turns out that if we used volume, we would need to specify the surface that volume rained on. Depth is used to describe rain (and also sprinkler irrigation) in a way that cancels out the effect of the surface. In practical terms, depth is calculated by dividing the volume of water collected by the area that intercepted the rain.

For example, if I leave a 5-gal bucket and a coffee mug in my yard during the storm, the coffee mug will intercept a smaller volume than the bucket, but they both would intercept the same depth. Let’s say that the mug collected a volume of 8 fl oz of water, that is the same as 14.43 cubic inches, and had a diameter of 3.5 inches (i.e. a radius of 1.75 inches), so it is area is 1.752 * 3.14 = 9.6 square inch. By dividing the volume collected by the area, we get the depth of rain: 14.43 ÷ 9.6 = 1.5 inches of rain. In the bucket, that has a diameter of 12 inches and hence an area of 113 square inches, we collected 93.6 fl oz or 169 cubic inches. Can you calculate the depth in inches?

Depth of water applied in time

There are two questions an irrigation manager should be able to answer: “How long do I need to irrigate?” and “How often do I need to irrigate?”. The fundamental concept needed to answer the first question is the application rate, or precipitation rate, that tells you what depth of water your irrigation system applies in one hour. It’s similar to what meteorologist call rain intensity, but while rain intensity is highly variable over time, luckily, application rate is *relatively* constant in an irrigation system. I say “relatively” because changes in pressure during irrigation also change the precipitation rate. Additionally, if the system is not properly designed, and some areas receive less pressure than others, those areas will have a lower application rate.

How to look up the application rate

The quickest way to figure out the application rate of an irrigation system is to refer to the manufacturer's specifications documentation or to calculate it from other variables indicated in the specifications. I still believe that the best way is to measure it in the field by looking it up or calculating it, is a quick way to have an initial reference point. Looking it up has some limitations though, and we will discuss them in this section with the hope that you’ll avoid common mistakes resulting from misinterpretation of sprinkler specs tables.

Sprinklers apply water to a circular area around them. The maximum distance that water reaches from the sprinkler head is called the radius or throw. Another way to think about the throw is that it’s the radius of the wetted circle around a sprinkler. A very common way to space sprinklers is to install them “head-to-head” or placing them at a distance from each other equal to their radius. This way, the water from adjacent sprinklers overlaps by a full radius, an arrangement that compensates for lack of uniformity in the sprinkler profile. One can arrange head-to-head sprinklers in a square or an equilateral triangle layout. Manufacturers report application rate data for each combination of nozzle size and pressure, assuming that the sprinklers are installed head-to-head.

Application rate is determined by: 1) nozzle flow rate, or the volume of water in time produced by the sprinkler and 2) sprinkler head spacing, or the distance between sprinkler heads. Nozzle flow rate affects application rate by affecting the volume of water in time produced by the sprinkler; sprinkler spacing affects application rate by affecting the area to which this volume of water is distributed. When designing a system, we can select the appropriate sprinkler and decide the sprinkler spacing. If we decide that we will install sprinklers head-to-head, then we can look up the resulting application rate in manufacturer’s sprinkler performance tables (Figure 1). This doesn’t work for a system already installed, because the spacing is already fixed. If your irrigation system spacing is different from the nozzles’ radius, you cannot look up the application rate in a table! You’ll have to calculate it.

To complicate the matter, pressure affects sprinkler performance parameters. Manufacturers report tables with specifications of each sprinkler model at different pressures including flow rate and radius. As mentioned, some manufacturers also report application rate (or precipitation rate, Figure 1, pg. 13) at various pressures assuming that sprinklers are installed at a spacing equal to the radius (head-to-head).

10 Series MPR *15° Trajectory*

Nozzle	Pressure (psi)	Radius (ft)	Flow (gpm)	■ Precip (in/h)	▲ Precip (in/h)
10F	15	7	1.16	2.28	2.63
	20	8	1.30	1.96	2.26
	25	9	1.44	1.71	1.98
	30	10	1.58	1.52	1.75
10H	15	7	0.58	2.28	2.63
	20	8	0.65	1.96	2.26
	25	9	0.72	1.71	1.98
	30	10	0.79	1.52	1.75
10T	15	7	0.39	2.28	2.63
	20	8	0.43	1.96	2.26
	25	9	0.48	1.71	1.98
	30	10	0.53	1.52	1.75
10Q	15	7	0.29	2.28	2.63
	20	8	0.33	1.96	2.26
	25	9	0.36	1.71	1.98
	30	10	0.39	1.52	1.75

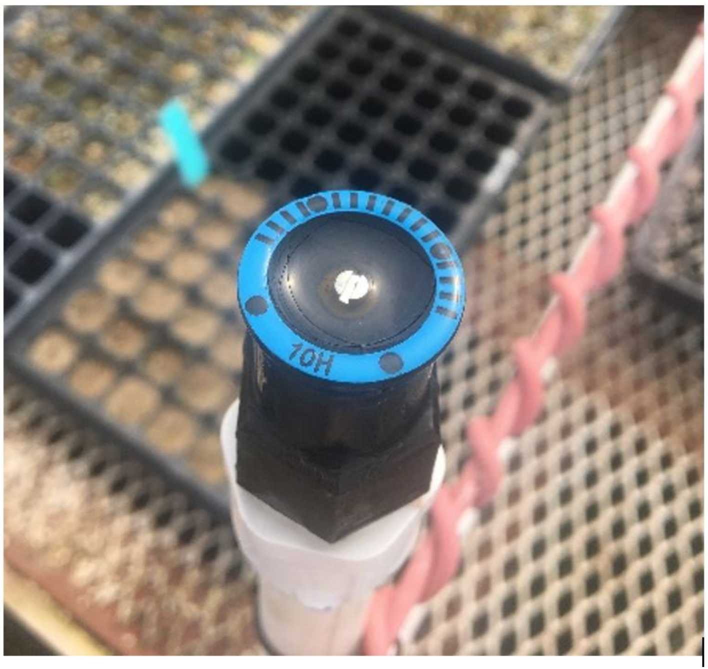

Figure 1. Specifications of the RainBird MPR 10H spray nozzle

As you may expect, radius increases with increasing water pressure at the sprinkler head, and so does the flow rate. With more pressure, water reaches farther, and a larger volume of water is discharged in time. Since these tables assume that sprinklers are always spaced head-to-head, as the radius increases, so does the spacing used to calculate the application rate reported in the table.

Therefore, in the table, both radius and flow rate affect application rate in opposite ways: a larger radius means a wider spacing and a larger area to which the water is applied. Thus, a larger radius decreases the application rate; conversely, a larger flow rate means a larger volume applied over time and thus a larger flow rate increases application rate. In other words, when looking at tables, we find ourselves in the artificial scenario where the spacing is adjusted to match the radius for each pressure. This is useful when designing a system but does not make sense for an existing irrigation system. When looking at the tables, an increase in pressure, which increases radius/spacing and flow rate, can increase or decrease the application rate. Again, this is meaningful only in the design phase and is not a real scenario for an irrigation system already installed. In an existing irrigation system, the spacing is fixed, and higher pressure and increasing flow rate, will always result in a higher application rate. The increase in radius will have no effect, except for some edge effect at the borders of the irrigation block.

In Figure 1, a Rain Bird MPR 10H sprinkler is used to irrigate propagation benches in a greenhouse. From the table we learn that if the pressure at the sprinkler head is 25 psi and the sprinklers are installed head-to-head using a square spacing pattern, then the application rate is 1.71 inch/hour.

If instead the pattern is an equilateral triangle, then the application rate is 1.98 inch/hour. This is among the highest application rates you will ever encounter, while with typical values are between 0.1 and 1 inch/hour. Note that in this case, increasing pressure is associated with a decreasing application rate. This is not always the case in sprinkler performance data tables. Note that MPR (or MP from other manufacturers) stands for Matched Precipitation Rate, meaning that different models of the same sprinkler family producing different arcs (e.g. 10F full arc or 360°; 10H half circle or 180°; 10T a third of a circle or 120° etc.) apply the same application rate. The matched application rate feature matches application rates across models with different arcs, not across different pressures! Be aware that matched precipitation rate sprinklers will apply different application rates if they are operated at different pressures.

How to calculate the application rate

For other sprinkler types, like impact sprinklers, manufacturers do not report the application rates, only radius and flow rate, in a table that details specifications per nozzle size at different pressures. For example, the impact sprinkler in Figure 2, pg. 14, often called a “Maxibird”, with a blue nozzle and operated at 55 psi will have a radius of 41 ft and a flow rate of 4.1 gpm.

One can calculate the application rate of a sprinkler system by dividing the flow rate (volume per time) by the surface irrigated (area) to obtain a depth per time. In Figure 3, pg. 14, the sprinklers are arranged in a square pattern, with four sprinklers, one at each corner; the square receives a quarter of the water that each of the four sprinklers produces.

Straight Bore Nozzle (SBN-1) Performance*

psi@ Nozzle	3/32" Red Rad. (ft.)	3/32" Red Flow (gpm)	7/64" Black Rad. (ft.)	7/64" Black Flow (gpm)	1/8" Blue Rad. (ft.)	1/8" Blue Flow (gpm)	5/32" Yellow Rad. (ft.)	5/32" Yellow Flow (gpm)	3/16" Beige Rad. (ft.)	3/16" Beige Flow (gpm)
25	-	-	32	2.20	35	2.80	38	4.20	39	5.50
35	37	2.00	37	2.70	38	3.30	41	4.80	42	6.30
45	38	2.30	39	3.00	40	3.70	42	5.40	44	7.10
55	38	2.50	41	3.30	41	4.10	43	6.00	45	7.90
60	38	2.60	41	3.50	42	4.20	44	6.40	45	8.40

NOZZLE SIZE (Stream Height: 6 ft.)

*Shipped Assembled with a 1/8" (08) Straight Bore Nozzle.

Figure 2. Specifications for the Rain Bird 2045PJ "Maxibird" impact sprinkler. Note the blue nozzle in figure.

Thus, it's as if each square received all the water discharged by just one sprinkler, and to calculate the application rate one just divides the flow rate of one nozzle by the area of the square between four sprinklers. If we assume that the sprinklers will be installed at a spacing equal to their radius (head-to-head), the side of the red square in Figure 3 equals the radius of each sprinkler, and the area of the square can be calculated by taking the square of the sprinkler radius.

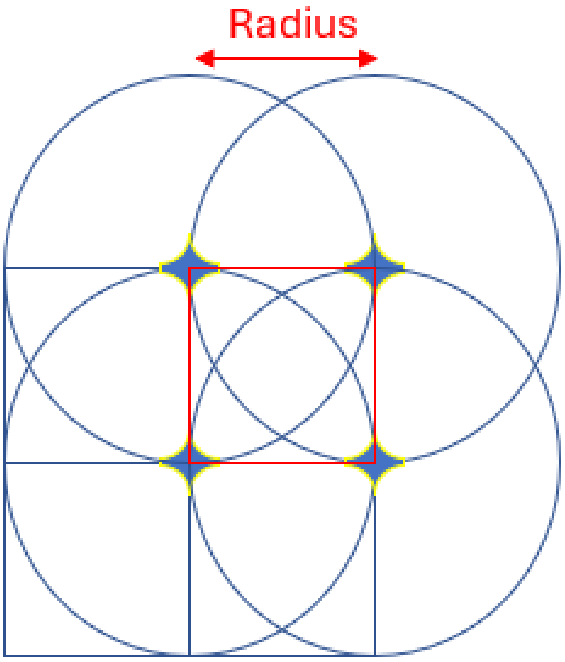

Figure 3. Schematic view of four sprinklers arranged in a square pattern and spaced head-to-head.

For example, for the MPR 10F sprinkler in Figure 1, at 25 psi, the flow rate is 1.44 gpm, the radius is 9 ft, and the area of the square is 81 ft². Dividing the flow rate by the area, we get 1.44 gpm ÷ 81 ft² = 0.0178 gpm/ft². Since the flow rate is in gallons per minute and the radius is in feet, to obtain precipitation rate in inches per hour we need to multiply by 96.25 to convert from gallons to cubic feet, from minutes to hours and from feet to inches. If you do that, you'll get 1.71 inch/hour, as reported in Figure 1. If you want to know how we got the conversion factor, look at Equation 1 below. We color-coded the units to show you how they cancel out. We obtained the conversion factor 96.25 from 60 * 12 ÷ 7.48, since there are 60 minutes in one hour, 12 inches in one foot and 7.48 gallons in a cubic foot.

Now we are ready to calculate the application rate for the Maxibird sprinkler in Figure 2. With a radius of 41 ft and a flow rate of 4.1 gpm, we get an area of 1,681 ft² and an application rate of (4.1 ÷ 1681) * 96.25 = 0.235 inch/hr. If you don't like to use equations, you can download an Excel spreadsheet that automatically calculates the application rate for a square, rectangular or triangular pattern. Just input the numbers for sprinkler spacing and nozzle flow rate. Download it here or scan this code.

Area = radius x radius = 9 ft x 9 ft = 81 ft²

$$Application\ rate = \frac{1.44\ gal}{min}\ \frac{\square}{81\ ft^2}\ \frac{60\ min}{hr}\ \frac{ft^3}{7.48\ gal}\ \frac{12\ in}{ft} = \frac{1.71\ in}{hr}$$

Flowrate   Area   Conversion factors

Measuring application rate in the field

The best way to obtain the application rate of your system is to measure it in the field. One simple way is to buy rain gauges (Figure 4). These are inexpensive and can be placed at several locations in the field. I was never lucky using rain gauges. Often the application rate is so small that after 30 minutes of irrigation it's very difficult to visually interpret the depth from the graduated scale on the gauge (0.05 or 0.08 inch?). Additionally, rain gauges are typically small, tall cylinders with small top surface and hence intercept small volumes. So, it's difficult to measure that volume even if one has another graduated cylinder to measure water volume. They are good for rain, since you can get one inch of rain in a 3-hour storm, but irrigation systems can have an application rate as low as 0.1 to 0.3 inch per hour, and often it's impossible to irrigate for more than one hour just to get a measurement.

I had better luck capturing water with containers like 6-inch buckets. These intercept larger volumes that are easy to measure with a graduated cylinder. Then one can divide the volume of water by the container surface area to calculate the depth intercepted during the irrigation run time. For this reason, I don't like to use Tupperware (Figure 5) since they have rounded corners and it's hard to calculate their surface area accurately. I prefer to use round buckets, and I recommend that you couple your application rate measurement with a distribution uniformity measurement. If you irrigate with sprinklers, it's always good to measure distribution uniformity and this way you get both measurements in one shot. By measuring distribution uniformity, you will also get information on how variable the application rate is throughout the field. Since pressure strongly affects the application rate, be sure to also measure pressure to relate it to the measured application rate.

To get a very rough estimate of application rate, you can also measure the depth of water in a bucket with a ruler. Obviously, this is not an accurate method to measure low application rates (again, try to measure 0.05 inch with a ruler), but it only requires simple equipment that you can find around the office. Also, it's useful as a very visual teaching and demonstration tool to show irrigators how much water was applied in one hour by the irrigation system. One can couple this with the observation of water depth evaporated from a bucket in a week during different seasons (typically in the range of 0.5 to 1.5 inch). With these two pieces of information one can give irrigators a very convincing visualization of the nursery's weekly irrigation requirement in hours.

Figure 4. Measuring application rate with a rain gauge. Note the small volume in the gauge after 30 minutes of irrigation.

Finally, let us warn you that evaporation from the catch cans can substantially reduce the application rate value obtained, even in the relatively short time it takes for two highly motivated individuals to measure and record volumes in 36 buckets (about 20 minutes). Therefore, we recommend that you measure the application rate during a cold, cloudy day (Figure 4) and that you work swiftly when recording data. One could argue that evaporation also occurs when irrigating and thus it should be factored into the application rate measurement. This is partly true but evaporation from free water surface in buckets during a sunny and windy day is substantially higher than from the surface of wet nursery container substrate. I have measured variability in application rate up to 20% in association with high evapotranspiration days.

Figure 5. Measuring Distribution Uniformity and Application Rate with Tupperware and with round buckets.

Figure 6. Measuring container diameter to calculate container surface area. Note that the plant is small and does not affect the container capture factor that in this case is 1.

What volume of water does each container receive?

This question comes up quite often. If I irrigate for one hour, with an application rate of 0.3 inch/hour, how much water did my 1-gal pot receive? It's not necessary that you read this paragraph (skip to the next if you're bored) but the answer again has to do with depth, area and volume. If you weigh containers with a scale to decide how to schedule irrigations, this paragraph will be interesting to you because it allows you to relate the irrigation run time to the milliliters of water intercepted by the containers. One milliliter of water weighs one gram.

If your application rate is 0.3 inch/hour, in 45 minutes the system applies (0.3 ÷ 60) * 45 = 0.225 inches of water. To calculate the volume of water intercepted by the container, we need to multiply this depth by the container's top surface. If the diameter of the container in Figure 6 was 5 ½ inches, its area is $(5.5/2)^2$ * 3.14 = 23 inch^2. The volume of water intercepted is then 23 * 0.225 = 5.34 inch^3 or 87 mL or 3 fl oz. This is true only if the plants are small and their canopy does not interfere with water interception. In some instances, the canopy sheds water out of the container (umbrella effect) or channels more water into the container (funnel effect) than the container without a plant would have. The ratio of water volume intercepted by a container with a plant compared to the volume intercepted by the container without a plant is called the capture factor. Capture factors larger than 1 indicate funneling effect, while lower than 1 indicate umbrella effect. To make things more complicated, plants capture factors change as their canopy grows. There is no general rule and the only way to obtain capture factors is to measure them.

Watch this video to learn how to or scan this code:
https://www.youtube.com/watch?v=AMht9LvtJCc

Evapotranspiration

Reference Evapotranspiration (ETo) is a measure of the depth of water evaporated and transpired by a well-watered surface of grass. As a first approximation, it can be used to estimate the water needs of your nursery. The California Department of Water Resources maintains a network of weather stations called CIMIS that collect ETo data all over the state and a website to download the data (https://cimis.water.ca.gov/). I downloaded, averaged and plotted 5 years of weekly ETo data for three stations in counties where nursery production is common. Escondido represents Southern California coastal inland climatic conditions. Camarillo represents Southern California coastal conditions and Parlier represents San Joaquin Valley conditions. In June and July, Parlier reaches reached 2 inches per week, while Camarillo does did not exceed 1.5 inch per week. Escondido is somewhere in between. Conversely, in January and February, ETo in Parlier never surpasses surpassed 0.3 inch per week, while in Escondido and Camarillo, it's almost always 0.5 inch per week. The drop in ETo around May and June for Camarillo and less noticeably for Escondido is an effect of what we call May Gray and June Gloom. The range experienced by Parlier in summer and winter represents the extremes in conditions experienced by most nurseries in the state of California.

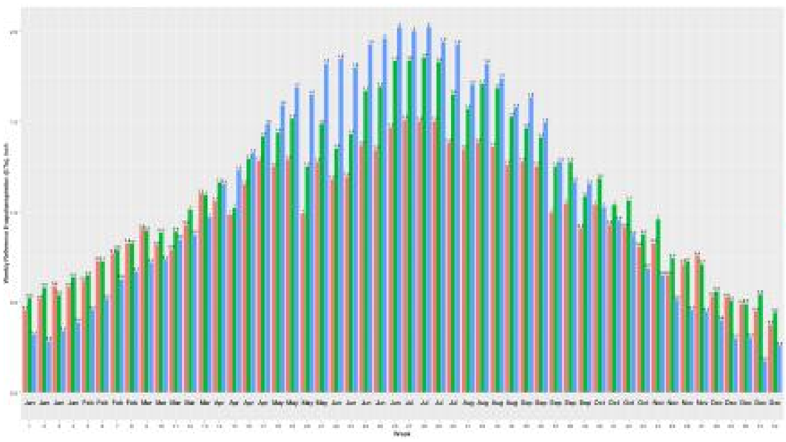

Figure 7. Weekly Reference Evapotranspiration from CIMIS stations in Camarillo, Escondido and Parlier

Irrigation scheduling

Knowledge of your plants' evapotranspiration and of your irrigation system application rate is a powerful tool to drive irrigation scheduling decisions. The idea is to use irrigation to replenish the same depth of water that has transpired and evaporated from the containers. Since our irrigation systems are not perfect, we need to increase the evapotranspiration factor by some quantity meant to make up for lack of uniformity in water delivery in the irrigation system.

We do this by dividing evapotranspiration by a number called Distribution Uniformity or DU. Since DU is always smaller than 1, the result is larger than the evapotranspiration that we started with. You can learn about DU by reading the article in this newsletter:

https://cesandiego.ucanr.edu/newsletters/Extension_Connection_Newsletter94712.pdf or scan this code:

For example, if you are in Parlier in early May (week 19), a good estimate of your nursery's evapotranspiration based on CIMIS reference evapotranspiration is about 1.7 inches of water per week. If the Distribution Uniformity of your sprinkler system is 0.8, then you need to apply 1.7 ÷ 0.8 = 2.125 inches per week. If your application rate is 0.3 inch per hour, then during week 19 you need to run your sprinklers for 2.125 ÷ 0.3 = 7 hours.

Large or small application rate?

It's a common desire of the nursery manager to tweak the irrigation system to obtain the highest application rate possible. This is based on the idea that one needs to irrigate each irrigation block in the shortest possible time to irrigate the whole nursery in one day during summer. This reasoning is only partia+lly justified. One could run two low-application rate (e.g. 0.15 inch/hour) blocks at the same time for two hours, instead of running each high-application rate (e.g. 0.3 inch/hour) block for one hour sequentially. In both cases, we irrigated for two hourshours, and each block received 0.3 inch.

But admittedly, running irrigation blocks sequentially allows workers to access non-irrigated blocks to spray, harvest, prune, fertilize, weed, etc. In the second configuration, irrigation interferes less with the other activities of your busy nursery, and I understand why some growers are adamant about having high application rates. One word of caution here: do not try to increase your application rate after the fact. Instead, have someone design your high-application rate irrigation system properly from the beginning.

If the irrigation system is already designed with a certain (low) application rate, it means that the pipes are sized to carry a certain (low) flow rate. I've often seen workers swapping nozzles for larger ones in an attempt to get more water out of them.

Larger flow rate in the pipes means lower pressure overall because 1) there are larger pressure losses in the mainline; and 2) the pump performance curve produces less pressure at higher flowrate. It also means large differences in pressure between sprinklers caused by pressure losses in laterals. All these contribute to terrible distribution uniformity. The pressure in some areas may drop so much that you get less flow rate out of the nozzles than with the original design. Resist the temptation!

Conclusion

The application rate is a specification of your irrigation system that you need to know. We recommend measuring it, although in some cases you can look it up in the manufacturer's specifications or calculate it. It's one of the key features to keep in mind when you design your irrigation system and it's difficult to change it after the system is already installed. Knowledge of the application rate is used to calculate the irrigation application duration needed to apply a certain water depth. The latter can be estimated from reference evapotranspiration or obtained by direct water use measurements, for example, with a scale. Knowing the application rate of each of your irrigation blocks is an essential piece to make an irrigation schedule for your nursery.

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Meet the Academics

Get to know the people behind Cooperative Extension San Diego!
Each issue we like to highlight some members of our amazing team.

Meet our Coordinator

Chandra Richards, PhD

Land Use Academic Coordinator II

Chandra Richards joined UCANR as the Agricultural Land Use Academic Coordinator II in May 2021. In her first three years, she provided invaluable technical assistance and application support for the Department of Conservation's Sustainable Agricultural Lands Conservation Program throughout San Diego, San Bernardino, and Riverside Counties. Her impact spans five successful planning grants protecting agricultural and open spaces, aligning community needs, and bridging gaps in sustainability. She also developed meaningful connections with California Native American Tribes, local governments, planning agencies, and water districts to highlight barriers in agricultural resilience and preparedness.

Since 2024, Chandra has acted as Principal Investigator for the Climate Smart Land Management Program grant to elevate voices and opportunities for historically underrepresented communities regarding agricultural land access, tenure, and diversification. She wrote the bulk of the $1.7M Climate Action and Land Equity project (CALE) to support growers across the Southern California region. She continues to showcase land access issues requiring policy support and unite the efforts of agricultural service providers and educators. She hopes that this three-year grant will expand UC ANR's role in land equity issues, especially regarding land matching, succession planning, and planning.

She has been working in San Diego County for the past 8 years on a range of projects spanning agriculture, forest health, habitat restoration, and watershed resilience. Dr. Richards earned her Ph.D. in Soil Biogeochemistry from UC Berkeley, where she was a California Sea Grant fellow focusing on how soil conditions affect water quality, fish health, and estuarine systems in Northern California. She has Bachelor of Science degrees in Environmental Chemistry and in Mathematics from Pennsylvania State University. Raised on the east coast in Pennsylvania and Virginia, Chandra recognized the importance of environmental sciences from an early age, especially regarding the natural and human impacts of climate on the environment and communities. She continues to advocate for environmental issues as a grant writer, mentor, consultant, and volunteer.

Meet our Staff

Sierra Reiss

Land Equity Project Manager

Sierra Reiss joined the University of California Agriculture and Natural Resources (UCANR) in February 2025 as the Land Equity Project Manager (Project Policy Analyst 3). She works alongside Chandra Richards on the Climate-Smart Land Management Program, bringing a strong background in environmental conservation and equitable land access.

Born and raised in Northern California, Sierra grew up surrounded by redwoods and diverse ecosystems, which sparked her passion for protecting the environment from a young age. She earned a Bachelor of Science in Sustainability with a minor in Environmental Geography from San Diego State University. Over the past eight years, she has been deeply involved in the San Diego community, working to increase access to nutritious food, expand educational opportunities, and raise awareness about environmental issues.

Before joining UCANR, Sierra was the Education Manager at the Resource Conservation District of Greater San Diego where she worked alongside local organizations and schools to connect students with grants, facilitate field trips and classroom visits, and manage multiple education programs. Alongside this job she worked to coordinate the education programs and events for Wild Willow Farm where she worked closely with the South Bay community to increase access to healthy nutrition and education. More recently, Sierra worked as a contractor, creating interactive GIS StoryMaps that combined her love for environmental education and design.

Sierra's expertise and dedication to climate resilience paired with outreach and education will play a key role in advancing the CALE Project and supporting UCANR's broader efforts to create more resilient and equitable landscapes.

Calendar

Stay up-to-date with seminars, webinars, trainings, events, and more!

MARCH

CONSERVATION AND LAND MGMT WORKSHOP

March 26, 4:00 PM to 6:00 PM

San Diego County Farm Bureau

LAST WEDNESDAY GROWERS MEETING

March 26, 7:30 AM to 8:30 AM

San Diego County Farm Bureau

AGRITOURISM AND FARM BUSINESS PLANNING WEBINAR

Record Keeping Basics

March 31, 11:00 AM to 12:00 PM

Online, https://bit.ly/3RfV3D9

FARM BUSINESS PLANNING ONLINE COURSE

March 31 - May 9

Online, On Demand, Register by 3/26

https://bit.ly/41GWCis

APRIL

LAST WEDNESDAY GROWERS MEETING

April 30, 7:30 AM to 8:30 AM

San Diego County Farm Bureau

MAY

2025 PROFESSIONAL LANDSCAPE IPM WORKSHOP

May 12, 7:30 AM to 4:00 PM

JULEP Venue | 1735 Hancock St., 92101

Registration information coming soon

CALIFORNIA AGRITOURISM SUMMIT

May 14 - 15, Two full days starting 7:30 AM

The Flower fields at Carlsbad Ranch and California Center for the Arts, Escondido

https://bit.ly/2025CAAgTourismSummit

Extension Connection

We hope you have enjoyed this issue of the Extension Connection!

We will continue bringing you the latest news from UC Cooperative Extension San Diego, and we would also like to hear from you.

What Do You Think?

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