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INTRODUCTION FROM OUR

County Director

Dear Readers,

With this new edition of the Extension Connection newsletter, it is our pleasure to announce that there has been a change in leadership in San Diego County. Starting July 1, 2023, Chris McDonald and Ramiro Lobo have been appointed as Interim County Co-Directors for the San Diego UCCE office. We also want to thank Oli Bachie for his service and contributions as County Director for the past few years.

Chris is a natural resources advisor who has been working in UCCE for 13 years and in San Diego for 10 years. In his natural resources advisor role, he works with land managers across Southern California to provide local science-based solutions using his expertise in vegetation management, particularly sensitive species management, habitat restoration and weed management. He also works on projects to stop the spread of emerging invasive weeds, weeds that are new to the county, region and in some cases new to North America.

Chris was also the County Co-Director in San Bernardino County for 6 years. In San Bernardino he worked to improve the connections between UCCE programs and the public, and to ensure our programs meet the needs of the public. His expertise in San Bernardino will help to ease the transition in his new Co-Director role in San Diego. Chris has a MS and PhD from the University of Arizona in natural resources studies, and a BS from the University of California, Riverside.

Ramiro has been the Small Farm and Agricultural Economics Advisor for the University of California, Cooperative Extension in San Diego County since 1997. His work as an advisor focuses on conducting research and education programs for new and existing small-scale producers on topics related to agricultural business and risk management, new crop development and evaluation, new entry grower startup information, market development through agricultural tourism and direct marketing efforts, IPM and pesticide safety, and Food Safety education.

Ramiro is one of four advisors affiliated with the University of California Small Farm Program Team. His research has resulted in the adoption and growth of new crops in San Diego County including dragon fruit, blueberry and coffee. Ramiro's work has also contributed to the growth and expansion of agricultural tourism and direct marketing at the county and state level. His familiarity with local agriculture and understanding of the issues impacting local farmers will help our office better serve our farming clientele.

We are thankful for the opportunity to take on this new role and are fully aware of the many difficult issues that lie ahead, from agricultural sustainability, water conservation, labor management, pest management, agricultural production, drought, wildfire, increasing regulations to food insecurity. However, our success is largely dependent on the partnerships and collaboration with you, our clients and stakeholders. Whether it is our volunteers serving the community, our programs providing valuable education in your neighborhood, or our advisors working to ensure you have the knowledge and expertise to tackle the challenges you face, we are here to support and empower you. The local UC Cooperative Extension is the gateway that connects you to the University of California system!

In this issue you'll find valuable information about avocado water use, irrigation mysteries, how to prepare yourself for wildfires, and the 4-H fair. Thank you for taking the time to read this newsletter and feel free to reach out with any questions about the content or if there are specific topics you would like us to address. Chris can be reached by email at cjmcdonald@ucanr.edu and Ramiro can be reached by email at relobo@ucanr.edu.

We look forward to working and collaborating with you!

Sincerely,

Dr Chris McDonald and Ramiro E. Lobo
UC Cooperative Extension San Diego County - Interim County Directors

Avocado Crop Water Use Varies Spatially and Temporally

Introduction

Evaporation from vegetation is generally given a more specific term, evapotranspiration or ET for short. ET is the loss of water from a vegetated surface through the combined processes of soil evaporation and plant transpiration. The rate of ET for a given vegetation is a function of several factors. The first and most critical factor is soil moisture. ET simply cannot take place if there is no water in the soil. However, if adequate soil moisture is available, plant type, canopy feature, row orientation and slope, tree spacings, and weather components affect ET rate. Differences in crop height, ground cover and crop rooting characteristics result in different ET levels in different types of crops under identical environmental conditions.

Most studies on water use by avocado orchards have focused on determining the level of water application necessary to obtain satisfactory fruit set, size and yield rather than directly determining the actual water need of the trees. Therefore, data on water use by avocado orchards and optimal irrigation strategies is limited, and the lack of accurate information may hinder the achievement of resource-efficient avocado production and sustainability. We are currently conducting a large-scale study to acquire relevant information on crop water consumption and develop cost-effective irrigation tools and strategies in California avocado production systems. This article presents some preliminary results of this study.

Field Experiment

Field studies are currently being conducted in 12 avocado sites in San Diego, Riverside, Orange, and Ventura Counties.

Fig. 1. *Ground view of a flux tower/ monitoring station in an avocado orchard in Ventura County.*

The experimental orchards have different plant density, row orientation, canopy features, soil types and conditions, climate, and water qualities that can provide a good representation of avocado production systems in California. A flux tower was set up in each of the experimental sites to measure actual ET (crop water consumption) on a continuous half-hourly basis. The flux tower contains a combination of surface renewal and eddy covariance equipment that continuously measures high frequency data for the energy balance analysis (Fig. 1). Some results of the current irrigation study are presented in this article.

Net Radiation Flux as a Driver of Crop Water Use Variations

The solar and longwave radiation that impinges on Earth's surface heats the ground surface. The surface reflects some of the incoming solar radiation and also emits outgoing longwave radiation. The remaining radiation is the net radiation at the surface. In other words, net radiation (Rn) represents the gain of energy by the surface from solar radiation. Typically, the largest term in the surface energy balance is the net radiation flux which is the main source of energy for the evapotranspiration process from a ground surface (avocado orchard in this study).

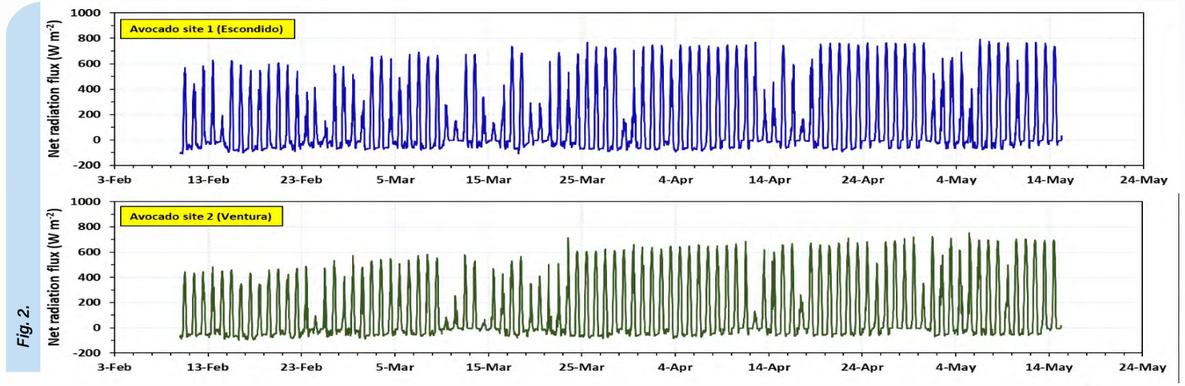

Fig. 2.

The amount of net radiation flux is driven by the time of day and year, and ground shading percentage, location, and slope (in sloping surface) of avocado orchards. In this study, a net radiometer was used to monitor net radiation flux measure on a continuous half-hourly basis under a slope-parallel fashion in each site.

A comparison of Rn values over a 96-day period for two avocado sites in Escondido and Ventura is shown in Fig. 2. During the night, Rn is negative due to a net loss of long-wave radiation from the surface. The maximum Rn typically occurs around solar noon. Due to several cloudy and rainy days over the period, significant variability was observed on the maximum daily value of Rn in both sites. For instance, the value was 271 and 87 w m^{-2} for avocado sites 1 and 2 on March 10, respectively. Two days later on March 12, the maximum Rn was 672 w m^{-2} at site 1 and 560 w m^{-2} at site 2. Overall, the average daily Rn at site 1 was approximately 8.2% greater than site 2 over the period which suggests a higher potential water consumption of avocado trees at the avocado site in Escondido.

The cumulative actual ET across the above avocado sites in Escondido and Ventura demonstrated nearly 15% differences over the 96-day period (Fig. 3). Higher Rn values and less foggy conditions and dew forming at site 1 could be the main reason of lower crop water consumption at site 1 when compared with site 2. The average air temperature and wind speed were 15% and 16% higher at site 1, respectively. Also, the average air relative humidity was 1.8% lower at this site. These three weather components play a crucial role in the amount of energy present in the avocado canopies to evaporate water and drive transpiration. Averagely lower sensible heat flux (H) values were occurred at site 1 which means a larger fraction of Rn was devoted to actual ET.

Ground heat flux (G) value was near zero due to the canopy coverage by the avocado trees and accumulation of dried leaves on the ground that insulated the soil. Slightly higher G values were determined at site 2, however, G values don't seem to have a significant impact on the daily ET.

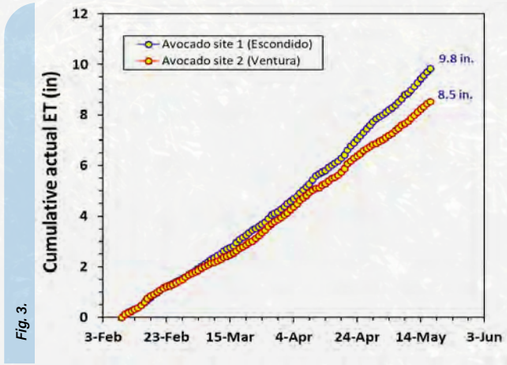

Fig. 3.

Fig. 2. Half-hourly flux of net radiation at two avocado sites in Escondido and Ventura. The data are reported for a 96-day period (February 9, 2023, to May 15, 2023)

Fig. 3. Cumulative actual evapotranspiration at avocado sites 1 and 2. The monitoring towers were erected at the elevation of 760 feet (site 1) and 163 feet (site 2) above sea level. Dominant soil texture is sandy loam at site 1 and loam at site 2. Site 1 has a south facing 44% slope with tree spacings of 19 by 20 feet, and site 2 has a southwest facing 3% slope with tree spacings of 12 by 14 feet.

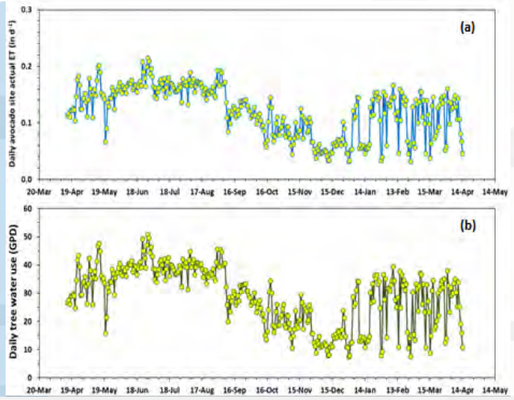

Fig. 4.

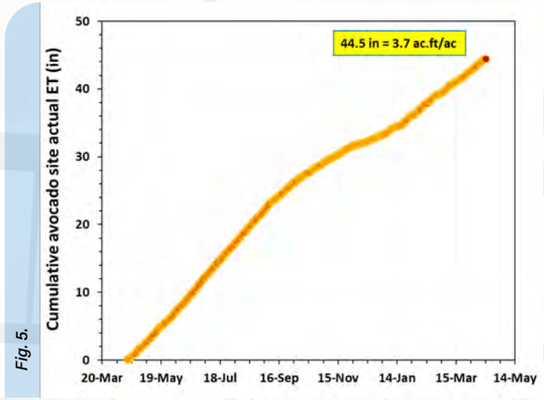

Fig. 5.

Actual Crop Water Consumption of Avocado Orchards

The results from the avocado experimental sites illustrate considerable variability in avocado consumptive water use (actual evapotranspiration or ET), both spatially and temporally. Daily crop water use varied between 0.3 in d^{-1} (7.6 gallons per day per tree) and 0.21 in d^{-1} (50.8 gallons per day per tree) over a 12-month period (April 15, 2022 through April 14, 2023) measurements at site 1 (Fig. 4). More uniform daily crop water consumption over the summer season occurred than other seasons specifically the winter and part of the spring when the weather condition was more unstable.

The seasonal avocado consumptive water use was 44.5 in. (3.7 ac-ft/ac) at this avocado site (Fig. 5). Nearly 63% of the avocado seasonal water use (27.8 in.) occurred April to September and 37% of the avocado seasonal water use (16.8 in.) occurred October to March. This trend clearly indicates while irrigation events of avocado orchards may be necessary during the fall and winter periods, greater chance of precipitation and less crop water demand may have a significant impact on the total amount of irrigation water needs and frequency of irrigation events during these months. The data of actual ET, precipitation, and soil moisture sensors verified that approximately 55% of the total crop water needs during the six months period of October 2022-March 2023 was supplied by the late fall to the winter rainfalls at avocado site 1.

It should be noted that a seasonal crop water use of 3.8 ac-ft/ac is the maximum seasonal water use measured for avocado orchards across the experimental sites (occurred in another experimental site, a high density mature avocado orchard). In other words, and as a preliminary result, a seasonal crop water use of 3.8 ac-ft/ac or less for avocado groves could be expected in California production systems. More data is required to derive a solid conclusion and develop more accurate information and cost-effective irrigation tools for avocados. This study intends to develop a comprehensive data set over the next couple of years to accomplish this task.

Fig. 4. Daily actual evapotranspiration at avocado site 1 over a 12-month period (April 15, 2022, through April 14, 2023) (a). Considering daily actual ET measured and the tree spacings, the average crop water consumption during this period was determined in gallons per day per tree (GPD) (b).

Fig. 5. Cumulative avocado actual ET at site 1 over one-year study period (April 15, 2022, through April 14, 2023).

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Why Pressure Drops as Water Flows in a Pipe and Other Irrigation Mysteries

Tricks to Irrigate More Evenly

The primary objective of an irrigation system is to distribute water to plants as uniformly as possible. Various devices such as sprinklers, micro-sprinklers, spray-stakes, and drippers are used to deliver this water to plants. However, most of these devices have a problem: they deliver larger volumes of water per minute when exposed to high pressure and lower volumes when exposed to low pressure. Water pressure in a pipe decreases the farther it travels through a pipe, so sprinklers connected to the beginning of the pipe receive more pressure than those connected to the end of the pipe. Consequently, the plants at the end of the pipe will receive more water than the plants at the beginning, leading to negative effects that we all know: over-irrigation of some areas, under-irrigation of other areas, production of runoff, compliance issues with water quality regulations, etc.

Irrigation engineers have devised two solutions to this problem. The first solution involves making sprinklers and drippers insensitive to pressure differences. Some drippers are designed to be "pressure compensating", which means they automatically adjust to varying pressures and apply the same volume of water within a wide range of pressures (from around 10 to 40 psi). If you use drip irrigation, I recommend installing pressure compensating (or PC) drippers. For sprinklers, you can achieve the same result by installing a fixed pressure regulator at each sprinkler head. The pressure regulator drops the pressure to a certain predetermined level. It is important to purchase pressure regulators that match the pressure recommended by the manufacturer of your sprinklers, and make sure that your pressure is never lower than that value (not even at the very end of the pipe).

Fig. 1. This sprinkler was equipped with a 20 psi pressure regulator.

What Causes Pressure Loss?

Water always loses pressure as it flows through a pipe. In fact, you can think about this in a different way: you can say that water moves because there is a pressure drop and so water moves from high pressure to low pressure.

The critical question is how significant shouldthis pressure loss be? And he answer to this question is the second engineering solution. If you can minimize pressure loss, your sprinklers or emitters will experience almost identical pressure, resulting in a more uniform water application. This takes us to the main mystery of this article: how to calculate pressure loss in a pipe and what factors influence it?

Allen Hazen was an American engineer who specialized in sewage and filtration systems. He, along with Gardner Williams came up with an equation to calculate pressure loss in pipes. Unlike other equations studied in college, such as those by Chezy, Poiseuille, Darcy, Pitot, Torricelli where we tried equally as hard to remember as we tried drinking to forget, the Hazen-Williams equation was more practical and it's still used today. This equation

Fig. 2 *Pressure compensating emitters called "Woodpeckers" are a popular choice to irrigate trees*

allows you to estimate pressure loss in psi based on several factors: 1) the pipe length; 2) the pipe diameter; 3) the flowrate of water in the pipe (measured in gallons per minute or gpm); 4) a factor that accounts for roughness of the pipe material.

Understanding the Hazen-Williams equation is crucial in designing an efficient irrigation system. I know we all became horticulturist because we hated math, but we can make sense of the equation below: L is the pipe length in feet, Q is the flowrate in gpm, C is a roughness coefficient that is 140 for PVC or polyethylene and the ID is the pipe inside diameter. Let's demonstrate what happens to pressure loss if we change just one component at a time.

$$PressureLoss\ (psi) = \frac{4.55\ L\ \frac{Q}{C}^{1.852}}{ID^{4.87}}$$

Let's begin with length, L. The length has no power exponent, so it is linearly related to the pressure loss. Pressure loss is directly proportional to the length of pipe. If we take one pipe and double its length, what happens to pressure loss? Pressure loss is doubled. For example, if I lose 3 psi in 50 ft of pipe, then I will lose 6 psi in 100 ft of pipe.

Let's take a pipe and only change the flowrate, Q. Q affects the pressure loss differently than L; the flowrate has an exponent of almost 2, so if the flowrate through the pipe is doubled, then the pressure loss increases by almost 4 times. For example, if I lose 3 psi with 60 gpm, I will lose 11 psi with 120 gpm.

Now let's look at the inner diameter (ID) of the pipe. First of all, ID is located in the denominator of the equation, so the larger the diameter, the smaller the pressure loss. This hopefully discredits the common misconception that by reducing the diameter of a pipe, one "squishes" the water and causes the pressure to increase. In reality, nothing causes the pressure to increase except for a pump or a drop in elevation. Reducing the pipe diameter will increase the velocity of water, but this increased velocity comes at a price by increasing friction, which leads to more pressure loss. If we decrease the diameter of one pipe and compare the pressure loss, then the smaller pipe would have more pressure loss. But more importantly, look at that exponent. The exponent is almost 5, meaning that increasing the diameter will exponentially reduce pressure loss. If I lose 3 psi with a 2-inch pipe, I will lose only 0.4 psi with a 3-inch pipe and almost 88 psi in a 1-inch pipe. This is why it's critical that you hire an irrigation professional who can size your irrigation system.

It is important to remember that the individual components combine to form the Hazen-Williams equation, and we have made certain simplifications in our description.

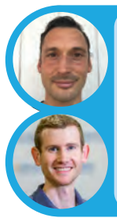
How To Minimize Pressure Loss

The obvious question now is: why don't we always use a large diameter pipe so that all these extension advisors will quit whining about pressure? The simple answer is that larger pipe is more expensive and larger trenches are required to install it. In practice, we often prioritize cost savings over appropriately upgrading or designing our irrigation systems. The length of pipe needed to transport water from one place to another is often a fixed distance so there is not an opportunity to affect L to minimize pressure loss. Flowrate is more complex. Remember, lowering flowrate reduces the amount of pressure loss, so does installing smaller nozzles or sprinkler heads produce a smaller flowrate in the pipe for those sprinklers? Yes, and this would cause a reduction in pressure loss in that pipe and thus more uniform irrigation. The problem is that you will have to run the irrigation system for a longer time, and we all know that in the summer this can be a challenge, particularly in nurseries. Irrigators don't particularly like waking up at 4 am and working until 9 pm, and nurseryman don't like paying overtime for those workers. Often, we see nozzle replacement occurring with the mentality that this will allow the whole nursery to be irrigated faster, but this causes larger pressure losses in the pipes and bad distribution uniformity.

In conclusion, to minimize differences in water received by your plants, pressure compensating drippers and pressure regulators are always your friends, and the Hazen-Williams equation allows you to predict how much pressure loss there will be in a pipe and thereby to properly size that pipe in order to minimize differences in pressure.

You can download an Excel spreadsheet with Hazen-William equation here:

https://ucanr.edu/sites/floriculturenursery/Irrigation/



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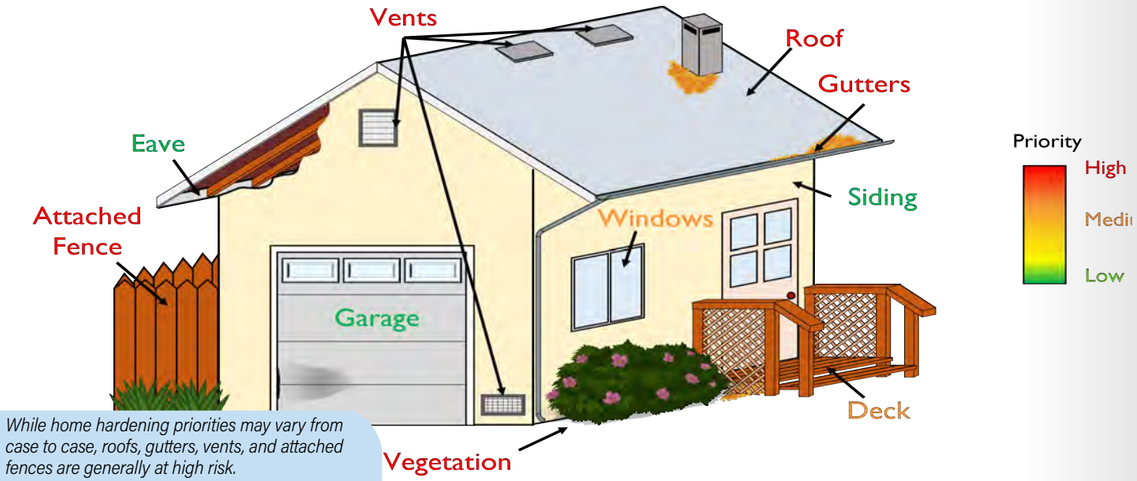
Are You Prepared For Wildfires?

The month of May was dedicated to wildfire awareness, but being prepared for a wildfire is an ongoing task throughout the year. We all have limited time and resources, and it can be overwhelming to think about all the possible things to do, but don't worry, there are ways to prioritize your actions, and some of them are inexpensive! You probably heard about defensible space and home hardening. The idea behind those strategies is to protect vulnerable components of your house and reduce the exposure to flames and ember ignition in your property. In general, it is a good idea to start with your home and the immediate vicinity (0-5 feet).

Where Do You Start?

The roof is usually the largest surface of your building, and it can easily collect embers during a fire. Are the roof intersections and gutters clean of leaves or debris? Those areas are vulnerable to ember ignition, so regular maintenance is key. What about your vents? By replacing the typical 1/4" mesh screen with 1/8" mesh metallic screen, you can significantly improve their ember resistance! Windows are also vulnerable components. Dual-pane windows are much more resistant to heat exposure, but replacing single-pane windows can be costly. As a temporary solution, you could prepare plywood sheets to cover the windows before evacuation. No matter what, it is important to remove flammable materials from the vicinity of windows, since the heat could shatter the glass and expose your home to flames and embers.

During a fire, embers are carried by the wind and tend to accumulate near your home. By removing all flammable materials from within 5 feet of your home, you will significantly



While home hardening priorities may vary from case to case, roofs, gutters, vents, and attached fences are generally at high risk.

reduce its risk of ignition. In places where mulch reaches the siding of the house or a fence, you could replace it with gravel or non-combustible materials. And if your fence is attached to your house, consider installing a metal gate or a non-combustible section to interrupt the potential fire path. What about vegetation? It depends! Some plants can ignite and burn better than others, but it's usually a combination of species, maintenance, and proximity to other plants or combustible objects that makes them dangerous. For example, by watering your plants, removing dead branches and twigs, and spacing them apart, you can reduce their risk of ignition or prevent the fire from reaching your home. If you have trees, the lower branches are more vulnerable to fire, especially if they have small plants nearby. A possible solution could be clearing the space around the tree.

These are just some of the preparedness actions you can take. For more information and resources, check out the UCCE website (https://ucanr.edu/sites/fire/).

You can also complete a 10-minute survey at: **https://bit.ly/WildfireSurveyUCANR** from UC Cooperative Extension advisors to help them better understand wildfire preparedness and impacts in California!

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4-H Fair Season Is Back!

The fair has been a well-loved tradition for many communities and San Diego County is no different. San Diego 4-H'ers can experience and exhibit at three different fairs, East County Junior Fair, Ramona Junior Fair, and the San Diego County Fair. Youth commit many hours to perfecting their projects. This could include but is not limited to yearlong animal projects like dairy goats, fine tuning their jam recipe, selecting the best picture from their photography project, or showcasing all the hard work they put into raising a market animal like a pig or steer.

This year marked the 75th year for the East County Junior Fair. The fair ran from May 12th to May 21st at the Lakeside Rodeo Grounds. The fair culminated in the Junior Livestock Auction on May 20th. The East County community came out to support the 4-H, FFA, and Grange members that participated through their Annual BBQ dinner and at the auction.

The San Diego Fair came and went with a blast! It started June 7th and ran through July 4th. This is one of the largest fairs in all of California. Youth from all over San Diego County exhibited animal and arts projects. The Junior Livestock Auction commenced on June 24th, 2023, where community members supported youth and their projects.

The last fair of the season is the Ramona Junior Fair. This fair will run from July 22nd to July 29th with the event culminat-ing in the Livestock Auction on July 29th. The Ramona Junior Fair is a community affaire like non-other. The local community has continued to support this fair through fundraising efforts like their Annual Pie Auction, with a jar of cookies that went for $1800, to patronizing food booths run by the local clubs and purchasing animals at the auction.

Fairs have always been an amazing way for the 4-H community to showcase all the wonderful youth development and personal growth opportunities it provides through experiential learning. Stop by and talk to a 4-H youth or parent at a fair and be ready to hear all about what they have learned about their project!

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4-H Youth Development Program

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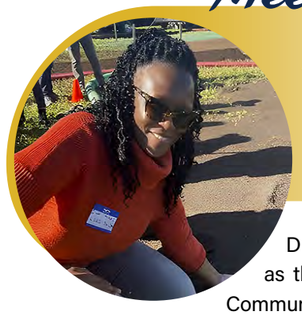
Meet the Team

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

Meet our Staff



Esther Mosase

Community Education Specialist

Dr. Esther Mosase joined ANR as the UC Cooperative Extension Community Education Specialist for Climate Smart Agriculture in February 2019.

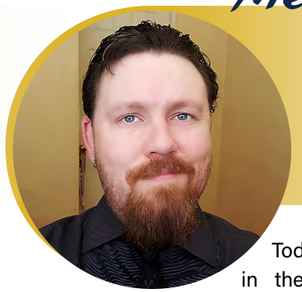
Mosase has a master's degree in Agricultural Engineering and a Ph.D. in Civil Engineering. Her master's and Ph.D. research focused on water resources, watershed modeling and management, and Remote Sensing engineering. She has also used GIS extensively throughout her career.

Raised in a farming family in Botswana, Mosase experienced the impact of climate change firsthand. "I remember we had drought, normal, and extremely wet years," she said.

In addition to helping farmers with the climate-smart farming grant applications, Mosase is helping farmers cope with water quantity and quality concerns.

"For instance, one farmer wanted to improve water quality at the edge of his avocado and citrus farm before it entered the stream. He also wanted to be helped with pools of standing water on the farm that usually affect the health of avocado trees," Mosase said. "We advised him on what to do regarding the standing water, but we partnered with him to research the effectiveness of bioreactors. The idea was to compare materials that can reduce irrigation water pollutants before reaching streams."

Meet our Staff



Todd Joseph Renstrom

Administrative Assistant 1

Todd Renstrom may be a new face in the UC Cooperative Extension office, but he comes from a strong pedigree of university work; his mother, Lori Renstrom, worked out of the San Diego office for 20 years, and recently retired. As one left, the other came right in.

Though he has only been with UCCE since August of 2022, he's done all he can to help out, from driving to Fallbrook to pick up plants for the Master Gardener fall plant sale, helping Admin staff clearing out the unused secondary office, or working with Advisors on mailing list projects and large-scale printing jobs. He is always ready to lend a hand and greet visitors to the office with a smile, and looks forward to a long, successful career with the UC. And who knows, maybe someday when he's ready to retire, if he has kids, one of them can come in and make it a Renstrom trifecta!

When he's not working, Todd is a self-professed nerd who enjoys Warhammer 40k, video games, and Dungeons & Dragons. He also loves nature, and is always up for swimming, snorkeling, or SCUBA diving off the beautiful San Diego coastline.

2023

Calendar

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

AUGUST

SDGE WILDFIRE SAFETY FAIR
- August 26th
- Valley Center, CA

LAST WEDNESDAY GROWERS MEETING
- August 30th
- San Diego County Farm Bureau, Virtual

SEPTEMBER

CANERS RESEARCH UPDATE MEETING
- September 6th
- San Diego County Farm Bureau, CA

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?

TAKE OUR SURVEY

Please consider subscribing to this quarterly newsletter and following us on social media!

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