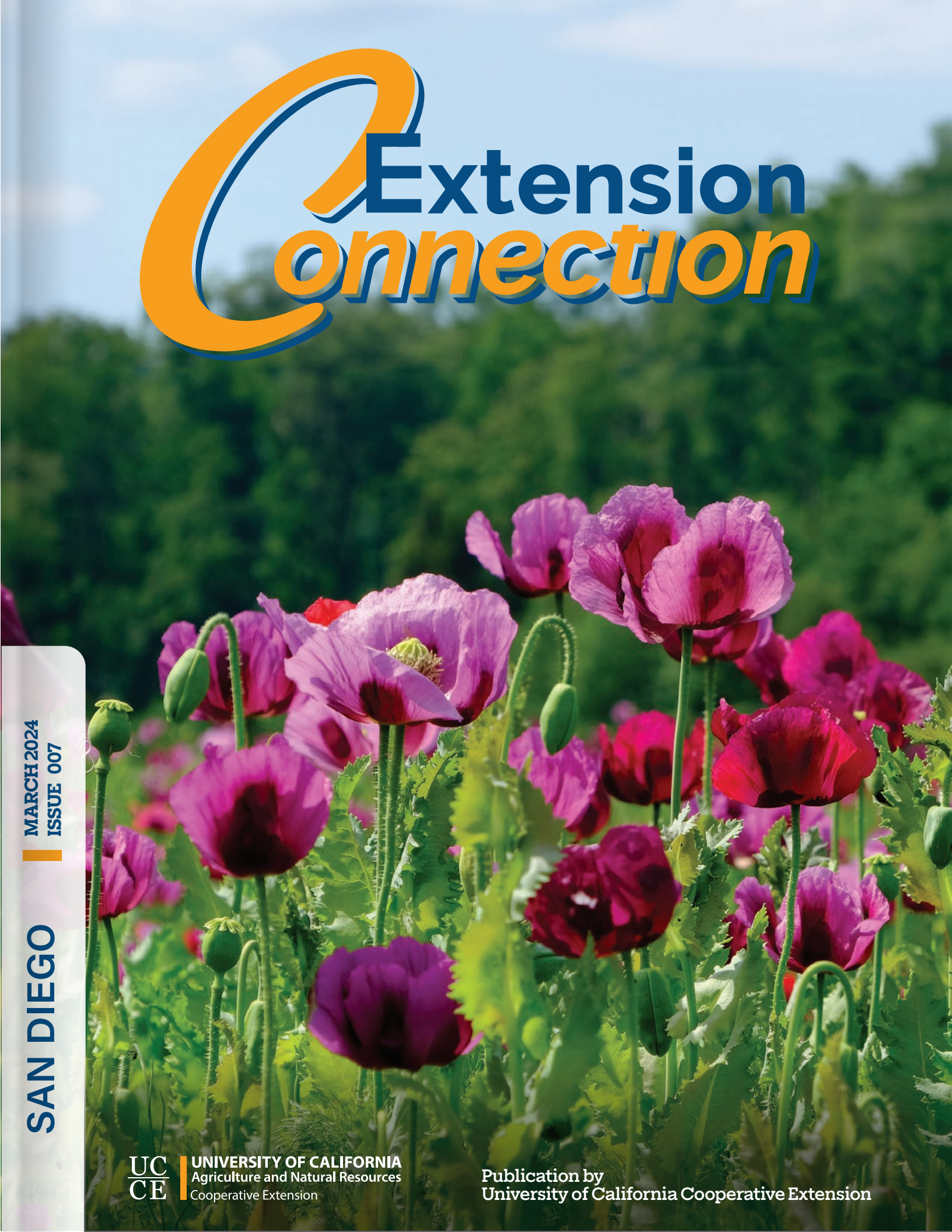
Extension Connection



SAN DIEGO

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QUARTERLY UPDATES FROM OUR

County Directors

Dear Readers,

With the rain we've been receiving across Southern California and San Diego lately, the hills are green and lush. So far this growing season, we've had two years of back to back above average rainfall. As it keeps raining, some parts of the county have received an average years' worth of rain before the year is up (the water year runs from October to September, coinciding with our dry season.) Despite the issues associated with it, rain is good for our groundwater, for farming, for the environment and for the landscape as we have lots of green all over the county.

Our UC Cooperative Extension office in San Diego County has experienced some growth as well and we are about to welcome two new advisor positions into our county. We have closed the search for a soil health and organic materials management position and an urban agriculture, environmental issues, and food systems position. We are excited to fill these new positions to help bring science-based solutions to address important, local issues in their areas of expertise. In addition, our team has also grown with the addition of three new staff members Lindsey Pedroncelli, Michael Jaquez, and Marilynn Click. Please join us in welcoming them by reading their biographic sketches included in this issue.

We are also growing the programs we offer to the public! We are happy to announce we have started a new Master Food Preserver Program to teach members of the public safe and effective methods of preserving food, which helps to ensure that you, your family, and your community have more access to healthy, delicious food. You can read more about the Master Food Preserver Program and the Community Education Specialist leading the program in this issue.

We hope you enjoy the articles in this quarterly newsletter on woodchip bioreactors, which are a great way to reduce runoff pollution, on whether African tulip trees harm pollinators, and about demonstrating urban agriculture.

Have a great Spring,

Chris and Ramiro
UC Cooperative Extension San DIego, Co-County Directors

Denitrifying Woodchip Bioreactors

By Gerry Spinelli and Chris Shogren

The name sounds extravagant, but denitrifying woodchip bioreactors, in their simplest form, are just a lined trench filled with woodchips through which agricultural drainage or runoff water slowly flows through under anaerobic conditions. The woodchips provide food for natural bacteria to convert nitrate in the water to harmless nitrogen gas. While research and adoption of woodchip bioreactors in Southern California is in the infancy stage, they have been used in the Midwest for over 20 years. Woodchip bioreactors are a new option that can help reduce the amount of nitrate in drainage water. These bioreactors are easy to build, cheap to maintain, and operate passively.

How do they work?

You and I, and all organisms in the animal kingdom are aerobic heterotrophs. A heterotroph is an organism that cannot produce its own energy and requires a food source (as opposed to plants which are autotrophs, which transforms light into an energy source). Aerobic means that we use oxygen in our metabolism. We use carbohydrates (that are reduced) as a donor of electrons to reduce oxygen (O_2, that is oxidized) turning it into water (H_2O). From this reaction we obtain energy for our metabolism. There are some bacteria that can use a different oxidized compound (other than oxygen) as an acceptor of electrons for their metabolism. These bacteria use nitrate (NO_3^-) and reduce it to molecular nitrogen (N_2) that is gaseous, inert and harmless. A woodchip bioreactor creates the right conditions for these naturally occurring denitrifying bacteria to do what they're good at: using nitrate and transforming it into molecular nitrogen. For bioreactors to harness the benefits of denitrifying bacteria two things are needed: a source of carbon and anaerobic conditions. Woodchips are a cheap and readily available source of carbon, and anaerobic conditions are ensured as long as the water level remains high enough to continuously cover most of the woodchips. Generally, bioreactors are also lined to prevent high nitrogen water from infiltrating into the groundwater, but this is not necessary for their function.

How much nitrate can they remove?

The amount of nitrate removed from the water depends on several factors including retention time, water temperature, and age of bioreactor. Because denitrification is a biological process, the bacteria need time to feed and remove nitrate. For example, water that is retained in the bioreactor for 8 hours will have less nitrate removed compared to water retained for 24 hours (standard retention time). Water temperature also greatly influences how well the bacteria can do their job. Cooler temperatures slow the denitrification process. Fresh woodchips supply the bacteria with more carbon to feed on, thus removing more nitrate. The initial performance of bioreactors can be misleading and should be designed with long term performance in mind. As a reference, in the study conducted in the Salinas Valley linked at the end of this article, nitrogen concentration reductions by the bioreactor ranged from 5 mg/liter of nitrate-nitrogen in winter to up to 10 mg/liter of nitrate-nitrogen in summer.

How much water can they treat?

The amount of water that can be treated is determined by the size and design of the

bioreactor and assumes that there is no preferential flow through the woodchips. To begin our calculation of how much water can be treated we start with the porosity of the woodchips. The porosity of the woodchips is fairly easy to measure. For example, one can fill a 5-gal bucket with woodchips, then add water until the bucket is full, then measure the volume of water added. A good reference value for woodchip porosity is 70%. One can calculate the volume of the trench and multiply it by the woodchip porosity to calculate the volume of water in the bioreactor. Let's say the trench is 20 ft long, 5 ft wide, and 5 ft deep on average. That gives us a volume of 500 ft^3 or 3,740 gallons. If the woodchips porosity is 70%, then the bioreactor can hold 3740*0.7=2,618 gallons. If we want the water to go through the bioreactor for 24 hours, or 1,440 minutes, then this bioreactor can treat 2,618/1,440 = 1.8 gpm. This seems like a small amount, but the bioreactor works 24/7, while your agricultural operation produces runoff or tile drainage discontinuously.

What maintenance do they require?

Woodchip bioreactor maintenance is minimal. Since the woodchips need to remain submerged under water to create the anaerobic conditions for the bacteria, adjustable weirs located at the inlet and outlet of bioreactor are used to manage water flow and maintain the water level in the bioreactor. If the flowrate entering the bioreactor changes substantially, it is recommended to adjust the weirs accordingly. The woodchips slowly degrade over time due to microbial activity and will eventually need to be replaced. Woodchip breakdown time varies based on many factors, including the waters average temperature and nitrate concentration. In the studies conducted in the Salinas valley, referenced below, authors found that 10% of woodchips needed to be added annually, but they cite a study where woodchips in the saturated layer lasted >30 years. This aligns with the study conducted in the Midwest referenced below where woodchips showed lifespans between 15 to 20 years under optimal conditions before they need to be replaced.

How much do they cost?

The main costs associated with installing a woodchip bioreactor are excavation, inflow control structures, liner, and woodchips. Total cost will vary by site, but this article from 2021 reports installation costs ranging from $6,940 to $11,820 in the Midwest. Bioreactors are eligible for financial assistance through the NRCS

Environmental Quality Incentives Program (EQIP) which may provide a one-time installation payment or free design and engineering.

Can you use them in California?

There are no regulations prohibiting the use of woodchip bioreactors in California. That being said, the unincorporated area that is regulated by the County of San Diego Water Quality Program and many other areas throughout the state, have water quality regulations that prohibit the discharge of agricultural runoff. This limits the use of bioreactors (and other technologies such as activated carbon filters to remove neonicotinoids). Local water quality jurisdictions may have different regulations and it is recommended that you contact them before starting any major project.

Where can you get more information?

Contact your local UC extension advisor, Gerry Spinelli (San Diego) or Chris Shogren (Los Angeles). This article from UC extension advisors in the Salinas Valley provides an on-farm example of how much nitrate can be removed from water. The YouTube video from the Minnesota NRCS here shows the construction and importance of bioreactors. The website from Purdue engineering here has some useful links. The NRCS code which lists bioreactors as a conservation practice can be found here and the EQIP page can be found here.

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Small-Scale Urban Agriculture Demonstration Site

By Lindsey Pedroncelli

Eric Middleton, Jan Gonzales, Ramiro Lobo, and I are working on a project assessing the feasibility of growing several high value crops in Southern California. With our demonstration site at the Carlsbad Flower Fields, we aim to show how best to grow blueberries, ginger, and turmeric in containers in small-scale, urban settings, such as backyards or vacant lots, in Southern California

Growers and aspiring farmers in San Diego County have expressed interest in using new growing techniques, expanding into urban areas, and diversifying their farming operations, but oftentimes they are lacking the resources to set up these operations in the most profitable way. Additionally, the inaccessibility and high cost of land and inputs are often prohibitive to trying out new techniques. We aim to address this need at our urban agriculture demonstration site where we are evaluating the best ways to grow high value crops in small-scale, urban settings in Southern California.

We chose to grow blueberries, ginger, and turmeric because they are relatively easy to grow perennial plants that yield high value products. Increasing this profit margin will help to offset the high costs associated with obtaining land and starting a farming operation in Southern California. Blueberries have successfully been grown in Southern California, but to our knowledge, ginger and turmeric have not

been grown in the region on this scale. We are testing ginger and turmeric production practices developed in Hawaii, Florida, and Virginia, and blueberry production practices from the Pacific Northwest to assess how they can be adapted to the Southern California region. All three crops are being grown in containers, which helps to make the farming operation mobile and eliminates the risk of planting in infertile or contaminated soil. Plants are being grown either outdoors or under high tunnels, which can help control temperature and sun exposure. We are testing out two high tunnel designs: a kit with steel hoops, and a "DIY" design with PVC hoops. For all three crops, we are conducting a survey of the pests and diseases that affect these crops and will establish scale-appropriate integrated pest management guidelines. We are also testing several fertilizer regimes and cultivation techniques.

To evaluate which varieties grow best and produce the highest yield, we are growing several blueberry, ginger, and turmeric varieties at our demonstration site. The three main blueberry varieties are 'Snowchaser', 'Misty', and 'Star', and we are also growing 'Farthing', 'Meadowlark', 'Sunshine Blue', 'San Joaquin', and 'Jubilee'. The three main varieties have different seasonality, meaning they will produce fruit at different times during the season. We are eager to see if growing these three varieties will help to extend the growing season. Fruit from each plant will be harvested and weighed weekly to track yield. We are growing traditional yellow ginger (*Zingiber officinale*) and orange turmeric (*Cucurma longa*), and we also have several other varieties including black turmeric, blue turmeric, yellow turmeric, green turmeric, mild white turmeric (mango ginger), spicy white turmeric (*Cucurma zedoaria*), galangal Thai ginger, lesser galangal Thai ginger, shampoo ginger, and spiral ginger. Ginger and turmeric will be harvested in the fall and each plant will be weighed to track the yield.

We will create a production guide detailing each step that should be taken to set up and make a profit from an operation like this. We will include everything from where to buy a high tunnel kit and how to build it, to what containers and growing media to use, which varieties to grow, where to source plants, how often to irrigate and fertilize, and how to manage pests and diseases. There will also be guidance on selling and marketing the products, and how to participate in agritourism.

Building the site ourselves has allowed us to experience first-hand the challenges that arise when starting a farming operation at this scale. One of the first challenges was finding where to buy our starting plant material. Additionally, when we began building the site, we found that the soil was too compact to drive ground posts into, so we had to figure out how to drill into the ground to secure our high tunnels. We had to prepare for and deal with the aftermath of several rainstorms, which shifted our site prep timeline. Building the steel high tunnel tested our strength, but we are excited to see how it compares to a PVC high tunnel, which was much easier to build. We have been presented with fantastic learning experiences every step of the way, all of which will be translated into our production guide.

Our demonstration site is located at the Flower Fields in Carlsbad and will be open for guided tours starting in March of 2024. Our website will be up and running soon, but please feel free to contact us via email if you are interested in scheduling a tour.

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Do African Tulip Trees Harm Native Pollinators?

By Eric Middleton

African tulip trees (*Spathodea campanulata*) are originally native to tropical dry forests in Africa but are now a common ornamental in parts of Southern California. They are frequently found in parks and residential yards and are easily recognizable by their large red, orange, or yellow trumpet-shaped flowers. The trees bloom in late summer and early fall and can grow quite large (up to 80 ft), although smaller trees are also common.

Despite their beauty, African tulip trees may be hiding a deadly secret. Previous studies from Brazil have found that the nectar of these trees may be toxic to some insects, and numerous dead arthropods have been found inside the flowers. In particular, this seems to be a problem for native stingless bees in Brazil. Similar effects have also been reported from Australia, where native stingless bees have been found dead inside the flowers of African tulip trees. In both countries, the trees appear actively detrimental to at least some species of native pollinators.

African tulip trees with both orange and yellow flowers growing in Mission Valley, San Diego

This begs the question: Do African tulip trees in Southern California harm our native pollinators? No studies have been published on the effects these trees have on native pollinators in California, and the concern is that California native bees can be attracted to and then killed by the flowers.

To begin to answer this question, I located multiple African tulip trees around San Diego and checked their flowers for dead insects during late summer and early fall of 2022 and 2023, with most of the effort taking place in 2023. Several UC Master Gardener volunteers across San Diego and Orange counties also checked African tulip trees around where they live and added to the data collection effort.

We found multiple dead native bees and numerous other dead insects inside African tulip tree flowers. In total, we sampled ~50 trees, checked ~9,500 African tulip tree flowers, and found a total of 1,214 dead insects inside, including 241 dead bees. Almost all the bees were tiny native bees in the genera *Halictus* or *Lasioglossum*. From our results so far, it seems like African tulip trees may pose at least some threat to our native bees.

Several dead Halictus bees found inside a single African tulip tree flower

However, the number of dead bees we found in flowers seemed to vary a lot by location and by time of year. For example, I found 84 dead native *Halictus* bees in a single day in a single small African tulip tree in Mission Bay in late August 2023. On the same day, numerous other African tulip trees within a couple hundred feet had no dead bees in their flowers. Additionally, we found the most dead bees right at the end of August, with fewer and fewer being found later on in the season. Time and place appear to matter quite a lot for how much these trees impact pollinators.

For 2024, I'd like to organize a more thorough and consistent sampling effort. With that information, we can better understand where and when African tulip trees are an issue and determine how best to move forward. For now, we don't have enough information to say with certainty that African tulip trees are a real threat to our native bees, only that they can sometimes be a problem in certain locations.

Stay tuned for updates on this research once the African tulip trees start blooming again this year! In the meantime, if you have African tulip trees in your yard or in parks close to where you live, take a look inside the flowers. You just may find some dead bees or other insects.

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New Master Food Preserver Program

By Marilynn Click

New to San Diego County, we are proud to introduce our UC Master Food Preserver Volunteers. In today's world (with a growing focus on sustainability, self-sufficiency, and healthy living), preserving food has never been more important. Our program empowers individuals with the knowledge, skills, and confidence to become experts in the art and science of food preservation.

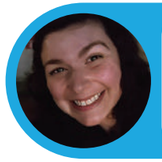
Imagine a community where surplus fruits and vegetables from backyard gardens and local farms are transformed into delicious jams, pickles, and canned goods; therefore, reducing food waste and providing nutritious options year-round. This is the vision behind the Master Food Preserver Volunteer program.

Through hands-on training, expert-led workshops, and comprehensive educational resources, volunteers learn safe science-based methods for canning, freezing, drying, and fermenting a wide variety of foods. In turn,

they become trusted advisors within their communities, continuing to share their expertise and promote safe food preservation practices.

The Master Food Preserver Volunteer program is more than just preserving food. It is about building connections, fostering resilience, and empowering individuals to take control of their food supply in a sustainable and environmentally friendly way. We hope to see you at an upcoming workshop or presentation. Together, we can make a tangible difference in our community's food landscape.

Contact us at mfpsd@ucanr.edu or visit our website at https://ucanr.edu/sites/MFPSDC/



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Bread and Butter Pickled Jicama

14 cups cubed jicama
3 cups thinly sliced onion
1 cup chopped red bell pepper
4 cups distilled white vinegar (5%)
4½ cups white sugar
2 tablespoons mustard seed
1 tablespoon celery seed
1 teaspoon ground turmeric

Yield: About 6 pint jars

1. Wash and rinse pint canning jars; keep hot until ready to use. Prepare lids according to manufacturer's directions.

2. Combine vinegar, sugar and spices in a Dutch oven or large saucepot. Stir and bring to a boil. Stir in prepared jicama, onion slices, and red bell pepper. Return to a boil, reduce heat and simmer 5 minutes. Stir occasionally.

3. Fill hot solids into clean, hot pint jars, leaving ½-inch headspace. Cover with boiling hot cooking liquid, leaving ½-inch headspace. Remove air bubbles and adjust headspace if needed. Wipe rims of jars with a dampened clean paper towel; apply two-piece metal canning lids.

4. Process in a boiling water canner according to the recommendations in Table 1. Let cool, undisturbed, 12-24 hours and check for seals.

Table 1. Recommended process time for Bread and Butter Pickled Jicama in a boiling-water canner.

		Process Time at Altitudes of		
Style of Pack	Jar Size	0 - 1,000 ft	1,001 - 6,000 ft	Above 6,000 ft
Hot	Pints	15 min	20 min	25 min

Developed at The University of Georgia, Athens, for the National Center for Home Food Preservation
Released by Elizabeth L. Andress, Ph.D., Department of Foods and Nutrition, College of Family and Consumer Sciences. March 2003.

This material is based upon work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Agreement No. 00-51110-9762.

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

Lindsey Pedroncelli, Ph.D.
Staff Research Associate 2

Lindsey grew up in Sonoma County, California, and has been fascinated by plants her whole life. She earned a B.S. in Microbiology from Cal Poly, San Luis Obispo and a Ph.D. in Plant Pathology from University of California, Riverside, where she developed a passion for agriculture and science communication. She began working as a Staff Research Associate with UCCE San Diego in September of 2023 and is currently helping to develop best practices for growing blueberries, ginger, and turmeric in small-scale urban settings in San Diego County. She enjoys helping growers manage plant diseases while also educating the public about where their food comes from.

Meet our Staff

Michael Jaquez
Community Education Specialist III

Michael Jaquez is our newest Community Education Specialist with the Climate Smart Agriculture team at University of California Agriculture and Natural Resources. Based in San Diego County, he is excited to create connections with local farmers and growers and provide technical assistance to increase the use of climate smart agricultural practices. Michael obtained a B.S. degree in Animal Science with a minor in Dairy Science from California Polytechnic State University, San Luis Obispo and later returned to Cal Poly to complete a M.S. degree in Agricultural Education. As a San Diego native, Michael has spent time within the dairy industry, worked as an agricultural educator and FFA Advisor, and helps with his family's regenerative meat and egg farm located in Ramona, Three Sons Farm.

2024

Calendar

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

APRIL

COC DEMO GARDEN LUNCH & LEARN
- April 3rd, 12 PM - 12:30 PM
- County Operations Center, Courtyard
- Link to event page

CHULA VISTA EARTH DAY, MG TOOL CARE
- April 13th, 11 AM - 3 PM
- Chula Vista Bayfront Park
- Link to event page

CORONADO FLOWER SHOW, MG TOOL CARE
- April 20th, 1 PM - 4:30 PM
- Spreckels Park
- Link to event page

LAST WEDNESDAY MEETING
- April 24th, 1 PM - 2 PM
- San Diego County Farm Bureau, Virtual
- Link to event page

MAY

COC DEMO GARDEN LUNCH & LEARN
- May 1st, 12 PM - 12:30 PM
- County Operations Center, Courtyard
- Link to event page

MASTER GARDENERS SPRING GARDEN EXPO
- May 4th, 9 AM - 3 PM
- Home Depot, 7530 Broadway, Lemon Grove
- Link to event page

MASTER GARDENERS SPRING GARDEN EXPO
- May 18th, 9 AM - 3 PM
- College Area Community Garden, near SDSU
- Link to event page

LAST WEDNESDAY MEETING
- May 29th, 1 PM - 2 PM
- San Diego County Farm Bureau, Virtual
- Link to event page

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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