California Plant and Soil Conference

Tuesday-Wednesday, February 6-7, 2024

DoubleTree by Hilton Fresno Convention Center

Are We Ready? Adapting Agronomy to an Uncertain Future

Book of Abstracts

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UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

American Society of Agronomy
California Chapter

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California Chapter – American Society of Agronomy

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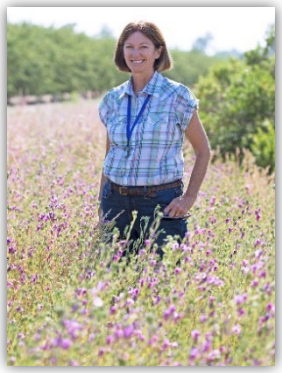
California Chapter Honorees

YEAR	HONOREE	YEAR	HONOREE	YEAR	HONOREE
1973	J. Earl Coke	1998	Bill Isom		Terry Prichard
1974	W.B. Camp		George Johannessen	2013	Harry Cline
1975	Ichiro “Ike” Kawaguchi	*1999*	Bill Fisher		Clyde Irion
1976	Malcom H. McVickar		Bob Ball		Charles Krauter
	Perry R. Stout		Owen Rice	2014	Gene Aksland
1977	Henry A. Jones	2000	Don Grimes		Kerry Arroues
1978	Warren E. Schoonover		Claude Phene		Stuart Pettygrove
1979	R. Earl Storie		A.E. “A1” Ludwick	2015	Bob Beede
1980	Bertil A. Krantz	2001	Cal Qualset		Carol Frate
1981	R.L. “Lucky” Luckhardt		James R. Rhoades		Allan Romander
1982	R. Merton Love	2002	Emmanuel Epstein	2016	Larry Schwankl
1983	Paul F. Knowles		Vince Petrucci		Scott Johnson
	Iver Johnson		Ken Tanji		Joe Fabry
1984	Hans Jenny	2003	Vashek Cervinka	2017	Ron Brase
	George R. Hawkes		Richard Rominger		Ken Cassman
1985	Albert Ulrich		W.A. Williams		William Peacock
1986	Robert M. Hagan	2004	Harry Agamalian		Oliberio Cantu
1987	Oscar A. Lorenz		Jim Brownell	2018	Timothy K. Hartz
1988	Duane S. Mikkelsen		Fred Starrh		Peter B. Goodell
1989	Donald Smith	2005	Wayne Biehler		José I. Faria
	F. Jack Hills		Mike Reisenauer	2019	Jim Ayars
1990	Parker F. Pratt		Charles Schaller		Mary Bianchi
1991	Francis E. Broadbent	2006	John Letey, Jr.		Gene Miyao
	Robert D. Whiting		Joseph B. Summers	2020	Louise Jackson
	Eduardo Apodaca	2007	Norman McGillivray		Steve Orloff
1992	Robert S. Ayers		William Pruitt		Steve Wright
	Richard M. Thorup		J.D. Oster	2021	Keith Backman
1993	Howard L. Carnahan	2008	V.T. Walhood		Marsha Campbell
	Tom W. Embelton		Vern Marble	2022	Bruce Robert
	John Merriam		Catherine M. Grieve		Blake Sanden
1994	George V. Ferry	2009	Dennis Westcot	2023	Bob Hutmacher
	John H. Turner		Roland Meyer		Brock Taylor
	James T. Thorup		Nat Dellavalle		David Zoldoske
1995	Leslie K. Stromberg	2010	L. Peter Christensen	2024	Rachael Freeman Long
	Jack Stone		D. William Rains		Shannon C Mueller
1996	Henry Voss	2011	Blaine Hanson		Richard Smith
	Audy Bell		Gene Maas		
1997	Jolly Batcheller		Michael Singer		
	Hubert B. Cooper, Jr.	2012	Bob Matchett		
	Joseph Smith		Don May		

2024 Honorees

Rachael Freeman Long

Presented by Sarah Light



Rachael Freeman Long

Rachael grew up in Berkeley, California but was fascinated by farming. She's the daughter of a UC Berkeley biology professor and graduate of UC Berkeley with a B.S. in biology and an M.S. in entomology from UC Davis. She's always been interested in wildlife, conservation biology, and natural history. Her interest in agriculture was likely inspired from spending summers as a kid with family in Sonoma County, surrounded by vineyards.

As a UC Cooperative Extension farm advisor and county director, Rachael has spent the past 37 years doing research on crop production, pollination, and pest control, in collaboration with farmers. What sparked her interest in working in agriculture was hearing a farm advisor talk about integrated pest management programs on farms, when she was in college. She found that so inspiring that she changed her major from pre-med to agriculture, a decision that was not only great for her career, but she met her husband through work, and currently lives on a farm in the Woodland, CA area.

Before settling in Yolo County as a farm advisor in 1992, Rachael worked with UCCE in Sonoma and San Joaquin counties as well as at UC Berkeley, overseeing projects in fruit and nut crop production. As a farm advisor in Woodland, in the Sacramento Valley, she focused on field crops, including alfalfa hay and other forages, dry beans, and hybrid seed crops, such as sunflowers, melons, and onions. She retired July 1, 2023, after serving growers in Yolo, Solano, and Sacramento counties for 31 years.

Rachael's research on crops, pollination, and pest control guide farming practices statewide. To produce practical research results, Rachael collaborated on studies with farmers and colleagues for decades. Her field studies informed the alfalfa, sunflower, onion seed, lima bean, garbanzo, common bean, and blackeye production manuals that she authored. Cost-of-production reports on alfalfa, sunflowers, and dry beans that she wrote have been used by growers for obtaining farm loans. Rachael's research and extension of integrated pest management practices have resulted in enhanced biodiversity, reduced pesticide use, higher crop yields, healthy soils, carbon sequestration, and greater farm productivity and profitability. She was the recipient of the Bradford Rominger Agricultural Sustainability Leadership Award in 2019.

Since her start in 1986, technology has changed rapidly in agriculture, which she called, "challenging and exciting." She worked extensively with farmers over the years, learning about global positioning systems (GPS), subsurface drip, and healthy soils practices. Knowledge gained helped with developing and implementing her research and outreach programs. For example, for a recent project addressing labor shortages, she developed research-based guidelines for growers to use spray drones to control pests in alfalfa hay production. Rachael's work in the late 1990s documented how pesticides were transported offsite from farm fields in surface irrigation water. At the time, the agricultural industry was concerned the results would prompt increased regulations and restrictions on farming practices. But she persisted and her research led to the development and adoption of practices – such as pesticide choice and

vegetative filter strips including cover crops – that are now commonly used to protect surface waters from pesticides used on farms.

Rachael's work on hedgerows of native flowering plants on field edges showed increased natural enemy and bee activity on farms for enhanced pollination and pest control services in adjacent crops, reducing pesticide use and boosting yields. Her studies also revealed that hedgerows sequester 36% more carbon than farmed areas, helping scientists figure out ways to reduce our carbon footprint. As a result of her work, hedgerows are now by far the most applied-for conservation practice used by farmers and landowners through the USDA Natural Resources Conservation Service cost-sharing programs across the state.

Rachael also worked on bats and pest control, documenting the importance of insectivorous bats for providing biocontrol of pests in croplands, making bats a valuable ally for farmers. As a result of her work, the pallid bat was recently listed as our state bat, joining the ranks of other icons such as the California quail, a win for bat conservation.

Rachael says, "I'm proud of my community and appreciated the opportunity to work with farmers, and the privilege of conducting research on farms. I'll forever be grateful to landowners for their support of my projects, even ones that seemed so far out there, like studying bats and pest control in walnut orchards!" She appreciates all the mentors she's had over the years, including colleagues, Pest Control Advisors, and farmers. She notes that one of the most enjoyable parts of her job was mentoring and working with students on crop production studies. She's proud that many of her students have gone on to pursue productive careers in agriculture and natural resource conservation. She attributes the success of her program to teamwork, institutional knowledge, and focusing on common ground, that is, areas of shared interest and needs, like pollinator conservation.

Rachael, who received prestigious emeritus status from UC Agriculture and Natural Resources is still finishing up some research projects. As a scientist, she's also committed to piquing children's interest in science. She has published three children's books chronicling a boy's adventures with wildlife, based on stories she told her own son, Eugene. Rachael recently published a new book series, starting with 'See You Later, Alligator' (Yorkshire Publishing) that's also available online as a storymap (zamorastories.com). In retirement, she's enjoying having more time to write kids' books focusing on science literacy and wildlife conservation. Stay tuned for her next book, B is for Bees.

Shannon C. Mueller

Presented by Carol Frate

Shannon C. Mueller

Shannon was born on the agricultural side of the Cascades in Yakima, Washington. It is not surprising, as her father was in the ag chemical business, that her family eventually settled in California's San Joaquin Valley where she attended elementary and high school in Visalia. Following her graduation, Shannon pursued her education at UC Riverside, interested in majoring in some aspect of science. A course in botany inspired her to obtain her B.S. degree in Plant Science in 1981. She continued her studies at Cornell University obtaining a M.S. in Agronomy and Plant Breeding in 1984. She stayed at Cornell working on a Ph.D. and adding a minor in Animal Nutrition. On one of her visits home, Shannon met with UC Cooperative Extension farm advisors and discovered that the combination of applied research and extension was very appealing. When an agronomy Farm Advisor position opened in Fresno County, she applied and was hired in 1988 with responsibilities for alfalfa hay and seed, dry beans, oilseed crops, and bees and pollination.

Throughout her 31-year career, Shannon exemplified professionalism on every research project, extension effort, committee, advisory board, or workgroup with which she was involved. She was an excellent collaborator with county and campus colleagues from UC, USDA researchers, farmers, industry, commodity groups, and experts beyond state borders. When she accepted a request or responsibility for a task, it was always done well and completed on-time.

Shannon led and collaborated on many research and extension projects that provided important information on a wide spectrum of production issues to assist growers in their farming operations. These trials included stand establishment, plant nutrition, and harvest/storage management in alfalfa hay; disease management, planting date, fertilization, and irrigation in garbanzo beans; and pest control, disease management, irrigation, and row spacing in blackeyes. Alfalfa seed production was the primary focus of much of her research program. Over the years, she conducted trials on various aspects of pest management, dodder control, irrigation, desiccation and pollination. When the vegetable crops farm advisor position in Fresno was vacant for an indefinite period due to budget issues, Shannon filled in for several years conducting trials on white rot of garlic and on melon varieties while maintaining her responsibilities in agronomic crops. In addition to research reports, she authored or co-authored numerous publications and proceeding articles including the UC publications "Key Features of Common Lygus Species in the Central San Joaquin Valley" and "A Field Key to Lygus Species of the Central San Joaquin Valley."

The results of Shannon's work with alfalfa seed and pollination resulted in practices used to this day. California is a major producer of alfalfa seed, and production is centered in two areas of the state, Fresno and Imperial counties. Pollination by insects is critical to seed production and honey bees were the only managed bees used for pollination. However, they are inefficient pollinators of this crop due to the anatomy of the alfalfa flower and because honey bees prefer the nectar and pollen of other crops. Also, there were growing concerns about the future availability of honey bees, as the Africanized Honey Bee had moved into California and was expected to disrupt the commercial pollination industry.

Although efforts to use alfalfa leafcutting bees in the past had failed, Shannon spearheaded and coordinated a collaboration among university researchers, growers, and seed companies to re-evaluate if leafcutter bees could successfully maintain or increase seed yields.

Consulting with leafcutter bee experts from the Pacific Northwest and Canada where these bees are commonly used for seed production, Shannon and her collaborators focused on the biology of leafcutter bees and ways to manage them under the high summer temperatures of the San Joaquin Valley and the intense insecticide regime needed to control lygus bugs. Various domiciles and nest materials were evaluated along with population density and distribution. In order to determine whether the bees could be forced into diapause to maintain generations from year to year, leafcutter bee larvae were collected during the season and exposed to different temperature regimes before being returned to the field. The samples were x-rayed at UC Davis to monitor development following the temperature treatments.

Unfortunately, the treatments were ineffective and growers must purchase bees on an annual basis. Today leafcutter bees are commonly used in commercial fields to augment pollination by honeybees.

Another major contribution to the alfalfa seed industry was the research conducted by Shannon, Dr. Larry Teuber (UC Davis), and Dr. James Hagler (USDA - Arizona) on gene transfer between alfalfa seed fields by honey bees, specifically how far GMO traits might be carried from one seed field to another field of a conventional, non-GMO variety. This work entailed marking bees with distinctly colored fluorescent powders as they exited a hive and collecting the bees from up to 5 miles away. Information from these studies was critical to establishing buffer zones between seed fields planted with varieties containing GMO traits and fields with non-GMO varieties. It also provided the basis for Imperial County growers to agree to plant only non-GMO varieties, as the necessary distance to prevent introduction of GMO traits into alfalfa seed fields of non-GMO varieties was unworkable in their situation, and export markets were not open to GMO varieties at that time.

Because of Shannon's work with honey bees in alfalfa, she became involved with honey bee pollination issues in almonds. As rental fees increased due to limited supplies of honey bees for pollination, colony strength evaluations became increasingly important.

Growers wanted to make sure they were getting what they paid for in terms of strong colonies for pollination, and beekeepers wanted to make sure they were fairly compensated for maintaining and renting strong colonies. To understand the needs and problems of both farmers and bee suppliers, she established and maintained hives at the UC Kearney Agricultural Research and Extension Center. Working with UC apiculture specialist Eric Mussen and local beekeepers, she developed a uniform protocol for evaluating the strength of hives and an on-line training course on "Honey Bee Colony Strength Assessment" for apiary inspectors and beekeepers.

Throughout her career, she served on numerous county, state, and regional Boards and Committees. She was the liaison to the Alfalfa Seed Production Research Board from 1990-2019, the California Crop Improvement Association Board from 2009-2019, and the Western Extension Leadership Development program from 2008-2019.

In the last 10 years of her career, Shannon was County Director first of Fresno County and then of the Multi-County Partnership of Fresno/Madera counties. This was not so much by choice as by necessity. During this time she successfully oversaw the hiring of at least 8 farm advisors, a significant number

during a period of tough budget restrictions and strong competition among county extension offices for filling vacancies.

Now that she is retired, Shannon enjoys quilting and traveling. She has been to New York, Oregon, Washington, Arizona, Southeast Asia, France, Ireland, and Italy with more trips planned in the coming year. She also enjoys taking early morning walks with her husband Dave Vaughn and their dog Bones.

Richard Smith

Presented by Michael Cahn

Richard Smith

Richard Smith was born February 26, 1954, in Watsonville CA. He grew up with two brothers and two sisters. His father, William, was a retired captain in the US army and veteran of both WWII and the Korean War and worked in plumbing. His mother, Elizabeth, managed the household and worked in various jobs. Richard attended Watsonville high school and during afternoons and summer months worked in an array of agricultural jobs including pruning trees, picking apples, apricots and berries. Unlike many of his friends, Richard recalled enjoying working on farms and with plants which prompted his interest in studying botany at California State University Sonoma.

After graduating with a bachelor's degree Richard spent a year in Guatemala where he participated in an NGO group helping the local population recover from a major earthquake. He worked in the hospital laboratory and during his stay in Guatemala met visiting UC Davis students who were conducting field studies on potatoes. Impressed by their research and knowledge, Richard decided to enroll in a Master's program in the Agronomy Department at UC Davis after returning from Central America in 1981. After graduating with his Master's degree in 1985, Richard entered the farm advisor internship program, first working under the supervision of Bob Mullen in San Joaquin County, and later for Wayne Schrader in San Diego County, both of whom were vegetable crop advisors. In 1987, Richard was hired as a UC vegetable crop farm advisor in Stanislaus County, and in 1989, he transferred to San Benito County where he became the small farm advisor.

Richard's research in San Benito County had a major focus on vegetables, where he worked on important plant diseases including garlic rust and powdery mildew in peppers. In 1999, Richard transferred to Monterey County where he became the vegetable and weed science advisor. His research and extension program covered Monterey, Santa Cruz, and San Benito counties, and had a strong focus on nutrient management of vegetables, but also conducted research on weed control on vegetable crops produced in the region.

Richards early collaborations were with Louise Jackson, who was the UC Davis Cool Season vegetable specialist stationed at the USDA-ARS station in Salinas. They worked on understanding the nitrogen cycle in vegetable systems and evaluated strategies of using winter cover crops to reduce nitrate leaching losses. Subsequent to Louise leaving Salinas, Richard began a long collaboration in vegetable nutrient research with Tim Hartz, UC Davis vegetable crop specialist. Highlights of their work together included evaluating tools such as the soil nitrate quick test and petiole sap analysis for in season monitoring of crop N status. They investigated calcium deficiency in lettuce, determined the nitrogen uptake pattern of a range of vegetable crops, and evaluated the efficacy of controlled release fertilizers and nitrification inhibitors.

Another important collaborator was UC Davis Weed Specialist, Steve Fennimore. Their work together helped with the registration of new herbicides and later helped bring in new technologies into the Salinas Valley, such as finger weeders, and robotic thinning and weeding machines.

Much of the focus of his program was to find ways for growers to better manage nitrogen which contributed to a more complex approach to N fertilizer management in vegetable systems. His research evaluated N management over the entire year and looked at the N supplied to vegetable crops from soil organic matter, organic amendments, crop residues, soil nitrate, and nitrate in water. He also investigated the rooting patterns of many vegetable crops, and throughout his career evaluated the use of winter cover crops for improving soil health and for scavenging residual mineral N remaining in the soil in the fall. A more recent direction to his research has been evaluating the efficacy of fall applications of high carbon soil amendments, including almond hulls and yard compost, to tie up soil mineral nitrogen in the fall thereby preventing nitrate leaching losses during the rainy winter months.

Throughout his career, Richard made thousands of farm call visits to assist growers, PCA's and Crop Consultants with diagnosing crop production problems caused by abiotic conditions, diseases, insects, nutrient deficiency, salinity, or chemical sprays. He developed a deep wealth of knowledge of vegetable production during his career and has been the go-to person for answering questions on vegetable production on the central coast for more than 30 years.

Richard has also been at the forefront of solving major problems facing the vegetable industry on the central coast. One of the most recent and impactful issues was the major loss of lettuce production in 2020 caused by Impatiens Necrotic Spot Virus (INSV) and Pythium wilt disease. He helped lead the efforts to find varietal tolerance, and worked with UC and USDA entomologists to understand the role of weeds in the overwintering of western flower thrips which are carriers of INSV. Other important issues that Richard has been involved with include investigating the cause of elevated cadmium levels in spinach and helping with the Central Coast Irrigated Lands Regulatory Program (Agriculture Order). Richard took leadership in organizing a group of UC and USDA advisors, specialists and researchers to work with the Central Coast Regional Water Quality Control board to craft water quality regulations that would be achievable for the agriculture industry.

During his career, Richard has been a member of the California Weed Science Society, American Society of Agronomy, American Society of Horticultural Science, and the California Chapter of the American Society of Agronomy, where he also served as president in 2015. Richard has been a regular organizer of the Eco-Farm Conference held each winter in Asilomar CA and leads the field tour of organic farms on the Central Coast.

Richard retired in December 2022, but has continued working part time as an emeritus farm advisor, as he is still in high demand. When not working, he enjoys his time mountain biking, hiking and back packing, playing mandolin, and taking care of his backyard garden and orchard. He has had more time to spend with his wife Wendy, and to visit with his children Jay and Lily.

Agenda

Tuesday, February 6

General Session: 9:30 A.M. – 12:00 A.M. *SALON C*	
Are We Ready? Adapting Agronomy to an Uncertain Future Chairs: Daniel Geisseler, Sarah Light, Lauren Hale CEU: 1.5 CCA (1.0 Crop Mgmt., 0.5 Precision Ag.)	
9:30 – 9:45	**Daniel Geisseler**, *UC Davis*, Introduction
9:45 – 10:20	**Tapan Pathak**, *UC Merced*, Impacts of climate change on California's agriculture and tools for managing risks
10:20 – 10:55	**Claire Heinitz**, *USDA-ARS*, Mining the National Plant Germplasm System for sources of climate resiliency in perennial crops
10:55 – 11:30	**Stavros Vougioukas**, *UC Davis*, Advances in automation technologies and effect on farm workers
11:30 – 12:00	**Michelle Leinfelder-Miles - Honoree presentation**

12:00	Lunch Break

SALON C		*SALON D*	
Session 1 – Nutrient Management Chairs: Mark Cady, Marja Koivunen CEU: 1.5 CCA (Nutrient Mgmt.); 1.0 CDFA INMP		**Session 2 – Precision Agriculture** Chairs: Nick Clark, Marja Koivunen CEU: 1.5 CCA (0.5 Crop Mgmt., 0.5 Precision Ag., 0.5 IPM)	
1:25	Introductory Remarks	1:25	Introductory Remarks
1:30	**Jerome Pier**, *QualiTech*, Getting real about foliar nutrition	1:30	**Nick Cizek**, *FarmTest*, On-farm research on your customers' farms with their equipment
2:00	**Charlotte Decock,** *Cal Poly San Luis Obispo*, The interaction of soil health and plant nutrition	2:00	**Elia Scudiero**, *UC Riverside*, Making sense of high-resolution satellite imagery to improve plant, soil, and water management
2:30	**Sydney Cho**, *UC Davis*, Almond hulls and shells as potassium-rich organic matter amendments	2:30	**Peter Larbi**, *UC Davis*, Precision pesticide application technology
3:00	Break		

SALON C		*SALON D*	
Session 3 – Micronutrients Chairs: Mark Bolda, Nick Clark CEU: 1.5 CCA (Nutrient Mgmt.)		**Session 4 – Animal-Plant Systems Management** Chairs: Ranjit Riar, Sultan Begna, Sonia Rios CEU: 1.5 CCA (Crop Mgmt.)	
3:25	Introductory Remarks	3:25	Introductory Remarks
3:30	**Sharon Benes**, *CSU Fresno*, Micronutrient Nutrition: How Much Attention Should We Place on These Essential Nutrients?	3:30	**Rebecca Ozeran**, *UCCE*, Economic and Practical Investigations of Livestock-crop Integration in California
4:00	**Patrick Brown**, *UC Davis*, 100 Years of Boron Research – what we know and what we don't know	4:00	**Stephen Kaffka**, *UC Davis*, Alternative forages for water-stressed dairies in the San Joaquin Valley
4:30	**Bob Beede**, *UCCE*, Zinc: The Mighty Micronutrient! Factors affecting nutrient uptake	4:30	**Amelie Gaudin**, *UC Davis*, Outcomes and challenges in integrating livestock in California cropping systems
5:00	**Poster Session and Evening Social** (beverages and hors d'oeuvres served) ***Salon A***		

Wednesday, February 7

6:45-8:25 AM	**Student-Mentor Breakfast**

SALON C		*SALON D*	
Session 5 – California IPM Toolbox Chairs: Mark Bolda, Sarah Light, Ian Grettenberger CEU: 1.5 CCA (IPM); pending: 1.5 DPR		**Session 6 – Soil Management** Chairs: Lauren Hale, Sarah Light, Hossein Zakeri CEU: 1.5 CCA (1.0 Soil & Water Mgmt., 0.5 Crop Mgmt.); 0.5 CDFA INMP	
8:25	Introductory remarks	8:25	Introductory remarks
8:30	**David Haviland**, *UCCE*, Embracing IPM and sustainability within today's regulatory environment	8:30	**Eoin Brodie**, *Berkeley Lab*, Soil Biodiversity in California Agriculture: Framework and Indicators for Soil Health Assessment
9:00	**Jhalendra Rijal**, *UCCE*, Tree and nut crops IPM: What's working – What's not	9:00	**Michelle Leinfelder-Miles**, *UCCE*, On- farm practices to improve soil health outcomes
9:30	**Margaret Lloyd**, *UCCE*, Non- chemical management of soilborne pathogens	9:30	**Sarah Light**, *UCCE*, Equipment considerations for implementing regenerative practices
10:00	Break		

SALON C		*SALON D*	
Session 7 – Evolution of pests and management challenges Chairs: Ian Grettenberger, Sonia Rios CEU: 1.5 CCA (IPM); pending: 1.5 DPR		**Session 8 – Groundwater Recharge** Chairs: Wendy Rash, Mark Cady CEU: 1.5 CCA (Soil & Water Mgmt.)	
10:25	Introductory remarks	10:25	Introductory remarks
10:30	**Ian Grettenberger**, *UC Davis*, Insecticide resistance: Diamondback moth and alfalfa weevil as case studies	10:30	**Helen Dahlke**, *UC Davis*, Agricultural Managed Aquifer recharge on perennial crops: what to look out for
11:00	**Oleg Daugovish,** *UCCE*, Weed management in strawberry and avocado	11:00	**Tim Godwin**, *DWR*, Groundwater strategies for implementing the Sustainable Groundwater Management Act: Promoting Ag-MAR in California
11:30	**Cassandra Swett**, *UC Davis*, Challenges to genetic resistance-based disease management arising from resistance breaking pathogen strains and potential for stress to compromise resistance gene expression--a case study of Fusarium wilt in tomato	11:30	**Lucia Levers**, *USDA-ARS*, The Economics of AgMAR

CA-ASA Business Meeting and Awards Luncheon	**Daniel Geisseler presiding**
12:00	Opening Business Items
12:30	Announcement of Student Scholarship and Student Poster Awards
1:20	Closing Business Items

SALON C		*SALON D*	
Session 9 – Bees, Pollinators Chairs: Ian Grettenberger, Mark Bolda CEU: 1.5 CCA (IPM); pending: 1.5 DPR		**Session 10 – On-farm Water Management** Chairs: Sonia Rios, Sultan Begna CEU: 1.5 CCA (Soil & Water Mgmt.); 0.5 CDFA INMP	
1:25	Introductory Remarks	1:25	Introductory Remarks
1:30	**Jo Ann Baumgartner**, *Wild Farm Alliance*, Why incorporating pollinator habitat on the farm not only helps with seed set but is crucial for effective IPM	1:30	**Khaled Bali**, *UCCE*, Intermittent groundwater recharge strategies on alfalfa for sustainable production and water conservation
2:00	**Elina L. Niño**, *UC Davis*, Protecting pollinators in California's agricultural landscapes	2:00	**Daniele Zaccaria**, *UC Davis*, Effects of winter cover cropping on radiation balance & water productivity of micro-irrigated pistachio

2:30	**Neal Williams**, *UC Davis*, Area-wide approaches to promoting pollinators. Predicting pesticide risk and habitat placement for pollinators in working lands	2:30	**Ali Montazar**, *UCCE*, Recent advances in California avocado water management

Main Session

Chair: Daniel Geisseler

Impacts of Climate Change on California's agriculture and Tools for Managing Risks

Tapan Pathak, UC Cooperative Extension Specialist, Specialist in Climate Adaptation, Department of Civil and Environmental Engineering, University of California, Merced

Agricultural industry in California is valued around $50 billion and grows more than 400 commodities. Despite the productive and profitable market, agriculture is constantly threatened by climate change. Some of the changes in climate include gradual upward temperature trends, increased frequency and intensity of extreme events, and highly variable winter precipitations. These changes are already impacting agriculture in California through implications such as increased plant stresses, reduced winter chill, increased pest, and disease pressure, shifts in phenology etc. These conditions provide a glimpse of the future. Farmers and ranchers, including socially disadvantaged farmers and ranchers, beginning and limited resource farmers and ranchers are under constant pressure to adjust to uncertain weather and climate events to minimize risks. In this presentation, I will provide an overview of climate change in California, its effects on different crops, as well as farmers' perceptions onthis issue. Presentation will also cover examples of a few decision support tools available for managing risks.

Mining The National Plant Germplasm System For Sources Of Climate Resiliency In Perennial Crops

Claire Heinitz, USDA-Agricultural Research Service, National Clonal Germplasm Repository Unit, Davis CA.

Genetic diversity is key to climate resilience, and agricultural biodiversity is threatened. Conservation of plant genetic resources in the form of historic cultivars, breeding material, landraces, and crop wild relatives in ex situ genebanks not only preserves the material, but makes it usable by research and industry partners. The National Plant Germplasm System is a collection of research units administered by the USDA Agricultural Research Service, often in cooperation with land grant universities. It serves as the nation's genebank – an invaluable resource of diverse plant material and associated data that is available free of charge to researchers worldwide. The National Clonal Germplasm Repository in Davis, CA conserves clonal collections of Mediterranean fruit and nut trees and grapes, including crop wild relatives of important California crops that can provide growers with more options in the face of climate related challenges. Crop wild relatives (diverse species related to domesticated crops) are critical for introducing resiliency to stress, even in woody perennial species that are often propagated clonally. Historically, 'wild' species have been employed as rootstocks to address pest and horticultural issues. Recently, the potential uses of crop wild relatives as rootstocks and also in scion breeding have been expanding to include abiotic stress and other climate related challenges. The National Plant Germplasm System is a resource designed to meet these needs, but many challenges remain in the conservation of these species.

This presentation will review ongoing research and success stories in the utilization of crop wild relatives from the genebank to address climate resiliency in fruit trees, nuts and grapes. It will also include a discussion of the major threats to crop wild relative diversity, and introduce the recently released

"National Strategic Germplasm and Cultivar Collection Assessment and Utilization Plan" – a multi-year plan to strengthen the NPGS system.

Advances In Automation Technologies and Their Effect on Farm Workers

Stavros Vougioukas, Department of Biological and Agricultural Engineering, University of California, Davis

Increasing farm labor shortages and rising costs, combined with advances in robotics and AI, have been critical drivers behind developing automation technologies for specialty crops. Significant progress toward automation has been made in tasks that don't require physical manipulation of the crop. Autonomous driving technology has matured enough to be offered commercially and is an enabler for other successfully developed technologies, such as robotic mowing and spraying. Robotic weeding has also made significant progress, and commercial systems are becoming available. However, tasks such as robotic thinning, pruning, or harvesting that require careful manipulation of the crop are still at the prototype stage. Among these tasks, harvesting is particularly labor-intensive and must be done selectively, at high speed, without damaging the crop. Developing cost-effective robotic harvesters faces challenges related to crops, technology, and economics. Robotic and mechanical harvest aids offer an intermediate step to full harvest automation by making farm work easier and increasing the productivity of hand workers. The introduction of robotics may reduce the number of hand workers and operators needed for specific tasks, but it will also require new skills from the workers and operators that work alongside the robots or deploy and supervise them. The above topics will be the focus of this presentation.

Session 1: Nutrient Management

Chairs: Mark Cady, Marja Koivunen

Basics of Foliar Nutrition

Jerome Pier, *Qualitech, Inc.*

Plants obtain essential nutrients mainly through their roots, but foliar uptake is also possible. Plant macronutrients, nitrogen, phosphorus and potassium, are required in relatively large amounts and root uptake is the dominant mechanism. Plant essential micronutrients are required in small amounts and are ideally suited to foliar application. Adverse soil chemistry reduces the solubility and availability of micronutrients in the soil solution limiting root uptake. Several essential micronutrients also have poor mobility within a plant's vascular system. These challenges present an opportunity for foliar micronutrient applications. In addition, certain plant growth stages require more macronutrients than can be provided by root uptake providing another opportunity for foliar supplementation. Adding fertilizers to pesticide spray mixes is a convenient method of incorporating foliar supplementation into a comprehensive fertility program. There are several factors that must be considered to maximize the benefit of foliar fertilization. The Four Rs apply to foliar fertilization. Plants must not be under stress when foliar fertilizers are applied. Foliar fertilizers must be compatible with all spray tank ingredients. Fertilizer nutrients must be in a soluble form and have a low point of deliquescence to be available for foliar uptake. There are important formulation differences between foliar fertilizers that influence the likelihood of applied nutrients entering leaves and translocating from the point of entry to nutrient sinks. As growers require higher yields to maintain profitability, foliar fertilization is a critical part of a balanced and comprehensive fertilizer program.

The Intersection of Soil Health and Plant Nutrition

Charlotte Decock, *California Polytechnic State University, San Luis Obispo, CA. Grimm Family Center for Organic Production and Research, College of Agriculture, Food and Environmental Sciences*

Soil health has gained much attention in recent years in the context of agriculture's potential to contribute to climate change mitigation, but the link between soil health and plant nutrition is much less discussed. Healthy soils are sometimes promoted as a way to reduce the need for external inputs. However, little data is available to guide if and how fertilizer rates can be adjusted with soil health management. In this talk, findings of effects of cover cropping, compost application and reduced tillage on plant nutrition in Central Coast cropping systems will be shared, and implications for nutrient management will be discussed. In addition to assessing effects of regenerative or soil conservation practices on greenhouse gas emissions, soil properties and crop production, soil health research has focused on identifying easy-to-measure indicators that are sensitive to management changes. These indicators are useful when the goal is to monitor and verify impacts of soil health management, but the link between these indicators and nutrient cycling is not well established. As such, emerging soil health metrics currently do not provide decision support for nutrient management. Meanwhile, standard soil tests have been scrutinized and calibrated to inform nutrient management decisions, but they poorly capture the capacity of a soil for biologically mediated nutrient supply. This opens opportunities for new indicators that support nutrient management in systems that rely more heavily on biological functioning, including fields under regenerative or organic management, or decision support for selection of novel biofertilizer products. Using examples from recent studies conducted in California, the

potential of emerging soil health indicators such as soil respiration, permanganate oxidizable carbon and H3A extractable nutrients (Haney-test) to fine-tune nutrient management decisions will be discussed. Finally, current limitations and knowledge gaps in the link between soil health management, soil testing and nutrient management planning will be highlighted, and emerging avenues for future research and development will be discussed.

Almond Hulls and Shells as Potassium-Rich Organic Matter Amendments

Sydney Cho, *University of California, Davis*

Patrick H. Brown, Sat Darshan S. Khalsa, Department of Plant Science, UC Davis

In almond orchards the regeneration of ecosystem health and productivity can be achieved through practices including recycling almond hulls and shells as soil amendments, reducing dust production during harvest, and minimizing synthetic fertilizer inputs. Returning almond hulls and shells to the orchard soil as organic matter amendments and using off-ground harvest machines can create opportunities for maintaining this organic layer of mulch without compromising profits. Hulls and shells contain substantial potassium concentrations, and applying these materials on the soil surface could reduce K fertilizer costs by around 80% while retaining plant K in the orchard. Previous studies have found that nutshell residues release K rapidly from water applications, can improve soil aggregation, and contribute to diverse microbial communities. However, field experiments assessing soil health benefits from almond hulls and shells have not been well studied. This presentation will provide an overview of the changes in soil physical, chemical, and biological properties from the use of almond hulls and shells in an orchard trial in the Sacramento Valley. Collaboration on this project will focus on the implications of applied almond hulls and shells on soil K, decomposition and moisture, and microbial community functions.

Session 2: Precision Agriculture

Chairs: Nick Clark, Marja Koivunen

On-Farm Research on Your Customers' Farms With Their Equipment

Nick Cizek, *FarmTest, LLC, CEO and Founder*

Commercial farming is at a tipping point. Technology advancements have added up so now, unlike before, crop consultants and growers can produce more actionable performance data on their farms than input providers. This presentation describes concrete examples and best practices for designing, executing, analyzing on-farm research on commercial farms with commercial farm equipment; the practical differences between plot and strip trials; understanding which results one can be confident in or not; embedding plot trials in variable rate prescriptions; and the practical limit of on-farm research using today's commercial farm equipment. Valuable research results are now achievable on commercial farms. Every field and orchard can be a useful trial and soon will.

Making Sense of High-Resolution Satellite Imagery to Improve Plant, Soil, and Water Management

Elia Scudiero, *Department of Environmental Sciences, University of California, Riverside*

In the rapidly evolving landscape of agricultural technology, high-resolution satellite imagery has emerged as a powerful tool for assisting plant, soil, and water management. This talk overviews the potential of high-resolution satellite imagery, focusing on applications that can significantly benefit vegetable crop farming in California. An introduction to high-resolution satellite imagery, explaining the technology's relevance and its capacity to bring about positive change in agriculture will be provided. Particularly, the potential for cost-effective, scalable, and efficient monitoring of vast agricultural areas will be discussed along with challenges and limitations inherent in working with high-resolution satellite imagery. The benefits and drawbacks of using imagery at different resolutions (cm- to m-scale) will be discussed. Two case studies will be discussed: the use of Planet imagery (0.5 to 3 m resolution) in on-farm strip trials testing different soil fertilization and conservation practices in an organic vegetable production in Hollister, CA; and the use of 3 m to 10 m resolution imagery to monitor onion biomass production and its response to soil salinity stress in four fields in Westmorland, CA. Insights gained from these trials empower farmers, consultants, and scientists to make more informed decisions when using high-resolution imagery.

Precision Pesticide Application Technology in Perennial Crop Production

Peter Ako Larbi, *University of California, Kearney Agricultural Research and Extension Center, Parlier*

Precision pesticide application (PPA) is the application of pesticide to a crop according to some predetermined criteria to attain plant-specific or site-specific treatment. Examples of such criteria are size of the target plant, level of pest pressure, and severity of disease. With pesticide dosage matched to each individual plant or site, PPA is aimed at reducing the amount of applied pesticide. At the basic level, PPA involves calibration of pesticide application equipment by human operators to ensure that the desired application rate is used. At advanced levels, it involves the use of sensing and imaging

technologies, for instance, to identify the presence or absence of the target (e.g., tree), to distinguish between targets and non-targets (e.g., diseased versus healthy foliage), or to recognize already treated target areas based on GPS (global positioning systems) technology to avoid retreatment. In response, PPA equipment utilize automation technologies in controlling opening and closing of spray nozzles, varying spray application rate proportionally to plant canopy characteristics and locations, and controlling spray parameters to conform to ambient weather conditions. Another aspect of PPA is the use of expert systems, for instance, to schedule pesticide applications based on target pest and/or weather conditions, or to predict the outcome of spray application based on application parameters. This presentation will cover the need for PPA practices in orchard and vineyard production, examples of PPA technology, and a discussion on best practices for effective adoption and utilization of PPA technology. The information covered in this discussion will help practitioners to identify and avoid misuse of PPA technology toward accurate and effective pest control.

Session 3: Micronutrients

Chairs: Mark Bolda, Nick Clark

Micronutrient Nutrition – What We Know and What We Don't Know

Sharon Benes, Department of Plant Sciences, California State University, Fresno

100 Years Of Boron Research – What We Know and What We Don't Know

Patrick Brown, Department of Plant Sciences, University of California, Davis

It is now 100 years since the discovery that boron is an essential element for plants. For the ensuing 70 years scientists struggled to understand the function or the mechanisms of uptake of this amazing element. This has now changed and over the past 30 years we have learned that B plays a critical role in cell wall development and membrane integrity with important consequences for flowering, fruit and seed set. Our understanding of how B is taken up by plants has also advanced and we now understand how plants adapt to low B and why they remain highly sensitive to high B. The combination of improved understanding of the biology of B and the impacts of B on plant growth provide a much clearer picture of how B should be managed in agriculture. This talk will provide a brief but fascinating summary of the role of B in agriculture and will highlight how that knowledge has helped guide modern B management practice.

Zinc: The Mighty Micronutrient in Deciduous Nut Trees

Robert Beede, UC Cooperative Extension Farm Advisor, Emeritus

Zinc (Zn) is considered the second most common nutrient deficiency in deciduous nut and fruit trees grown in the San Joaquin Valley. Alkaline soil pH, low cation exchange capacity, and rapid growth from high temperatures are likely contributors. Zinc deficiency is characterized by reduced leaf size ("little leaf"), markedly compressed internodes causing stunted current season's growth (rosette), wavy leaf margins, poor fruit set, reduced fruit size, poor flower bud development, and shoot dieback. Zinc functions in many enzyme and biochemical systems including its role as a precursor to indole acetic acid (auxin), the plant growth regulator critical to cell elongation and subsequent plant growth and development. Since soil zinc uptake is passive and reliant upon the transpiration stream, leaves and warm temperatures dictate its early spring transport. Deciduous plants must therefore accumulate adequate zinc concentrations **before** bud break to prevent protracted leaf out and poor canopy development. For this reason, post- harvest zinc applications have been recommended for decades by UC professors and Extension agents, even though the timing was recognized as being **less efficient** in uptake than spring applications when the waxes comprising the leaf cuticular layer had not yet fully developed. Early spring application provides greater zinc **absorption** into the leaf tissue, and less **adsorption** onto the waxy leaf surface, thus making them more **effective**. Even so, spring foliar applications fail to augment the plant's zinc pool prior to bud break, completion of current season's flower development, bloom, pollination, and early fruit set. The duration of their effectiveness can be affected by poor nutrient foraging characteristics of the rootstock, rapid scion growth, and heavy crop load. Zinc foliar maintenance programs for almond, pistachio, walnut, and pecan will be presented based on current research and field experience. Limited data will also be presented on the potential of using soil applications of chelated zinc to supplement timely foliar treatments. Sampling for zinc assessment and accurate interpretation of the lab analysis will be discussed. Zinc levels reported after foliar treatment are confounded by adsorption of zinc onto the waxes inherent on the leaf surface; acid

washing the leaves prior to analysis may not resolve this issue . Thus, visual assessment of new growth void of short internode distances, little leaf, and mottling is a more accurate index of adequate zinc nutrition than the high levels reported after foliar treatment.

Session 4: Animal-Plant Systems Management

Chairs: Ranjit Riar, Sultan Begna, Sonia Rios

Economic and Practical Investigations of Livestock-crop Integration in California

Rebecca Ozeran, UCCE Fresno and Madera Counties, Livestock & Natural Resources Advisor

Many decades ago, farms raising both crops and livestock were the norm, but modern California farms are dominated by specialization and large-scale production. Specialization at economics of scale tends to maximize production, while demanding high levels of external inputs, such as diesel fuel and synthetic pesticides, as well as large land areas. A growing number of crop and livestock producers seek to re-diversify their production systems and reduce their reliance on these costly inputs, to intensify production from their existing land base, to improve soil health, and/or to enhance ecosystem functions such as water infiltration and habitat quality for beneficial species. In recent years, research in California has begun to explore practices of crop-livestock integration, but there are broad topics where we still need more information. Many growers have adopted integrated practices despite the lack of widespread resources, and they are key partners and guides in two new UC Cooperative Extension research projects. We aim to explore: what are the costs and benefits of integrating livestock into a cropping system? What kinds of combinations have people tried, and how did they do it? Considering sheep in almonds, specifically, what are the food safety risks, and how do the economics compare between a grazed and an ungrazed orchard?

Alternative Dairy Forage Crops Can Be Used to Improve Water and Nutrient Management over a Multi-year Period while Providing High Quality Feed

Stephen Kaffka, Department of Plant Sciences, University of California, Davis.

Peter Robinson, Animal Sciences, UC Davis; Kosana Suvocarev, Land Air and Water Resources, UC Davis; Gene Aksland, Agronomic Services, Visalia; Nick Clark, UCCE Tulare County; Nadia Swanepoel, Department of Animal Sciences, UC Davis

The state's dairy industry and farming in general are faced with two difficult regulatory challenges: Groundwater overdraft, especially in the San Joaquin Valley, that now limits available irrigation water, and nitrate pollution of groundwater. One way to moderate the first problem is to grow crops in winter instead of summer when water use efficiency is greater. The second problem can be moderated by growing crops with deep root systems that recover nutrients (and water) left behind by shallower-rooted crops. Sugarbeets and safflower can be grown productively in winter in CA and are deep rooted. They provide good to excellent feed quality and high yields relative to water use. Over a five-year period, safflower and sugarbeets were evaluated as fall-sown, winter forages in trials at the UC Davis Research station and in on-farm trials with cooperating dairy farmers. Crops were evaluated for yield, rooting depth (6 to 9 feet), water use, nutrient recovery at depth in the soil profile, forage quality, and in feeding trials. Safflower produced 5 to 6 tons of dry matter per acre in diverse trials using 0.75 to 1.0 ac-ft of water from all sources. It preserved well as silage and feed quality was approximately similar to cereal silages. It was used to feed heifers, dry cows and late-stage lactating cows. Sugarbeets produced variable but high yields (10 to 14 t/DM/ac) with excellent feeding quality, using approximately 2 ac-ft of water. In a feeding trial and based upon on-farm experience, milk yield was preserved, fat content and cow health improved compared to standard, corn silage-based diets. But beets have proved difficult to

preserve as silage without dry matter yield losses. The benefits and limitations of both crops are discussed.

Outcomes and Challenges in Integrating Livestock in California Cropping Systems

Amelie Gaudin, *Department of Plant Sciences, University of California, Davis*

The California landscape, with its extremely diverse cropping systems is uniquely poised to facilitate animal grazing on cropland and utilization of ecosystem services provided by animals to lower GHG footprint and synthetic input needs. Using case studies in vegetable, vineyards and almond systems, I will show how sheep grazing in cropland could become a critical tool to enhance soil health and increase the resiliency of both sheep and organic crop operations as drought and climate change unfold. I will draw from several farmer-driven empirical and experimental studies to highlight the impacts of grazing small ruminants on nitrogen provision and retention, carbon sequestration, water conservation, pest control and biodiversity and some of the mechanisms involved. I will share some successful models of integrated crop livestock systems where sheep grazing of cover crops occur without yields and food safety tradeoffs and discuss some of the structural barriers, knowledge gaps and management challenges currently hampering wider adoption.

Session 5: California IPM Toolbox

Chairs: Mark Bolda, Sarah Light, Ian Grettenberger

Embracing IPM and Sustainability within today's Regulatory Environment

David Haviland, UCCE Kern County, CA, Area Integrated Pest Management (IPM), Advisor/Entomologist

We live in a rapidly-changing regulatory environment that greatly influences a farmer's ability to manage agricultural pests. Product bans, ever-changing maximum residue limits in key export markets, state-specific pesticide use restrictions, and an increase in non-scientific influences on policymakers, are all contributing to this change. This presentation will discuss key influences affecting crop protection, using a range of pesticide-based case studies from California, to highlight problems being faced by growers, while also presenting the current environment as an opportunity for increased adoption of IPM and sustainability.

Tree and Nut Crops IPM: What's Working – What's Not

Jhalendra Rijal, UCCE Stanislaus, Area Integrated Pest Management (IPM) Advisor/Entomologist

In this presentation, we review the brief history of integrated pest management (IPM) in California and how the different levels of IPM have been implemented in major tree and nut crops in California. We will discuss multiple examples of the adoption of strategies for pest management that include cultural, biological, chemical, and others. We will also discuss the potential barriers to adopting IPM in tree and nut crops. Some of the barriers include invasive species such as brown marmorated stink bugs, altered pest pressure due to changing environmental and host-related factors, unavailability of reduced-risk but effective insecticides, and ultimately unclear return on investment.

Non-chemical Management of Soilborne Pathogens

Margaret Lloyd, UCCE Yolo and Solano Counties, Organic Agriculture and Small Farms Advisor

Non-chemical management of soilborne pathogens requires attention and action from growers on numerous, sometimes simultaneous, aspects of crop production. Knowing what is important and how to weigh the options are critical to deciding the correct course of action. In this talk, I will discuss concepts and insights on managing soilborne pathogens without chemicals to help growers and technical service providers in the field.

Session 6: Soil Management

Chairs: Lauren Hale, Sarah Light, Hossein Zakeri

Soil Biodiversity in California Agriculture: Framework and Indicators for Soil Health Assessment

Eoin Brodie, *Lawrence Berkeley National Lab*oratory

Soil health depends on soil biodiversity. However, external pressures from land-use change, climate change and certain agricultural practices threaten the biotic networks that underpin the delivery of soil's many ecosystem services. Yet measuring soil biodiversity is a complex task, with a wide variety of possible indicators, and methodologies that are evolving with recent technological advances. I will present some outcomes from our report prepared by the Belowground Biodiversity Advisory Committee (BBAC) convened by the California Department of Food and Agriculture (CDFA). This report focuses on how best to assess soil biodiversity in the context of working lands and considers current and future challenges faced by California agricultural producers, policy makers, governing agencies, and related stakeholders. Monitoring soil biodiversity and its relationship to ecosystem multifunctionality is not a simple task, there is no one-size-fits-all approach, and therefore feedback from multiple stakeholders is needed to arrive at valuable, interpretable, practical, and reliable soil biodiversity indicators for working lands.

On-farm Practices to Improve Soil Health Outcomes

Michelle Leinfelder-Miles, *UCCE San Joaquin County*

The term 'soil health' has become familiar in agricultural research and management. While it is common to test soil for chemical properties, like nutrients, salinity, and pH, soil health also considers soil physical characteristics – like compaction, aggregation, and water infiltration – and biological characteristics – like soil respiration, active carbon, and nitrogen mineralization. These properties influence the soil's ability to function, and enhancing them can improve soil functioning to grow crops and produce ecosystem services. We often relate soil health to management practices like crop rotation, cover cropping, reducing tillage, and adding compost because these have been shown to increase soil functioning in agricultural landscapes. They are also some of the practices that are financially incentivized by the CA Department of Food and Agriculture Healthy Soils Program. Long-term goals of practice implementation may include soil carbon sequestration and greenhouse gas mitigation; however, these may not be realized in the short-term. The presentation will describe the results of research projects where soil health practices were implemented on commercial farms to better understand what benefits may be realized. For example, in a three-year warm season cover crop trial with cowpea and triticale, there were no changes in total soil carbon or nitrogen compared to the bare soil control, but there was a significant increase in water infiltration after three years. Likewise in a three-year trial evaluating green waste compost application, preliminary results indicate no statistically significant increases in total carbon or nitrogen compared to the untreated control; however, soil K increased at a site with inherently low soil K. These results indicate that there are benefits even with short-term practice implementation. The presentation will also address how water resource management influences soil health outcomes. In Mediterranean climates, water availability is becoming more uncertain in a changing climate. Deficit irrigation is an important tool in cropping systems for managing scarce water resources, but in an alfalfa deficit irrigation trial, soil biological activity and

salinity were impacted by deficit treatments. It is important for growers to identify their goals and management constraints when considering soil health practice implementation.

Equipment Considerations for Implementing Regenerative Practices

Sarah Light, *UCCE* Sutter-Yuba Counties

Regenerative agriculture practices can build soil health and increase the resilience of farms to climate extremes. Access to equipment can be a barrier to entry for growers who wish to experiment with new practices. This talk will address practical equipment considerations for implementing regenerative practices on California farms. Adapting new or existing equipment to address unique needs for management of cover crops, reduced-till systems, soil amendments, and high residue situations will be discussed. Stories from California farms will be shared including successes, challenges, and strategies for when things do not go as planned. There is no one-size-fits all for implementing regenerative practices in a Mediterranean climate with a diverse cropping systems and short crop rotations. Big picture equipment considerations for maintaining soil health and implementing soil building practices will be shared.

Session 7: Evolution of Pests and Management Challenges

Chairs: Ian Grettenberger, Sonia Rios

Insecticide Resistance: Diamondbak Moth and Alfalfa Weevil as Case Studies

Ian Grettenberger, *UC Cooperative Extension Specialist, Entomoloy; Department of Entomology and Nematology, University of California, Davis*

Kevin Godin, Madison Hendrick, Department of Entomology and Nematology, UC Davis

Insecticide resistance is a perennial issue that threatens management of arthropod pests. Repeated insecticide applications select for resistance, making pest management more challenging for growers faced with reduced susceptibility and fewer options. We use two studies addressing the scope of insecticide resistance as case studies for how resistance can develop, how it can become widespread, and what the outlook is for management. First, we focus on alfalfa weevil, the primary pest of alfalfa in the Western US. With collaborators, we assessed the scope of insecticide resistance in Western states for pyrethroids, with an emphasis on lambda-cyhalothrin. In addition, we examine how pesticide use has changed given this resistance and how resistance might be managed. In vegetables, diamondback moth is a key pest that has had a propensity for developing resistance. We have conducted a multi-year assessment of resistance for a range of insecticide. Resistance is widespread for some materials, but limited for others. Differences also exist in pesticide use between regions, reflecting changes in efficacy and challenges with management. Together, these two studies help provide insight into the challenges associated with insecticide resistance and highlight the need for proactive resistance management.

Yellow Nustedge Management in Conventional and Organic Strawberry and Weed Control in Avocado

Oleg Daugovish, UCCE Ventura County

Yellow nustedge management in conventional and organic strawberry and weed control in avocado. Cyperus esculentus has become increasingly difficult to manage in strawberry since the phase-out of methyl bromide. In a series of replicated trials, we evaluated end-season bed fumigation, pre-plant application of S-metolachlor, steam and anaerobic soil disinfestation as management tools for yellow nutsedge. End-season bed fumigation via two drip lines with metam sodium at 280 L ha^{-1} reduced nutsedge tuber germination 100% under the drip lines, but only 67-75% in-between drip lines. S-metolachlor at 0.36 and 0.72 kg ha^{-1} applied to beds immediately before plastic tarp installation and 30-35 days before strawberry transplanting provided 80-100% control of nutsedge shoots. Both S-metolachlor rates were slightly phytotoxic to strawberry, but the plants outgrew injury and yielded similar to untreated. Application of superheated steam to maintain soil temperature at 70 C for 20 minutes reduced nutsedge shoot emergence 84%. Maintaining anaerobic conditions under plastic mulch for three weeks after an addition of 9.2 t ha^{-1} of labile carbon sources and irrigation reduced nutsedge shoot germination 40-90%. These management tools are now widely used in coastal California strawberries.

Poste-emergent use of glyphosate has been a primary weed control strategy in avocado. To determine the phytotoxicity and efficacy of thirteen herbicides in bearing avocado we conducted trials in two seasons and two California locations. Glufosinate and glyphosate controlled 95-100% of the weeds for up to 8 weeks after treatment, but injured avocado when sprayed on canopy to simulate drift.

Rimsulfuron, oxyfluorfen, indaziflam, flumioxazin and saflufenacil provided 50-70% weed control and caused limited or no injury when sprayed on canopy. These studies showed that pre-emergent and early post-emergent herbicides are safe and can play in increasing role in weed control in bearing avocado, thus reducing reliance on glyphosate. Oxyfluorfen and flumioxazin are already available in avocado and clethodim and rimsulfuron were submitted to the federal IR4 program for registration.

Challenges to Genetic Resistance-based Disease Management Arising from Resistance Breaking Pathogen Strains and Potential for Stress to Compromise Resistance Gene Expression - a Case Study Of Fusarium Wilt in Tomato

Cassandra Swett, UC Cooperative Extension Specialist, Plant Pathology. Department of Plant Pathology, *University of California, Davis.*

Johanna Del Castillo, Elizabeth Hellman, Department of Plant Pathology, UC Davis. Tom Turini, UC Cooperative Extension, Fresno County

Genetic resistance is perhaps the single most important tool available to manage diverse devastating diseases across a wide array of crops, including tree crops, vegetables, cereals and ornamentals. However, there are many factors which can compromise efficacy of using genetic-based resistance, resulting in continued crop loss. This includes emergence of pathogen strains which overcome host resistance and environmental stresses that compromise the ability for the host to completely express the resistance phenotype. This talk will discuss these challenges in the context of Fusarium wilt resistance in tomato, specifically: (1) repeat emergence of resistance-breaking strains, (2) current diagnostic challenges in monitoring for resistance breaking to the newest resistance gene (I3), (3) lack of response measures for preventing spread of resistance breaking strains (such as equipment sanitation), and (4) associated issues with incomplete phenotypic expression particularly under salt stress, an emerging issue associated with drought-driven increases in groundwater use under climate change.

Session 8: Groundwater Recharges

Chairs: Wendy Rash, Mark Cady

Agricultural Managed Aquifer Recharge on Perennial Crops: What To Look Out For

Helen Dahlke, *Department of Land, Air and Water Resources, University of California, Davis*

Agricultural Managed Aquifer Recharge (Ag-MAR) is an emerging managed aquifer recharge technique that uses agricultural fields as percolation basins to recharge the underlying aquifers. Using conventional agricultural production systems for MAR provides several benefits (e.g. large spreading areas connected to surface water conveyance systems, flood mitigation, potential capture of large volumes) but also poses several concerns including crop tolerance to flooding, long-term impact on soil texture, leaching of pesticides and fertilizers to groundwater, and potential greenhouse gas emissions. In this presentation we will summarize findings from field and laboratory experiments conducted on perennial crops (almonds, alfalfa) to highlight the impact of Ag-MAR on the water balance, on crop health, yield and quality, nitrate leaching to groundwater and other considerations (e.g. pests). Experiments were conducted at different sites on soils promoting medium to high percolation rates within the Central Valley and northern California (Siskiyou County) to test the effect of realistic water application amounts and different flooding durations and frequencies in the winter months (December-May). Our results clearly indicate coarse textured soils that promote high infiltration rates can achieve recharge of several acre-feet/acre of water during one rainy season with little effect on the health of perennial crops. Late winter season or spring flooding (April, May) can cause declines in yield when crops have entered the active growing season. We also find that coarse textured or high Ksat soils promote fast and nearly complete (>70%) leaching of soil nitrate present in the soil prior to recharge within hours of the first water application. However, unless residual nitrate is exceedingly high (>500 ppm NO3-N) nitrate concentration of the recharging water in the soil stays below the 10 mg/L maximum contaminant level if > 2 acre-feet/acre of water are recharged. Given the high variability in precipitation and interannual surface water supply, Ag-MAR provides a powerful tool to capture excess water for improved long-term water supply.

Groundwater Strategies for Implementing the Sustainable Groundwater Management Act: Promoting Ag-MAR in California

Timothy Godwin, California *Department of Water Resources*

The 2014 Sustainable Groundwater Management Act (SGMA) has significantly modified the way in which the Federal, State and Local agencies manage water in California. Under SGMA local agencies formed Groundwater Sustainability Agencies (GSAs) and developed Groundwater Sustainability Plans (GSPs) that are required to operate to a sustainable yield and avoid undesirable results within 20 years. Agriculture depends highly upon our groundwater resources and without management have and could continue to cause significant impacts to beneficial uses and user of both groundwater and surface water. Nearly all the GSPs rely on projects and management actions to recharge groundwater basins. The Department of Water Resources is committed to supporting and assisting GSAs implementing their plans including finding streamlined pathways to enhance and significantly expand recharge of the groundwater systems that carry us through our dry years. The enactment of a series of executive orders

and special programs have resulted in greater clarity and expediency to implementing recharge projects for local agencies. The diversion of flood flows represents an opportunity to capture and store water otherwise considered nuisance and hazard to opportunity storage and drought resiliency. Developing recharge on agricultural lands could represent a new paradigm in agri-business practice.

Economics of Ag-MAR

Lucia Levers, *USDA*-Agricultural Research Service

Managed Aquifer Recharge is not a new concept, but interest in it as a tool to address water scarcity has increased in recent years. This is true in the state of California, which passed the Sustainable Groundwater Management Act (SGMA) in 2014 to protect groundwater resources. SGMA's goal is to bring overdrafted basins into sustainability by 2040 requiring local water agencies to develop sustainability plans, many of which involve some form of MAR. The economics of MAR are uncertain and require a more thorough understanding of the true costs and benefits of MAR which include construction, maintenance costs, and effective yields, but also environmental damages, location specific feasibility, equity, and water availability. In addition to assessing the larger scale concerns regarding the economics of MAR, we examine a sample of these plans from California's Central Valley and discuss whether they are likely to be successful in terms of water balance, as well as feasibility of their proposed MAR projects.

Session 9: Bees, Pollinators

Chairs: Ian Grettenberger, Mark Bolda

Why Incorporating Pollinator Habitat on the Farm Not Only Helps With Seed Set but is Crucial for Effective IPM

Jo Ann Baumgartner, Wild Farm Alliance

With DPR's new Sustainable Pest Management Roadmap, there is no turning back from their pledge to reduce high-risk, broad-spectrum pesticides. So, where does that leave PCAs and their growers for options? That's where increasing habitats to encourage diverse populations of beneficial arthropods and avian predators comes in, along with supporting pollinators, and while there has been a lot of research and practical application, there is more to do. We need to better understand the ecology of our beneficial organisms, and also the complementarity that comes with increased diversity where natural enemies attack pests in different places, ways and times for a blanket of attack. These beneficials and their habitat will play a critical role in the new Roadmap.

Protecting Pollinators in California's Agricultural Landscapes

Elina Niño, Cooperative Extension Specialist, Entomologist, Apiculture, Department of Entomology and Nematology, University of California, Davis.

Honey bees remain the primary managed pollinator used for pollination of dozens of California crops. However, beekeepers have been facing high losses of up to 50% annually. A number of biotic and abiotic stressors are impacting honey bee health such as pests, pathogens, poor access to proper nutrition, exposure to pesticides, and including colony and crop management during pollination. The concept of Integrated Pest and Pollinator Management considers pollinator protection while supporting effective pest control. Strategies to minimize potential harm to pollinators in agricultural settings will be discussed, as well as proactive actions by growers such as planting supplemental forage to support honey bee health.

Area-wide Approaches to Promoting Pollinators. Predicting Pesticide Risk and Habitat Placement for Pollinators in Working Lands

Neal Williams, Department of Entomology and Nematology, University of California, Davis.

Integrated pest management is increasingly approached from an area-wide perspective recognizing that mobile pest populations and their control require local action that is coordinated across landscapes. Similarly, for beneficial insects like pollinators, strategies to support their populations and mitigate pesticide risk associated with pest management must consider local actions within the broader landscape context. We integrate data from coordinated studies designed to quantify the impact of resource and pesticide stressors on the mason bee Osmia lignaria and the western bumble bee Bombus vosnesenskii. We present results from a field experiment across 14 sites to test how flower-rich habitat plantings designed to provide "clean" forage may mitigate resource and pesticide stressors. We also apply whole-landscape models of forage and pesticides to reveal locations that present the greatest risk

and also opportunities for coordinated area-wide action to benefit bee populations and communities. Habitat plantings benefited bees, but the effects differed based between species. Mason bees relied predominantly on pollen from habitat plantings and in doing so were exposed to multiple pesticides. The augmented resources were a net benefit despite pesticide exposure. Bumble bees used habitat plantings but integrated resources from throughout the landscape. For them habitat plantings mitigated pesticide impacts. Modelled pesticide exposure across landscapes strongly correlated with levels of pesticide residue in bee-collected pollen. Models of habitat placement show the benefit coordination among neighboring growers and land owner to achieve greatest financial benefits for individuals and neighbors.

Session 10: On-farm Water Management

Chairs: Sonia Rios, Sultan Begna

Intermittent Groundwater Recharge Strategies on Alfalfa for Sustainable Production and Water Conservation

Khaled Bali, UC Kearney Agricultural Research and Extension Center, Parlier, CA

Dong Wang, USDA-ARS, Water Management Research Unit, Parlier, CA. Sultan Begna, Department of Plant Sciences, UC Davis. Daniel Putnam, Department of Plant Sciences, UC Davis. Helen Dahlke, Department of Land, Air and Water Resources, UC Davis

Agricultural Managed Aquifer Recharge (Ag-MAR) can be utilized on agricultural fields to capture the excess water flow during winter to recharge groundwater. Ag-MAR has been used successfully to bank water in aquifers during wet years. Alfalfa is grown on over 500,000 acres in California with nearly 50% of California's production in the San Joaquin Valley. Over 80% of the alfalfa grown in California is flood-irrigated utilizing gravity-fed surface irrigation systems. On-farm groundwater recharge on alfalfa utilizing the existing surface irrigation infrastructures and excess surface water during high winter flows could be a promising water-saving practice for the sustainability of groundwater in California. Alfalfa is an ideal crop for Ag-MAR practices since it does not require any nitrogen applications after stand establishment.

We utilized existing surface irrigation infrastructure on an alfalfa field at the University of California Kearney Agricultural Research and Extension Center, Parlier, California to estimate the net recharge on a sandy loam soil using intermittent flooding practices. The alfalfa field had four irrigation treatments: full irrigation during summer growing season (March through November), mid-summer deficit irrigation treatment (March to August and complete irrigation cutoff after August cutting), winter flooding treatment, and no winter flooding. Recharge, actual evapotranspiration (ETa), soil moisture dynamics, and root water uptake were determined during the recharge period in winter over a three year period (2020-2022). Previously fully irrigated treatments in summer, followed by winter recharge led to cumulative groundwater recharge of 57, 66, and 56 in for 2020, 2021, and 2022, respectively. These applications resulted in a net recharge of 85, 89, and 84% of the applied irrigation water during the winter period, a significant contribution to groundwater aquifers. Mid-summer deficit irrigation treatments, followed by winter recharge, resulted in net groundwater recharge of 53, 59, and 50 in for 2020, 2021, and 2022, respectively, amounting to 78, 79, and 76% of the applied irrigation water during winter flooding periods. The utilization Ag-MAR on alfalfa fields resulted in no significant impact on alfalfa yield or quality and could provide options for storing more than 50 in of water into the aquifer that could be utilized to grow alfalfa or other major crops in the region.

Effects of Winter Cover Cropping on Radiation Dynamics and Water Productivity of Micro-irrigated Pistachio

Daniele Zaccaria, UC Cooperative Extension Specialist in Agricultural Water Management. Department of Land, Air and Water Resources, UC Davis

In the US, winter cover cropping is among conservation agriculture practices. However, cover crops are not widely adopted in the semi-arid Western states. According to the Soil Health Institute (2019), in

California cover crops are grown on less than 5% of total farmland. Among the main reasons for the low adoption rate are the paucity of accurate water-related information (i.e., uncertainties about water amounts needed to establish & maintain cover crops) and the lack of quantitative data about costs & benefits associated with winter cover cropping.
Currently, cover cropping is being promoted by Federal and State Agencies (CDFA – Healthy Soil Program; NRCS) through Climate-Smart Financial Incentives that are aimed at improving soil health and mitigate effects of climate variability and climate change. Although recent studies documented beneficial effects of cover crops on rhizosphere ecology, soil microbial habitat, and root health, there is paucity of information about the effects of winter cover cropping and vegetation residues on the radiation dynamics and water productivity for micro-irrigated pistachio. This talk will provide some background information on potential benefits and mechanisms of actions of winter cover cropping in perennial crops (i.e., orchards and vineyards). It will also outline preliminary results obtained from field research studies aimed to investigate the main effects of winter cover cropping and vegetation residues on the radiation dynamics, light use efficiency, and water productivity for young and mature pistachio orchards grown with micro-irrigation as compared to orchards with clean-cultivated floor. Finally, it will highlight some key aspects for follow-up research work.

Recent Advances in California Avocado Water Management

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

Avocado is primarily grown in Southern and Central California, typically in regions tempered by coastal climates and fine or course sandy loam soils. These regions face uncertain water supplies, mandatory reductions of water use, and the rising cost of water, while efficient use of irrigation water is one of the highest conservation priorities. Data on water use by avocado orchards and optimal irrigation strategies needs to be updated in light of the increasing water pressure, in order to achieve efficient water and fertilizer management. Moreover, due to increasing salinity in water sources, effective irrigation is more critical to ensure optimal yield and high-quality avocado fruits. This talk provides an overview of the preliminary findings of a large-scale research study carried out in 12 mature avocado sites in Southern California. Extensive field measurements and surveys are conducted to better understand the current water management practices and to acquire and develop relevant information on crop water use and crop coefficients, and sensor-based irrigation management in California avocado production systems. The results from the avocado experimental sites illustrate considerable variability in avocado crop water consumption both spatially and temporally. Across the avocado research sites, the average seasonal crop coefficient values varied from 0.57 to 0.71 over a six-month period (April through September) in 2023. The findings demonstrate that canopy features, soil types and conditions, pruning practices, soil surface cover, and row orientations need to be considered to perform effective water management in avocado orchards. Ground shading percentage and row orientations provide a good estimation of canopy size/volume and the amount of light that it can intercept are likely the most important drivers influence crop water needs. While the preliminary results show that the plant-based Stem Water Potential and Sap Flow sensors could be beneficial tools for irrigation management in avocados, additional validations are underway by this study.

Student Posters

Evaluating the Impact of Diverse Cover Crops on Yield Performance in a Central Valley Table Grape Vineyard

Omar Abulghanam, Department of Plant Science, California State University, Fresno

Helen Heng, Lauren Hale, USDA-ARS, Water Management Research Unit, Parlier, CA. Sharon Benes, Department of Plant Science, CSU Fresno.

The Central Valley of California, renowned for its prolific table grape vineyards, necessitates innovative agricultural practices to enhance soil health and resiliency. While cover crops have shown potential as a sustainable agricultural practice in various cropping systems their significance in table grape vineyards remains unexplored. This study aims to assess the impact of different cover crops on yield and quality of table grapes within the Central Valley. The primary objective is to analyze different soil edaphic factors that may shape soil health and influence crop quality & yield. The experiment will be conducted over two growing seasons (2023 & 2024) and features a cover crop species native to the area (*Phacelia tanacetifolia*) and an introduced cover crop species (*Secale cereale*). The four-year old vineyard is an 'Autumn King' variety planted on 'Freedom' rootstocks. The two cover crop treatments along with a bare-ground control are arranged throughout the vineyard in a randomized complete block design with each treatment getting one repetition per block across four total blocks. While the first harvest from this vineyard did not reveal significant differences in yield or table grape quality based on treatment, the second vineyard harvest had significantly lower yield in the rye treatment plots compared to the phacelia treatment and control. Cluster quality and berry size were also significantly impacted by the rye treatment, where vines adjacent to rye had lower cluster mass, higher yellowing of berries, lower quality scores, smaller berry diameters, and lower vine yields. There were no treatment variations in cluster shatter, berry width, berries rotten, berry brown spots, titratable acidity (TA), brix, or the ratio of TA to brix. In 2023 there was substantially more sun damage across the vineyard than in 2022. Further work will seek to evaluate if treatment impacts on vine canopy structure was an underlying mechanism impacting the 2023 yield and quality impacts of the rye cover crop.

Sustainability Indexing: An Ecosystem Perspective on Agricultural Sustainability

Aubriana Bernhardt, California State University, Monterey Bay

Arun D. Jani, Department of Biology and Chemistry, CSU, Monterey Bay, Seaside, CA; Judith E. Canner, Department of Mathematics and Statistics, CSU Monterey Bay, Seaside, CA

Improving the sustainability of agriculture is one of the most rapidly expanding realms of agricultural research. While there is a general consensus on what ought to be minimized (e.g., greenhouse gas emissions, leaching, etc.) and what ought to be maximized (e.g., nutrient use efficiency, carbon sequestration, etc.), there has been little done to develop an objective method of comparison of sustainability between agricultural ecosystems. The modern understanding of agricultural sustainability is still largely reliant on minimizing the detrimental effects of agriculture on the natural environment with little consideration for interactions between agricultural and natural ecosystems. The sustainability of natural ecosystems is measured through indexes that use nutrient cycling, biodiversity, and ecosystem services, among other indicators of ecosystem resilience. These same principles can be used

to measure the sustainability of agricultural ecosystems. Through the careful study of natural ecosystem sustainability indexes and key differences in population interactions within natural ecosystems and agricultural ecosystems, we can develop an agricultural sustainability index based off of the same indicators used to measure natural ecosystem sustainability. This research will produce a sustainability index for agricultural ecosystems that uses ecosystem interactions including measurements of nutrient cycling, biodiversity, and ecosystem services to more accurately quantify how various agricultural systems interact with the natural environment.

Measuring ET in Commercial Broccoli and Lettuce Fields – Salinas Valley, CA

Michael Biedebach, California State University, Monterey Bay

A.J. Purdey, Lee Johnson, CSU Monterey Bay; Nasa Ames Research Center, Earth Science Division.

In Monterey County, irrigated agriculture generates approximately $4.6 billion annually across 220,000 acres, providing regional economic stability. Efficient irrigation management strategies are important to sustain the region's agricultural productivity. Recent advancements and availability in satellite-derived evapotranspiration (ET) data provide great opportunities to guide irrigation and optimize on-farm water use efficiency. While satellite-derived ET data provide a great resource to water managers and irrigators, quantifying the accuracy and limitations remains important to build trust and increase operational adoption. Here, we evaluate the accuracy of OpenET data for common crops in the Salinas Valley. We deployed open path eddy covariance (OPEC) systems in commercial fields to measure on-ground ET rates from broccoli and head lettuce. We summarize the accuracy metrics across three time periods with distinct irrigation types: establishment sprinkler irrigation, post-establishment drip irrigation, and the entire season for each crop. Results show that satellite-driven ET models from OpenET were within previously published range of deviation when compared to on-ground measurements. We conclude by discussing the findings in the context of use cases related to irrigation management and quantifying the consumptive water use.

Evaluating Diverse Baby Greens Germplasm For Drought Tolerance And Nitrogen Responsiveness

Curtis Bireley , California State University, Monterey Bay

Kyle Brasier, Konnor Aiello, Arun D. Jani, CSU Monterey Bay. Ivan Olgui, Vilmorin-Mikado, Gilroy, CA

The Central Coast is a leader in the production of baby greens, which are popular with growers because of their profitability and short growth cycles. However, there is limited information available on the responsiveness of baby greens to irrigation scheduling and nitrogen fertilization rates. Growers often irrigate based on their experience with large crops, such as head lettuce. County records also show that nitrogen rates approximating 150 lb/ac, which rivals amounts applied to corn in the Midwest, are common for a five-week baby greens crop. From a water quantity and quality perspective, it is important to determine the irrigation and nitrogen responsiveness of diverse baby greens in the region. The objective of this on-going research is to evaluate arugula (*Eruca sativa*) and wild rocket (*Diplotaxis tenuifolia*) yields, water use efficiency, and nitrogen recovery under standard and reduced irrigation and nitrogen application rates in different Central Coast environments. Field experiments were conducted in Gilroy and Salinas, CA in 2023 using a split plot experimental design. In the first experiment, irrigation rate (50% or 150% of CropManage recommendation) was the whole plot factor, while nitrogen rate (50

lb/ac or 150 lb/ac) was the whole plot factor in the second experiment. In both experiments, baby greens entry (five arugula and 24 wild rocket entries) was the subplot factor. Our preliminary data showed there were no irrigation rate x entry or nitrogen rate x entry interactions at either site. However, yields of the different entries, when averaged over irrigation and nitrogen rates, were similar in each experiment. The lack of response to nitrogen rates suggests current application rates are excessive. Water use efficiency data is currently under evaluation.

Assessing the Potential of Alternative Phosphorus Sources for CA Agricultural Soils

Zander Brant, California Polytechnic University San Luis Obispo, CA

Sarah Milad, Miguel Ramos, Freddy Stacy, Cole Jones, Shelly Blackwell, Tryg Lundquist, Charlotte Decock, California Polytechnic University San Luis Obispo, CA

Synthetic fertilizers play a crucial role in obtaining high crop yields but as the reserves of these nutrient resources start to diminish, finding fertilizer substitutes must be prioritized. This research project helps to address this issue by assessing how soil phosphorus (P) dynamics vary upon amendment of P inputs derived from waste products, including algae taken from a wastewater treatment facility and bonemeal-derived organic fertilizer pellets compared to diammonium phosphate and a synthetic fertilizer blended with humic acid. Each of the four P sources were amended to four soils: a coarse-textured low P status soil, a coarse-textured high P status soil, a fine-textured low P status soil, and a fine-textured high P status soil. For each soil, there was an unamended control, and each treatment combination was replicated four times. Phosphate-P concentrations in the soil solution were assessed weekly for four months. As expected, P concentrations tended to be greater for synthetic versus organic inputs for both coarse-textured soils and for fine-textured high-P status soil. However, in the fine low P-status soil, P concentrations in algae-amended soils tend to outpace the P concentrations in the other fertilizer treatments. This suggests that algae may be a promising P fertilizer substitute in soils with high P sorption capacity. P concentrations were relatively low and increased slowly following organic P amendments, suggesting a slow rate of P mineralization. However, the percent P mineralized from organic P sources tended to be higher in the fine versus coarse-textured soil. Overall, our findings suggest that the choice of fertilizer P source should be informed by the soil's P status and texture.

Assessing Climatological and Agricultural Influence on California Groundwater Trends

Lily Caplon-Guin, University of California, Riverside

Dr. Hoori Ajami, Eric Wineteer, UC Riverside

Agriculture in California depends heavily on groundwater extraction, which could cause severe groundwater depletion, particularly during a drought. This study investigates the possible correlation between groundwater depletion during a 2010-2018 period in California and the proximity of wells to farmlands. We primarily focus on the differences in groundwater depletion between agricultural and non-agricultural sites and how changes in groundwater levels are influenced by precipitation and drought patterns. Groundwater level observations for 2010-2018 were extracted from California's USGS groundwater level monitoring network. The 2014 California Crop Cover Map was used to estimate the distance between the wells and other major land uses in the state. We included data from 361 wells corresponding to 780,000 measurements for the analysis. We performed exploratory data analysis in

Python to understand trends and variability in groundwater level observations using linear univariate regression models and boxplots, respectively. Preliminary findings suggest that groundwater levels in both agricultural and non-agricultural areas are declining during the analysis period, however, the magnitudes of the trends depend on the precipitation amount at a site. In wells that are located in higher precipitation percentiles, the slope of the trend is much higher for those near the farmlands than non-agricultural land, indicating a faster depletion rate. These early findings show that proximity to farmland correlates to groundwater depletion. Further analysis is needed to explore the role of droughts on declining groundwater levels.

Assessing the Potential of Alternative Phosphorus Sources for CA Agricultural Soils

Karla Cornelio, University of California, Divison of Agriculture and Natural Resources

Bruce Linquist, UC Cooperative Extension Specialist, Department of Plant Sciences, UC Davis

In California's water-seeded rice systems, both high yields and nitrogen (N) use efficiency are achieved when the pre-plant N fertilizer (usually aqueous-ammonia [aqua-N]) is injected into a dry seedbed before flooding and planting. However, there are situations where applying N fertilizer in this manner is not possible. The objective of this study was to evaluate alternative N management practices by testing different N sources and application times. In 2020, we tested 13 treatments and in 2021, six more treatments were added. The following N sources were evaluated: urea, ammonium sulfate, and three enhanced efficiency nitrogen fertilizers (EENFs). Application times for the EENFs, urea, and ammonium sulfate were one day after flooding and 2 weeks after flooding. Urea and ammonium sulfate were also applied in a four-way split. In 2021, additional treatments were added with aqua-N, ammonium sulfate, and urea applied before flooding, and urea applications at 3, 4, and 5 weeks after flooding. Grain yield and agronomic nitrogen use efficiency (ANUE) were used for comparison. All fertilizer N treatments increased grain yields relative to the zero-N control, which averaged 5093 kg ha−1. Applying aqua-N or urea preplant to a dry soil resulted in the highest yields and ANUE. The EENF fertilizers performed similarly to or worse than urea applied alone. If the field was already flooded, splitting urea applications was the best option. Only one split N treatment was evaluated in this study; this warrants further research on fine-tuning the best N splits for these systems.

Salinity Tolerance and Forage Quality Comparison for Four Varieties of Alfalfa (*Medicago sativa L.*)

Victoria De Leon, California State University Fresno.

Harmanpreet Sharma, Susana Lopez, Anil Shrestha, Sharon E. Benes, Ranjit Riar, Department of Plant Science CSU Fresno

Alfalfa is an important forage for California's dairy industry which leads the nation in milk production. With increasing drought and water scarcity, saline soils and irrigation waters will increasingly be used for forage production. Alfalfa seed companies have foreseen this trend and have invested considerable resources into breeding more salt-tolerant cultivars. In this 8-month, outdoor large pot experiment, four alfalfa (*Medicago sativa*) cultivars were evaluated at five irrigation water salinity levels (0.5, 5, 10, 15, 20 dS/m ECw, mixed salt solution) in a split-plot design. Due to an extended period of extreme heat in July and August, freshwater irrigation was periodically applied, resulting in average irrigation water salinities across the experiment of 0.4, 2.8, 5.4, 9.1 and 13.3 dS/m ECw. The cultivars included two newly licensed materials (B6269 SR and B6604-0588F) from Barkley Seed, Inc., and salt-tolerant (AZ90NDC-ST), and public (CUF 101) controls. At seed germination, V3 (B6269) and V4 (B6604) were much superior to V1 (CUF 101) and V2 (AZ90NDCST), especially at the higher irrigation water salinities. Although the effect of cultivar on cumulative dry matter (DM) yield was not statistically significant, the following numerical comparisons can be made. V2 (AZ90) was the most salt tolerant, followed by V4 (B6604) based on both absolute yield and relative yield (percentage of non-saline control) at the highest salinity levels (5.4, 9.1, and 13.3 dS/m ECw). Both Barkley varieties demonstrated a high level of salt tolerance as judged by their statistically similar yields as compared to V2 (AZ90NDC-ST), the salt tolerant control variety developed at the University of Arizona. More importantly, both Barkley varieties (V3-B6269 and V4-B6604) had very good seed germination under saline exposure (soil moistened with saline solution in petri dishes), maintaining, respectively, 60% and 80% germination even in saline solutions of 20 dS/m ECw. At the two highest salinity levels, B6604 (V4) had significantly higher seed germination than the other varieties and numerically, it had slightly higher cumulative yield than V3 (B6269) on an absolute basis. Overall, we would judge B6604 to be more salt tolerant than B6269 based on its higher seed germination under saline exposure.

The Role of Irrigation Management for Improving Nitrogen Use Efficiency in Broccoli

Shane Egerstrom, California Polytechnic State University, San Luis Obispo

Charlotte Decock, Matt Grieshop, Ria Chabra, Allison McLoughlin, Grimm Family Center for Organic Production and Resarch, California Polytechnic State University, San Luis Obispo, CA. Michael Cahn, UCCE Monterey County

The regulatory limits imposed by the Central Coast Regional Water Quality Control Board's Agricultural Order 4.0 create the need for careful accounting of N applications from all sources, including irrigation water. However, when irrigation water was used as a source of nitrate without supplemental fertilizer, commercial broccoli growers were unsuccessful. Because nitrate from irrigation water needs to remain in the root zone to be useful to the plant, the question is raised on how irrigation management affects nitrogen use efficiency (NUE). Soil type, organic matter content, and management may all influence the rate of leaching and therefore the effect of irrigation management on NUE. We plan to study the effect of management and field characteristics on NUE by carrying out 8 controlled field trials, 4 on organic

and 4 on conventional broccoli fields. Results from the first trial, a conventional broccoli field in Santa Maria, CA will be shown. Field trials are set up as a full factorial split-plot design with three blocks and two factors, irrigation management and N rate. Three beds follow the irrigation schedule of the collaborating grower, and three beds follow ET (evapotranspiration) based irrigation scheduling as recommended by CropManage. Each bed has five 100 ft subplots that range in fertilizer application from 0 lbs N/acre to 300 lbs N/acre. Soil samples to a depth of three feet are taken before planting, before each fertilizer application, and at harvest to assess the soil mineral N and calculate N budgets. At harvest, plant samples are taken to assess N uptake. Based on previous trials examining the effect of irrigation management on NUE, we expect the ET based irrigation scheduling to improve the crop NUE. Because organic based fertilizers are slow release as they become mineralized, we expect the effect of irrigation management to be smaller in organic fields versus conventional fields, especially when nitrate concentrations in irrigation water are low. Future field trials will bring comparative insight into the effect of organic management, and variation in groundwater nitrate contamination on NUE.

Evaluating Bacterial Diversity in Steam Fumigation Treatments in the Salinas Valley's Lettuce Fields

Erika Escalona, University of California, Davis

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As the specter of climate change looms larger, sustainable and environmentally friendly alternatives for pest and pathogen control in agriculture are becoming increasingly imperative. Steam fumigation, once an antiquated method overshadowed by chemical pesticides, is experiencing a resurgence due to heightened environmental concerns. Despite its historical use, there has been limited exploration of scaling up steam fumigation for field applications in vegetable crops. Although existing studies have highlighted the efficacy of steam fumigation, a critical knowledge gap persists regarding its impact on the soil microbiome, a fundamental determinant of agricultural productivity. This study seeks to advance the validation of steam fumigation as a practical alternative to chemical fumigation by conducting a comprehensive assessment of vegetable productivity in lettuce and spinach grown in steamed soils versus non-steamed soils. The experiment utilized a custom-built steam applicator equipped with a low-pressure 1,000 kg/hour steam generator in Salinas, CA, during 2022 and 2023. All research and trials were conducted at the Salinas Extension and USDA Center. Soil samples were collected before and after steam application, and crops were meticulously monitored for disease and weed control, alongside yields at harvest. Preliminary results indicate effective weed control and increased yields in the presence of disease pressure. In addition to evaluating the efficiency of steam fumigation in weed and pathogen control, this study delves into a thorough investigation of the bacterial diversity of soils. The trials, conducted from July 2023 to August 2023, involved verifying the performance of the steam applicator, assessing beneficial soil organisms using 16S sequencing, and evaluating treatment impact on bacterial diversity. By examining the results obtained from these multifaceted trials, we aim to provide comprehensive insights into the overall effectiveness of steam fumigation and its potential application in sustainable agriculture practices, with a specific focus on its influence on the soil microbiome.

Evaluating Nitrogen Management in No-Till and Conventional Tillage Systems of Sacramento Valley's Rice Fields

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No-till agriculture is gaining traction as a conservation management approach, offering potential advantages such as reduced soil erosion, enhanced soil health, lower production costs, earlier planting, and sustainable long-term crop productivity. While widely adopted in various agricultural contexts, the application of no-till methods in rice farming is not as prevalent. Previous studies have presented inconsistent yields, emphasizing the need for further investigation to understand the limiting factors. Conducting additional research will contribute to a deeper understanding of these constraints, enabling more informed decisions for refining future rice farming practices. This study specifically explores a modified no-tillage system, where field preparation occurs during the fallow summer period. We are assessing the feasibility of directly flooding and air-seeding these fields in the following year without additional tillage both on-farm and on-station. This study aims to evaluate and compare nitrogen management practices in no-till and conventional till systems in order to achieve maximum yields. Data were collected from six on-farm sites throughout the Sacramento Valley in 2022 and 2023 and from a replicated trial at the Rice Experiment Station (RES) in 2023. At each of on-farm sites over these two years, 1-acre portions of the growers' fields were marked off with a no-till area directly adjacent to an area that was conventionally tilled. At the RES, four basins (replications) were managed with the same no-till and conventional treatments as the on-farm trials. Nitrogen rate trials, pest, and weed monitoring areas were set up in each system at all sites. Preliminary data shows that overall, conventionally tilled rice had higher yields than no-till rice, but both system yields reached maximum yield at 175 lb N/acre. Additional findings indicate potential differences in weed and pest pressure between the two systems, with an overall higher percentage of stem rot and aggregate sheath spot, and watergrass, found in conventional till tha no-till when present. This data will be supported by the yields, weed, and pest pressure data from the RES systems site.

Surface Water and Groundwater Chemistry Variability in the Southern Sierra Nevada

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Mountains are an important source of water in arid and semi-arid environments. Given the higher elevation of mountains, mountains receive higher precipitation mainly in the form of snow which means more water will be available for streamflow and groundwater recharge. However, there is uncertainty how hydrologic processes in the mountain catchments control groundwater recharge processes. We aim to investigate the temporal and spatial variation of surface water and groundwater chemistry in the Kaweah River watershed in the Southern Sierra Nevada to better understand processes that control water chemistry. We analyzed monthly river and well samples for the 2022-2023 period to determine the alkalinity and pH of samples as well as major ion chemistry. Our results show that rivers located in the upper regions of the watershed have lower concentrations of ions. This is likely due to snowmelt contribution compared to rivers located in the lower regions. Our next steps would be to implement a mixing model to quantify proportions of groundwater discharge to stream along elevation gradient and

continue collecting and analyzing more samples to further examine the temporal changes in the stream chemistry.

Enhancing Vineyard Soil Health through Cover Crop Integration: Impact on Soil Microbial Community Structure and Enzyme Activities

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Growing concerns regarding sustainable use of land and water resources and nitrogen fertilizers as well as carbon emissions, have prompted California growers and researchers to explore methods for enhancing ecosystem health in perennial crop systems. One promising approach involves the implementation of cover crop systems, which have the potential to increase soil carbon, and particularly organic carbon—benefiting the soil microbiota. Addressing a knowledge gap regarding the impact of cover crop systems on dynamic soil properties, this study specifically investigates the response of soil microbial community structure, enzyme activities, and soil organic carbon content. Soil samples were collected from 1- and 4-year-old cover-cropped vineyards, comparing soil conditions beneath inter-row cover crops, interrow spaces maintained bare, and adjacent vines with bare soil. The study also contrasts the influence of introduced and native cover crop plant species on the soil biota, carbon levels, and dynamic soil properties over a production season. Employing routine soil chemical analyses, quantification of soil permanganate oxidizable carbon (POXC), phospholipid fatty acid (PLFA) analysis, and soil enzyme assays (specifically ß-Glucosidase), the study aims to provide insights into the response of these dynamic soil properties to cover crops. Preliminary findings from the previous season do not reveal a significant increase in the metrics mentioned through ANOVA ($P<0.05$) for the cover-cropped areas. It is pertinent to note that one of the fields encountered frost conditions, impacting the cover crop by diminishing biomass and potentially moderating its beneficial effects on the soil. However, amidst these challenges, there is a noteworthy increase in the mean levels of soil enzyme ß-Glucosidase and microbial abundance compared to bare soil across the fields. The heightened values imply a potential continual increase, aligning with trends observed in previous years where microbial abundance showed a significant difference. This underscores the potential positive influence of cover crop systems on soil health within vineyard ecosystems. Ongoing measurements will be conducted over the next few years to further explore these trends.

Advances in Paper Circular Chromatography for Qualitative Soil Health Assessment on Cropland

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In recent years, agricultural systems have been encouraged to shift and focus on more sustainable practices. When farmers prepare for a new growing season, soil nutrient content and fertility are crucial factors for success. Up until now, data corresponding to soil nutrient status is obtained through quantitative lab tests. The Paper Circular Chromatography (PCC) technique is a qualitative approach that produces distinctive visual characteristics including colors, channels, spikes, and concentric rings which can be correlated to soil porosity, mineral and organic matter content, and microbial enzyme activity.

Based on chromatography principles, the PCC test consists of a circular paper filter treated with silver nitrate and a soil sample treated with sodium hydroxide. Conventional quantitative lab tests although effective would benefit from the addition of a holistic qualitative tool like PCC as it would allow growers to increase soil health through the evaluation of the results. Additionally, because this is a low-cost approach farmers of all economic standpoints are able to obtain on-farm timely data to achieve their sustainability goals while they improve their soil health. Samples from six soil management scenarios were taken and evaluated. The distinct scenarios varied through practices of high agricultural disturbance, fields treated with sustainable practices like cover crop rotations and reduced tillage, resting lands, and undisturbed land like grasslands and forests. This was done to offer us results that could show how these different practices have an effect on the results shown from the PCC. Through the evaluation of both the PCC's features and corresponding quantitative tests, we evaluated the validity of PCC results. A second objective of our research focused on the grower's perception and willingness to adopt PCC as a part of their soil health monitoring proces.

Carbon and Nitrogen Mineralization from Oat and Fava Bean Residues in Community Garden Beds

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There are many potential benefits when implementing cover crops in conventional agriculture, and the practice is vital in sustainable farming systems. Existing studies have examined the decomposition and nutrient mineralization patterns of cover crops such as oat (*Avena sativa* L.) and fava bean (*Vicia faba* L.) in field soils, but there is limited information on cover crop decomposition and nutrient mineralization in raised beds containing heavily amended soils or other growing media with large organic matter fractions. Our objective in this experiment is to assess carbon (C) and nitrogen (N) release patterns from cover crop residues in community garden raised beds. We are testing residues from oat, fava, and an oat/fava mixture. Cover crop residues in mesh bags were placed on the soil surface or incorporated into the soil of raised beds planted to several different crops, including leafy greens and strawberry (*Fragaria* x *ananassa*). This experiment is being conducted in raised beds at California State University, Monterey Bay and the Oak Woodland Community Garden in Marina, CA. Our results will contribute to a better understanding of N mineralization patterns from cover crop residues. This information can be used in community gardens, which often serve economically disadvantaged communities with limited resources. Community gardeners will be better positioned to avoid unnecessary expenditures on fertilizers by having an improved understanding of the amount of N provided by cover crop residues. Future research may include testing other cover crop species and the impact of irrigation practices on cover crop nutrient mineralization.

Effects of Pellet Density in Organic Fertilizers on Nitrogen Mineralization

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Many different forms of organic fertilizer are being offered in pellets for grower convenience, but not much is known about how pelletization impacts the rate of nitrogen (N) mineralization. Because organic

growers rely on microbes to convert the fertilizer N to a plant-available form through mineralization, this gap in knowledge can leave growers in the dark about how to time applications based on when N will be available for plants. This study aims to determine how the pellet density index (PDI) impacts N mineralization rate. We incubated soil for 5 weeks with four organic fertilizers, referred to as 91% PDI, 84% PDI, 76% PDI, and mash (unpelleted). For each fertilizer source, we included treatments where the fertilizer was crushed vs. left intact. In addition, there was an unamended control treatment. Each treatment combination was replicated 5 times. The soil was sampled on days 0, 7, 14, 21, 28, and 35 of the incubation for analysis of ammonium and nitrate. We hypothesized the crushed treatments would mineralize faster than the intact treatments because of the increased surface area. Furthermore, we expected that the higher PDI crushed treatments would mineralize faster than the lower PDI crushed treatments because of their lower amount of binder, and that the lower PDI intact pellets would mineralize faster than the higher PDI intact pellets because the lower PDI pellets would fall apart easier. Preliminary results show no effect of PDI on N mineralization but crushing tends to increase mineralization on certain days. Overall, the total amount of nitrogen mineralized over the course of the incubation is relatively low, possibly because of high residual nitrate concentrations at the start of the incubation. Further research should examine the impact of pellet density on nitrogen mineralization in a variety of soil types.

Developing Crop Water Requirements & Crop Coefficients for Drip Irrigated Sorghum in Central California

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Conserving water for efficient irrigation management is essential, specifically in California, which regularly faces water scarcity challenges. Agriculture is a vital component of the state's economy and a robust consumer of water resources. Water conservation can be achieved by developing new crop water requirement estimates (CWR) and optimizing irrigation scheduling for high-demand agriculture productivity in California. The most accurate and precise technique to determine CWR involves the measurements of crop evapotranspiration (ETc) and crop coefficients (Kc) using precision weighing lysimeters (WL). This study aims to develop seasonal ETc and Kc for forage sorghum growing under surface irrigation in the Central Valley of California with a WL. During the 2021 growing season, we observed that seasonal ETc for forage sorghum was 870 mm, for 2022 was 665 mm, and for 2023 was 696 mm. At the same time, the average mid-season Kc was around 0.90 in 2022 and 1.19 in 2023. In addition, we also analyzed the relationship between forage sorghum Kc and fractional groundcover (Fc). We observed a strong correlation with an R2 of 0.96 between the two factors, indicating that Kc could be estimated from Fc measurements. This study represents the exact ETc and Kc for forage sorghum in California. This study represents the first experiment determining ETc and Kc for forage sorghum grown under drip irrigation in California. Findings also demonstrated the variability of CWR based on seasonal differences.

Web Application for Precision Irrigation Management – FAO-56 method

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Efficient water management in agriculture is crucial for optimizing crop yield and conserving resources. Precision irrigation systems offer a solution by tailoring watering schedules to the specific needs of crops based on various environmental and agricultural factors.This project presents a novel web application designed to assist farmers in determining precise irrigation requirements for annual and tree crops. The application calculates irrigation needs using the FAO-56 dual crop coefficient, incorporating real-time crop data, weather conditions (CIMIS), soil profiles, prior irrigation events, and crop characteristics. The web application integrates a user-friendly interface that allows farmers to input their farm details, such as crop type, soil texture, and irrigation system specifics. It uses these inputs along with forecasted weather data to compute the necessary irrigation volume and schedule, employing the FAO-56 dual crop coefficient approach for enhanced accuracy. A distinctive feature of the app is its adaptability; farmers can adjust farm parameters throughout the growing seasons as needed, and the system recalculates the irrigation recommendations accordingly. This dynamic adaptability ensures that recommendations remain relevant and precise, taking into account the ever-changing conditions of the farm and environment. The implementation of this web application aims to improve irrigation practices by providing tailored more accurate recommendations, reducing water waste, and improving crop management. By aligning irrigation practices with precise water requirements, the application supports sustainable farming and resource conservation.

Assessing Long-term Impacts Of Regenerative Management Practices On Vineyard Soil Health

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Vineyards are often developed on slopes or marginal lands, which results in soils that are particularly susceptible to erosion and degradation. To help mitigate these impacts, regenerative management methods— including the use of cover crops, conservation tillage, compost application, and livestock integration— can be used to improve soil health and increase soil organic matter. These practices can also improve crop productivity and quality, water holding capacity, nutrient availability, biodiversity, and carbon sequestration within soils. There has been widespread interest in the potential benefits of regenerative viticulture; however, there has yet to be an accepted rating system to monitor and evaluate the overall effects within the viticulture sector. Given that building soil health is a slow process, our understanding of the impacts of regenerative practices on soil health in California vineyards is further hampered by limited availability of long-term data on management effects. Moreover, regenerative agriculture explicitly promotes the adoption of multiple conservation practices, but the benefits of stacking practices are poorly understood. This lack of knowledge has stunted adoption rates of regenerative practices and created hesitation among growers. To improve soil health and create more resilient agricultural systems, this project aims to assess the effects of long-term management practices on vineyard soil health across an edaphoclimatic gradient in California. Soils were collected from eighty-seven different vineyard blocks across California, specifically targeting vineyard blocks where one or several regenerative practices have been adopted for five or more years. Following recommendations

from the Soil Health Institute, all samples will be analyzed for a minimum suite of soil health indicators for agricultural soils which include soil organic carbon concentration, carbon mineralization potential and aggregate stability. For each vineyard block, growers completed a qualitative survey reporting on the management history and the performance of the vineyard in relation to yield, crop quality, water, nutrient, and pest management. By linking grower surveys with biophysical data, we seek to understand the impacts of long-term adoption of regenerative management practices on vineyard soil health.

Bias Correcting Simulated Streamflow by Utilizing Random Forests and Linear Regression Models

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Climate change and water management in the Colorado River Basin have severely declined streamflow in recent decades. This has affected key agricultural regions around the Salton Sea as runoff from the basin dwindles. Streamflow observations at Lees Ferry Arizona, located at the Upper Colorado River Basin, have been utilized for bias correcting time-series of simulated streamflow under historic and climate change scenarios. Simulated streamflow from thirty-one global circulation models that represent Representative Concentration Pathways (RCPs) of 2.6, 4.5, 6.0, and 8.5 were used in our analyses. Beginning from the lowest to largest, the numerical values of the RCPs represent the predicted concentrations of greenhouse gas emissions in the year 2100. An Exploratory Data Analysis (EDA) was first performed to compare simulated streamflow at different time periods with observations. Time-series regression models represent a significant declining trend in simulated flow and intra-annual plots display strong seasonality when compared to observed streamflow. Root mean square error (RMSE) ranges from 250m^3/s to 1500m^3/s in summer months indicate large differences with observations. Deviations from streamflow observations display most data points concentrated around zero suggesting the projected streamflows are within the range of the observed value. To identify the most efficient method for bias correcting streamflow, both a linear model (LM) and a random forest (RF) model were constructed. The LM model was constructed using RCP deviations as individual target variables and their respective simulated RCPs as predictor variables. Predicted streamflows from the linear regression models had an average RMSE of 166.2m^3/s and an average R^2 of 0.03% indicating poor performance. Next, the RF models were trained using observed streamflow as the target variable and a simulated RCP flow as a predictor variable. RF models had an average RMSE of 131.1m^3/s and an average R2 of 0.02%. Further investigation is required to determine if introducing predictor variables such as temperature and precipitation will improve accuracy of the bias correction models.

Testing Plant-Based Carbon Nanoparticles on Arugula for Improved Yields and Nitrogen Recovery

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In the Salinas Valley, a recent regulation (Ag Order 4.0) places limits on nitrogen (N) fertilizer application on cropland. As a result, growers are searching for ways to reduce N fertilizer use without compromising crop yields. Plant-based carbon nanoparticles (CNPs) are relatively new to the agriculture industry, presenting a largely unexplored area of research in N management. Some recently developed CNPs are made from agricultural byproducts and have been mixed with fertilizers to stimulate growth, regulate N uptake, and reduce N inputs in corn (*Zea mays* L.). However, the impact of CNPs on baby greens yields, N recovery, and root growth dynamics has not been thoroughly investigated. Our preliminary results with head lettuce (*Lactuca sativa* L.) grown in pots containing sandy loam soil from the Salinas Valley have shown positive yield and N recovery responses to low dosages of CNPs. Building off this success, our objective in this study is to quantify the effects of different CNP application rates on arugula (*Eruca sativa* Mill.) yields and N recovery as well as root growth and morphology using two different agricultural soils (sandy clay loam and sandy loam) commonly found in the Salinas Valley. The study consists of two greenhouse pot trials, each of which will be replicated. Data collected from this study will be used to inform decisions about future field studies in which CNPs will be tested on the most responsive soils and at optimal rates. Here, we present preliminary findings from the sandy clay loam soil.

Offsetting Inorganic N Fertilizer Requirements with Organic Amendments: Their Influence on Forage and Grain Yield Response

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There is increasing interest in applying recycled organic waste streams such as compost, digestate, or hydrolysate to agricultural soils in California to help meet statewide GHG reduction targets. However, there is little information on how these amendments influence crop response to applied N fertilizer. The objective of this study was to determine how digestate and hydrolysate influenced in-season crop N status and productivity (forage and grain yields) for wheat and triticale grown in California. Nitrogen response trials were implemented with and without amendments at two sites in the 2022-23 season. In-season crop N status was measured using drones and handheld sensors. Results for forage and grain yields will be discussed with a focus on the potential for digestate and hydrolysate soil amendments to reduce inorganic N fertilizer requirements.

Developing Black Soldier Fly Frass as Soil Amendment and Biofertilizer for Melon

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As commercial agriculture faces soil management challenges, including nitrogen leaching, loss of soil microbial diversity, and topsoil erosion, new forms of soil amendments should be investigated. The Black Soldier Fly (BSF), *Hermetia illucens*, is an insect whose larvae can feed on food and agricultural waste and is currently being utilized in pilot waste processing facilities. The largest BSF waste management facility output by volume is insect manure or BSF-Frass (BSF-F), a nutrient-rich (3-2-2) soil amendment byproduct that recycles nutrients back into agriculture. Previous studies in maize show that BSF-F, consisting of minerals, organic matter, microbiota and chitin, can be applied in combination with Synthetic NPK to improve nitrogen-use efficiency. BSF-F was approved in California as a soil amendment, but we lack information about appropriate doses and benefits for the significant commodity: melon (cantaloupe) (*Cucumis melo* L.). To address knowledge gaps, we evaluated BSF-F as a nitrogen source for cantaloupe plants relative to Synthetic NPK, Chicken Manure, and Untreated control in the greenhouse and field. We hypothesized that BSF-F will positively affect cantaloupe growth and yield metrics and could supplement or replace conventional fertilizers. Greenhouse trial results suggested that amendment with BSF-F requires six and four times more nitrogen based on total nitrogen (471 kg N/Ha and 314 kg N/Ha) to produce similar shoot and root biomass as Synthetic NPK and Chicken manure applied at 78.5 kg N/Ha, respectively. In the field, BSF-F applied at 471 kg N/Ha was an effective standalone fertilizer producing significantly more shoot biomass and total slipped fruit yield in comparison to Chicken Manure (78.5 kg N/Ha), Synthetic NPK (78.5 kg N/Ha) and Untreated. We also conducted a Frass-Synthetic NPK Complementation Trial comparing different ratios of these two nitrogen sources based on plant available nitrogen. Observations suggest replacing 25% of plant available nitrogen from Synthetic NPK with BSF-F can produce similar biomass and leaf count as 100% Synthetic NPK (78.5 kg N/Ha). Future directions include microbiome analysis and BSF-F mineralization assays to understand the release of plant-available nitrogen from frass to make application recommendations.

Site-specific Estimations of N mineralization in the Central Valley Using an N Budget Approach

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In California, maintaining groundwater quality is of critical importance as one of the nation's most productive agricultural regions. One approach to tackle water quality issues such as groundwater contamination with nitrate is by providing tools to farmers that allow them to improve nitrogen (N) use efficiency. Our research is aimed at filling a gap in the literature by developing a tool that allows farmers to accurately estimate site specific non-fertilizer N release from native soil organic matter, and thus apply less fertilizer while developing effective pollution abatement strategies for their specific crop types. The annual crop types we focus on in this study include corn, sunflower, spring wheat, and cotton. Our approach to address our research objectives included assessing how much N our crops accumulate in their above ground biomass and determining how much of that N can be provided by non-fertilizer sources, and to validate our previous estimates of native N mineralization via field trials featuring N fertilizer exclusion zones. We utilized this data to develop N budgets for our crops and then

estimated N mineralization from soil organic matter after accounting for all other non-fertilizer N sources. We observed that our low organic matter sites (< 3%) mineralized a greater proportion of total N during incubation than their high organic matter (> 3%) counterparts. The calculated average N mineralized over the growing season in the top two 60 cm of the soil profile for high organic matter sites and low organic matter sites was 383 and 120 kg N ha-1, respectively. We also observed that peak N uptake for corn, sunflower, cotton, and wheat was estimated to be 3.2, 3.1, 2.7, and 5.1 kg N ha-1 day-1, respectively. By taking all site-specific non-fertilizer N sources into consideration, growers will be able to confidently reduce their fertilizer applications, environmental impact, and management costs.

Evaluating Nitrogen Availability from Organic Amendments in Organically Managed Processing Tomatoes in the California Central Valley

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To meet the requirements of state regulatory programs, California growers must minimize nitrogen (N) losses through improved management practices. This is particularly challenging for organic growers due to the variable nature of organic N sources that must be mineralized by microbes to become plant available. Furthermore, the rate and total amount of N availability is dependent on the composition of the material and environmental conditions. To assess N dynamics in organic agricultural systems, a randomized complete block design field trial was conducted in an organically managed processing tomato field in Esparto, CA. In addition to an untreated control, four amendments including a mixed blend compost, soymeal hydrolysate, and organic pelleted 4-4-2 & 6-6-2, were each applied at a rate equivalent to 44 lbs. available N/acre. Soil samples were analyzed every four weeks for total mineral N down to six inches during the growing season. Data collection included soil characterization, whole plant N uptake, yield, soil temperature, and moisture. Total carbon and nitrogen were also analyzed for all amendments. An ANOVA revealed a significant main effect ($p < 0.05$) and a Tukey test identified the compost experienced significantly lower residual N than other treatments (adjusted $p < 0.05$). Pelleted materials and soy hydrolysate demonstrated the highest net N mineralization within 4 weeks after application, with no significant difference between them (adjusted $p < 0.05$). An ANOVA did not reveal any yield differences between treatments (p-value = 0.210). These findings highlight the importance of timing fertilization with crop demands to reduce N losses. Additionally, the composition of the organic N source proved a crucial factor, leading to significantly different N availability.

Measuring Soil Salinity Using Spatial Analysis

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High-quality irrigation water is becoming scarce in California prompting the use of lower-quality, saline waters for irrigation. The 6500-acre San Joaquin River Improvement Project (SJRIP) located in the Grasslands Drainage Area reuses saline drainage water from 98,000 acres of productive farmland to irrigate salt-tolerant forages. To maintain the long-term sustainability of forage production under saline drainage water (4 to 8 dS/m ECw), decision support tools are needed to monitor soil salinity and its

spatial variability. One of these tools is the use of EMI (electromagnetic induction) sensors such as the Geonics EM38 and the CMD Mini-Explorer for ground surface mapping of the soil salinity for the generation of spatial maps to show the distribution of the salinity laterally and with depth. Our group is also analyzing satellite imagery to determine whether it can be a useful tool to detect forage yield decline under hypersaline conditions. The EM-38-MK2 was mounted on a non-conductive PVC sled and dragged behind all-terrain salinity surveys. The GPS unit was placed on the ATV to record the geographical coordinates vehicle (ATV) to perform the salinity surveys. The GPS unit was placed on the ATV for the EM measurements. It measures apparent electroconductivity (ECa) Data is used to generate smart-sampling design with the ESAP software. The ECa measurements for each survey were transformed into ECe estimates using spatially referenced multiple linear regression models by the ESAP-Calibrate program. A set of ECa readings, known as Calc ECa, was estimated using Rhoades' equation based on the measured salinity (ECe), SP, and water content values. This was done as part of the DPPC (dual pathway parallel conductance) correlation study. As a quality control measure, this analysis gave a theoretical value for the ECa measurements at each sampling point. Additionally, correlations between the measured and computed ECa, ECe, and other soil characteristics were carried out. Lastly, a spatially referenced regression model was created to forecast the salinity levels' logarithm (ln ECe) for each sampling location site and depth within the surveyed area. The collected data is displayed on ArcGIS using coordinates and analyzed specifically. Spatial patterns of soil salinity are compared for a better understanding of salinity and the type of forage production to be grown over that area.

Evaluating the Performance of the DayCent Biogeochemical Model to Predict N_2O Emissions from Select CDFA Healthy Soils Program Practices

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California state agencies employ multiple models to account for the environmental impacts of agricultural conservation management practices. The DayCent biogeochemical model, the backbone system informing CDFA's COMET-Planner, simulates C and N cycling through the soil, plant, and atmospheric systems. Model iterations are carried out at daily time steps, providing for a high-resolution picture of nutrient and gaseous fluxes. Using the data from a CDFA Healthy Soil Program Project field trial in cool-season vegetables that included two recommend practices - Compost Application and Nutrient Management - we compared measured values and model outcomes. Here, the current "out of the box" DayCent model was run and compared to static chamber GHG measurements taken over a single growing season. Model performance was quantified using various statistical measures including root mean square error (RMSE) and coefficient of determination (r^2). Overall, the model tended to overestimate N loss as N_2O. The model fit to measured data was poor (RMSE = 28.47; r^2<.01). The difference between total emissions for the treatments receiving compost were much higher than for those not receiving compost. For example, in the Grower's Standard treatment the model estimated an N_2O-N loss of 20.71 g N ha^{-1}, whereas the measured value was 8.12 g N ha^{-1}. Our direct measurements show that much less N_2O is likely being lost from the system under conservation management than the model estimates. It is imperative that the model is improved before it is used to account for agricultural GHG emissions from California specialty crop systems.

Can Satellite Time Series Data Discern Spatial Patterns in Dry Matter Yield in 'Jose' Tall Wheatgrass Fields under High Salinity Conditions in the San Joaquin Valley of California?

Mauricio Soriano, California State University, Fresno

Sharon Benes, Department of Plant Science, CSU Fresno. Nigel Quinn, HydroEcological Engineering Advanced Decision Support, Lawrence Berkely National Laboratory; Elia Scudiero, Department of Environmental Sciences, UC Riverside.

As the San Joaquin Valley continues to face drought and environmental policies, alternative waters that are often saline will increasingly be used for irrigation. Using saline water for crop irrigation has benefits for water conservation, but it poses some challenges such as salt accumulation in the root zone, potentially leading to osmotic and toxic ion stress in the crop. The use of time series data from satellite imagery has shown promise for predicting vegetation seasonality and allowing growers to maximize yields. Nevertheless, frequent data loss due to climate variability, erratic time sampling and insufficient ground-truthing threatens the accuracy of these modeling techniques. The San Joaquin River Improvement Project (SJRIP) is a 6,500-acre facility located in the Grasslands Drainage Area that reuses saline drainage water coming from 98,000 acres of productive farmland to irrigate forages and reduce saline discharge into the river. The intent of this research is to provide rapid and accurate decision support tools to SJRIP managers by developing a prediction model, based on time-series data, of *Thinopyrum ponticum* var. 'Jose' growing seasons using satellite images and vegetation indices. Using four fields ranging from 70 – 128 acres, satellite images from Sentinel-2 will be analyzed, and indices like Normalized Difference Vegetative Index and Soil-Adjusted Vegetative Index will be calculated and compared to forage dry matter yield to determine whether time series data can guide harvest periods and/or identify declining yield due to salt accumulation in the root zone. The overall objective of the research is to assess the potential of using satellite imagery as a management tool for tall wheatgrass production under saline-sodic irrigation to improve the long-term sustainability of the forage production.

A Quantitative PCR Assay For The Detection Of Fusarium Oxysporum f. Sp. Vasinfectum Race 4 From Plant And Seed Tissues

Michael Urner, California State University, Fresno

Michael Urner, Margaret L Ellis, Robert Hutmacher and Mauricio Ulloa, CSU Fresno

Fusarium oxysporum f. sp. *vasinfectum* (FOV) is a pathogenic soil borne fungus responsible for Fusarium wilt in cotton (*Gossypium* spp.). There are multiple races of FOV, but FOV race 4 is the most economically damaging race that threatens California cotton production. The purpose of this study was to evaluate a previously developed quantitative PCR (qPCR) assay as a potential diagnostic tool for the identification of FOV race 4 from contaminated plant materials. Briefly, cotton plants from fields with known FOV4 contamination were harvested just prior to defoliation and harvest. The stems were cut into 3-inch increments starting at the base of the stem and DNA was extracted from the stem segments using a commercial kit. FOV race 4 was detected from the stems and there was also a reduction in FOV race 4 DNA amplification in stems further from the stem base. There was no amplification of FOV race 4 DNA in the tip of the infected cotton plant. We also tested the ability of the qPCR assay to potentially detect FOV race 4 contaminated seeds. A tissue titration was made using cotton seeds that had been inoculated with FOV race 4 with clean cotton seeds with decreasing concentration of inoculated seed

tissue to determine the lowest infestation rate that can be detected with this assay. Development of this assay will give cotton growers crucial information faster and more accurately than the current methods.

Introduction of Aerobic Soil Conditions to Continuous Rice Enhances Soil Nitrogen Availability

Zhenglin Zhang, University of California, Davis

Zhenglin Zhang, Bruce A. Linquist, Department of Plant Sciences, UC Davis; Daniel C. Olk, USDA-ARS, National Laboratory for Agriculture and The Environment, Ames, IA

Rice in California represents 20 % of total U.S. rice production and is typically grown continuously without rotations. However, recent droughts have forced farmers to fallow their land, creating knowledge gaps in N cycling dynamics due to the extended duration of aeration. A two-year field study was conducted to test the hypothesis that fallow rice (FR), that is, rice cultivation following a fallow season, would have greater N uptake compared to a continuous rice (CR) system. Soil and fertilizer N uptakes were quantified using a 15N trial, where 15N-enriched ammonium sulfate was applied in microplots embedded within larger plots. For both seasons when 150 kg N ha-1 N was applied as a preplant fertilizer, the FR treatment yielded higher than the CR treatment, with yield differences averaging 1.97 Mg ha-1. Examining the sources of N in the plant, on average, soil N uptake in the FR treatment was 16.8 kg N ha-1 higher than the CR treatment at harvest. In contrast, fertilizer N availability was similar between FR and CR. Based on previous studies elsewhere, we hypothesize that the decreased soil N uptake was due to N stabilization by soil phenols that accumulate under continuous rice. Here we found that soil phenols were indeed higher in CR than FR. Complementing the rigorous field study, a region-wide survey study that incorporated 9 paired fields also consistently showed that CR had greater phenol levels compared to FR. Our results support previous findings that continuous rice systems characterized by straw incorporation and prolonged flooding result in reduced N uptake. By introducing aerobic environments to continuous rice soils, in this case an entire season of fallow, productivity can likely be enhanced due to increased soil N uptake. Future work should identify the time spans needed for phenols accumulation to impair soil N cycling under CR and for its reversal by soil aeration, as well as any roles of soil microbial populations in these soil N cycling patterns.

Examining the Impact of Cover Crops on Nutritional Quality in Central Valley Table Grapes

Helen Heng, USDA-ARS

In the face of dynamic environmental factors such as climate change, cover crops have become one mitigation strategy that conserves water while improving soil carbon and nitrogen. In 2022, California accounted for 2 billion dollars alone in table grape sales and is responsible for a majority of table grape production in the United States. Table grapes account for more than a third of global grape production, highlighting their rising popularity in contemporary cultivation and consumption. Grapes are a robust source of nutrition, producing metabolites such as flavonoids, phenolics, catechins and stilbenoids that possess powerful antioxidant, anti-inflammatory and anti-microbial properties. Numerous studies have explored how sustainable agronomic practices like cover cropping influence secondary metabolite production and quality in wine grapes, however, there are few studies that investigate how these practices influence nutrient quality in table grapes. Therefore, this study seeks to investigate how native (*Phacelia tanacetifolia*) and introduced (*Secale cereale* L. 'Merced') cover crops impact the nutritional quality in Autumn King table grapes. Grapes were homogenized and extracted with liquid nitrogen and methanol after harvest. 60 grapes per plot were randomly sampled and stored on dry ice in-field. Post harvest, grapes were stored in a -20ºC freezer before nutrient extraction and analysis. Nutrient composition was determined by ICP-MS on grape subsamples from 12 plots in a randomized block-controlled design located in Parlier, CA. Cover crop impacts on nutritional quality of grapes were examined. More studies are necessary in further assessing the impact of cover crops on grape nutritional composition.

Statistical Sample Area Determination Utilizing Remote Satellite Sensing

Charles Hughes, Crop View Consulting LLLC

Traditional sampling techniques, soil or tissue, rely on randomly selected locations. The methodology described herein is based on plant response either biomass or chlorophyl concentration and statistically determines sampling locations.

The block is first subdivided into Management Zones, (MZ), utilizing a biomass, (MSAVI2), chlorophyl (NDVI Red Edge), map. (based on a satellite image from the European Space Agency Sentinel 2 constellation), or a grower's knowledge of special areas. The MZ represents a more homogeneous area than the whole block. MZ are typically defined for low, medium, and high areas within the block. After converting pixels to points a histogram is plotted for the MZ to be sampled. Bins that are most representative of MZ are chosen and those points are plotted on a map. Bins for the low MZ are chosen from entire the first quartile. This helps to identify limiting growth factors in this MZ. Middle bins are chosen for the medium and high MZ.

The chosen points plotted on the map and a 100-foot sampling circle is drawn around a cluster of points that are located at least 50 feet away from roads. Samples are collected within the circle.

Evaluation of Lettuce Irrigation Application Efficiency in the Salinas Valley During 2022/2023

Lee Johnson, California State University, Monterey Bay; NASA ARC-CREST

California's Central Coast is a major U.S. vegetable producer. Lettuce is a leading commodity, grown on about 100,000 acres in the Salinas Valley with annual value near $1.4B (2022 Monterey County Ag Report). Crops are typically well watered and fertilized in pursuit of commercial yield and quality standards. Information on irrigation application efficiency can enhance water supply sustainability and mitigate impacts of nitrate infiltration on groundwater quality. The Crop Consumptive Use Fraction (CCUF), previously recommended by the Department of Water Resources, is a metric that expresses evapotranspiration (ET) of applied water relative to total applied water throughout the crop cycle. Under Assembly Bill 1668 addressing water conservation and drought planning, the metric can be used to help quantify application efficiency to support preparation of agricultural water management plans. This study evaluated field-level CCUF in 12 commercial lettuce plantings in Salinas Valley during the dry season (late spring-early fall) during 2022 and 2023. Seasonal ET evaluations were derived from satellite data through the publicly available OpenET cloud application (https://openetdata.org/), and from the CropManage (CM) irrigation and nutrient management decision-support system operated by Cooperative Extension (https://cropmanage.ucanr.edu). Applied water was monitored by in-line flowmeters, occasionally supplemented by grower reports of irrigation system runtime. A wide range of application efficiency was observed across 12 commercial fields. Satellite-based CCUF estimates ranged from 0.44-1.03 and CM estimates from 0.39-1.0, where lower values indicate lower application efficiency and values near 1 indicate high efficiency. Generally good agreement was seen between OpenET and CM based results. Mean absolute difference in CCUF across sites was 0.07, or about 10%. Additional evaluations were ongoing in broccoli during late 2023.

Using Cover Crops to Reduce Nitrate Leaching During on-farm Recharge in Small-scale Annual Cropping Systems

Jessica Kanter, UC Cooperative Extension, Fresno and Madera Counties

The Sustainable Groundwater Management Act (SGMA), which requires local water users to bring groundwater use to sustainable levels by 2040, has led to increased interest in expanding groundwater recharge. Recharge happens when water infiltrates deep into the ground to replenish underground aquifers. On-farm recharge is the practice of taking excess surface water and applying it to actively farmed lands for the purpose of recharge. There is still much to be understood about the suitability of certain cropping systems to implement on-farm recharge. Much of the research has been carried out in permanent crops, such as grapes and almonds. While small-scale annual systems have the potential to implement recharge, a concern is that residual nitrates present in annual croplands are very susceptible to leaching when fallow fields are flooded. Planting a winter cover crop may help reduce leaching in a field flooded for recharge, as the cover crops should take up excess nitrogen in the soil prior to flooding with surface water. The purpose of this project is to understand the movement of nitrate with and without a winter cover crop when annual crop land is flooded for the purpose of recharge. A randomized control trial was established at the Kearney Agricultural Research and Extension Center (KARE) in the first year and on a Fresno County vegetable farm in the second year. Data from the first two years of a three year project will be shared, including nitrate levels pre and post flooding at multiple soil depths and total nitrogen uptake in the cover crop biomass. Future plans for additional data collection will also be shared.

Low-tech, Low-cost and Open Source IoT-based Sensors for Water Management in California?

Crystele Leauthaud, UC Cooperative Extension Specialist, University of California, Santa Cruz

Paul Vandôme, Gilles Belaud, G-EAU, Univ. Montpellier, AgroParisTech, BRGM, Cirad, IRD, INRAE, Institut Agro, Montpellier, France

California is facing the challenge to produce sustainably with a water resource under pressure. It is essential to support water users towards better agricultural water management. Although a variety of irrigation monitoring equipment such as sensors are available on the market, they are not widely used by the agricultural community because of their high cost and complexity. Building upon experience undertaken in the Mediterranean region, we present here three types of sensors that can be used to improve monitoring of drip and surface gravitational irrigation. The sensors were designed using a participatory approach in order to take into account water users' requirements. They are based upon open source wireless technology, and have been to designed to be low-energy and economically and technically accessible. The first sensor is a soil moisture device and allows real time monitoring of the fulfillment of the water requirements of an irrigated crop. The irrigation schedule can therefore be adjusted accordingly. The calibration method implemented is simple, based on only one parameter. The two other sensors were designed for surface irrigation at the field level. During a surface irrigation event, water flows according to the slope of the field and it is difficult and time-consuming to predict the optimal time when inflow should be stopped. This system allows: (i) detection of water at the sensor location in the field, (ii) sending an alert by phone to the user and (iii) remote control of surface irrigation gates. These low-cost sensors can be used for real-time irrigation monitoring and as a decision-making tool for water management.

developed around paired eddy covariance towers supported by crop, soil, water, and economic assessments across multiple growing seasons. This provides an integrated assessment of contrasting management systems to enhance our basic understanding, create high quality-high resolution ecosystem scale data, and support modeling to inform policy and farmer support. Two other components of this project are: the California Agricultural Resilience index (an open science model that assess farm practices across soil, water, land use, etc from farm to statewide scales) and a Technical Service Provider training program (supporting workforce training and development of carbon farm and conservation planners). This collaborative interdisciplinary project aims to support the expansion of RA practice to increase agricultural and community resilience and help California continue its leadership role in combating climate change.

Groundwater Protection Targets

Kenneth Miller, Formation Environmental, LLC

Under the Irrigated Lands Regulatory Program, 13 Central Valley Water Quality Coalitions are required to develop Groundwater Protection (GWP) Formula, Values, and Targets. The purpose of the GWP process is to understand the current state of irrigated agriculture with respect to nitrate discharge below the root zone and determine Targets that are protective of groundwater quality. GWP Targets were conditionally approved in June of 2023, meaning that the Coalitions, growers, and their advisors need to begin working towards achieving them. This poster will review key information regarding the GWP Targets and what they mean for growers moving forward.

California Chapter Presidents

YEAR	PRESIDENT	YEAR	PRESIDENT
1972	Duane S. Mikkelsen	2001	Steve Kaffka
1973	Iver Johnson	2002	Dave Zodolske
1974	Parker E. Pratt	2003	Casey Walsh Cady
1975	Malcolm H. McVickar	2004	Ronald Brase
1975	Oscar E. Lorenz	2005	Bruce Roberts
1976	Donald L. Smith	2006	Will Horwath
1977	R. Merton Love	2007	Ben Nydam
1978	Stephen T. Cockerham	2008	Tom Babb
1979	Roy L. Bronson	2009	Joe Fabry
1980	George R. Hawkes	2010	Larry Schwankl
1981	Harry P. Karle	2011	Mary Bianchi
1982	Carl Spiva	2012	Allan Fulton
1983	Kent Tyler	2013	Dave Goorahoo
1984	Dick Thorup	2014	Steve Grattan
1985	Burl Meek	2015	Richard Smith
1986	G. Stuart Pettygrove	2016	Bob Hutmacher
1987	William L. Hagan	2017	Sharon Benes
1988	Gaylord P. Patten	2018	Daniel Munk
1989	Nat B. Dellavalle	2020	Karen Lowell
1990	Carol Frate	2021	Eric Ellison
1991	Dennis J. Larson	2022	Florence Cassel
1992	Roland D. Meyer	2023	Michelle Leinfelder-Miles
1993	Albert E. Ludwick	2024	Daniel Geisseler
1994	Brock Taylor		
1995	Jim Oster		
1996	Dennis Westcot		
1997	Terry Smith		
1998	Shannon Mueller		
1999	D. William Rains		
2000	Robert Dixon		

2024 Business Meeting Agenda

California Chapter of the American Society of Agronomy

February 7, 2024, 12:00 PM

1. **Call to Order** (Daniel Geisseler, President, California Chapter ASA)

2. **Approval of attached business meeting minutes from the 2023 CA-ASA Plant and Soil Conference** (Daniel Geisseler)

3. **Financial Report** (Lauren Hale, Secretary-Treasurer)

4. **Action Item: Update of bylaws** (Daniel Geisseler)
   Correct reference to by-laws of the American Society of Agronomy (see attachment).

5. **Action Item: Announcement of new Executive Committee Member and Nominations of new Governing Board Members for membership vote** (Daniel Geisseler)
   a) Mae Culumber, UC Cooperative Extension, to serve on the Executive Committee
   b) Nominations of new persons to serve on the Council of Representatives
      I. Jeff Mitchell, UC Cooperative Extension
      II. Sangeeta Bansal, CSU Fresno
      III. Charlotte Decock, Cal Poly San Luis Obispo

6. **Announcement of Student Scholarship Award** (Marja Koivunen, Chair of student scholarship committee)

7. **Announcement of Student Poster Awards** (Lauren Hale, Chair of student poster contest committee)

8. **Additional discussion as requested by the membership**

9. **Passing of the CA-ASA gavel to Incoming President** (Daniel Geisseler to Mark Cady, First Vice President)

10. **Thanking of Outgoing President** (Mark Cady)

11. **Business meeting adjourned** (Mark Cady)

Proposed Change to the CAL ASA Bylaws

Article I Section 1 of the by-laws of the California Chapter of the American Society of Agronomy (CAL ASA) (https://na.eventscloud.com/website/58588/by-laws/) refers to Article XI, Section 5 of the by-laws of the American Society of Agronomy. However, in the revised ASA by-laws (https://www.agronomy.org/files/about-society/asa-bylaws-2022.pdf), chapters are described in Article XII Section 4.

Current Article I Section 1:
"The name of the organization shall be the California Chapter of the American Society of Agronomy (California Chapter) as authorized under **Article XI, Section 5** of the Revised By-laws of the American Society of Agronomy, Inc."

Proposed updated Article I Section 1:
"The name of the organization shall be the California Chapter of the American Society of Agronomy (California Chapter) as authorized under **Article XII, Section 4** of the Revised By-laws of the American Society of Agronomy, Inc."

Persons Nominated by the Executive Committee to Serve on the Governing Board

Sangeeta Bansal is an Assistant Professor of Soil Health in the Department of Plant Science at California State University, Fresno. Her research focuses on various dimensions of soil health, and investigating interactions among soil physical, chemical, and biological indicators. Before joining CSU, she served as Postdoc Researcher at the University of California, Davis. As part of the NIFA project, she focused on understanding the strategic adoption of soil health management practices to improve the sustainability of irrigated agriculture. She has specifically studied the effects of regenerative practices in vineyards such as incorporation of cover crops, no-tillage, organic amendments, and sheep-grazing on soil microbial community structure and functions. Sangeeta currently serves as the chair of the Extension Education community of ASA-CSSA-SSSA and has been a member of the National Student Advisory Committee. She also acted as chair for the special session in the Soil and Environmental Quality Division.

Jeff Mitchell is a Professor of Cooperative Extension and Cropping Systems Specialist in the Department of Plant Sciences Science at the University of California, Davis. He received his PhD in Plant Biology from UC Davis. He leads research and extension education programs on conservation agriculture, precision irrigation vegetable crop production systems, and soil health. His focus has been on emerging precision irrigation with conservation agriculture practices and improving production efficiencies in terms of profitability, energy and water use and long-term soil resource quality. He was the primary creator of California's Conservation Agriculture Systems Innovation Center which currently has over 2,200 university, farmer, Natural Resource Conservation Service, public agency, and private industry members and affiliates, and he led the creation of the California Farm Demonstration Network. Recently, he has worked on an NRCS Conservation Innovation Grant focused on organic reduced disturbance vegetable project with more than 20 farmers in CA. He also has taught courses on vegetable production and agronomy at UC Davis for the past 18 years. Before beginning his graduate studies, he was a teacher and served as a US Peace Corps Volunteer in Botswana, in Southern Africa.

Charlotte Decock is an associate professor of soil health and fertility and research affiliate at the Grimm Family Center for Organic Production and Research at Cal Poly San Luis Obisp. Her teaching and research focus on soil health, sustainable plant nutrition and soil conservation management. Her work at Cal Poly aims to contribute to the development and assessment of soil and nutrient management practices that protect soil, water and air resources, while maintaining agronomic productivity and economic viability in California's cropping systems. She earned a Ph.D. in Soils and Biogeochemistry from UC Davis and a M.Sc. and B.Sc. in Environment Engineering from Ghent University (Belgium). During the last 15 years, her research has focused on nutrient cycles and greenhouse gas emissions in agroecosystems around the world; and how they are affected by management practices and climate change.

Dr. Mae Culumber is a UC Cooperative Extension Nut Crop Farm Advisor serving in Fresno County since 2016. Her graduate degrees include a PhD in soil science and a Master's in Ecology, both from Utah State University. Her program focuses on enhancing the viability of nut crop agriculture through applied research and outreach education with emphasis on soil and water conservation, soil salinity management, tree training and pruning, tree nutrition, and pest and disease management. Her research is focused on finding practical, sustainable solutions that are feasible to implement in orchard operations.

California Chapter of the American Society of Agronomy
Chapter Annual Business Meeting Minutes
February 8, 2023, 12:00 PM

1. **Call to Order** (12:30 PM PST by Florence Cassel [CSU Fresno], Past President, California Chapter ASA)

2. **Recognizing a moment of silence for those of us who have passed**

3. **Approval of attached business meeting minutes from the 2022 CA-ASA Plant and Soil Conference** (Florence Cassel)
   Motion to approve minutes: Sharon Benes
   Second: Nick Clark (UC ANR)
   Vote to approve: Motion approved by majority

4. **Financial Report** (N. Clark)
   a. For the 2022 CA ASA Plant and Soil Conference, the UC ANR Conference account beginning balance was $10,876.82. In this account there was income of $9,660.00 from attendee registrations and expenses of $6,368.89 from event planner, credit card, and CA DPR CEU application fees. The ending account balance was $14,167.93.

      The Wells Fargo Conference account beginning balance was $33,518.15. This account was used for collecting income from donations and sponsorships and paying expenses for scholarships and awards. The ending balance of this account was $34,033.78.

      The total CA ASA accounts balance after the 2022 Conference was $48,201.71.

      Motion to approve financial report: Florence Cassel
      Second: Ranjit Riar (CSU Fresno)
      Vote to approve: Motion approved by majority

5. **Action Item**: Announcement of third-year term completion, new Executive Committee Member, and nominations of new Governing Board Members for membership vote (Florence Cassel)
   a. **Completion of third-year term**:
      i. Gina Colfer (Wilbur Ellis), Mae Culumber (UC ANR), & Lauren Hale (USDA-ARS)
   b. Lauren Hale to serve on the Executive Committee
   c. Nominations of new persons to serve on the Council of Representatives
      i. Mark Bolda (UC ANR)
      ii. Wendy Rash (USDA-NRCS)
      iii. Sonia Rios (Bayer Crop Science)
   d. **Nominations from the floor of individuals for service on Council of Representatives:**
      i. None
   Motion to approve the nominations of new persons (5. c. i-iii) to serve on Council of Representatives: Bruce Roberts

Second: Sharon Benes
Vote to approve: Motion approved by majority

6. **Announcement of Student Scholarship Awards (WPHA)** (Mae Culumber, Chair of student scholarship committee)
    a. Maia Crummett (CSU Chico)
    b. Jasper Tao (CSUMB)

7. **Announcement of Student Poster Awards** (Ranjit Riar, Chair of student poster presentation committee)
    a. Undergraduate plant
        i. 3rd Kimberly Holguin, Chico State tied with Hovanness Dingilian, UC Riverside
        ii. 2nd Aubrey Teckam, CSU Chico
        iii. 1st Tyler Barton, CSUMB
    b. Undergraduate soils
        i. 3rd Seth Vicochea, CSU Chico
        ii. 2nd Maia Crummett, UCR
        iii. 1st Jasper Tao, CSUMB
    c. Graduate plant
        i. 3rd Cassandra Tice, CSUMB
        ii. 2nd Gabrielle Celaya-Finke, CSU Fresno
        iii. 1st Erik Spitzer, CSU Chico
    d. Graduate soil
        i. 3rd William Samson, UCR
        ii. 2nd Mauricio Soriano, Fresno State
        iii. 1st Michael Urner, Fresno State

8. **Presentation of Awards to 2023 Honorees** (Florence Cassel)
    a. David F. Zoldoske (presented by Florence Cassel)
    b. Bob Hutmacher (presented by Steve Wright)
    c. Brock Taylor (presented by Timothy Jacobsen)

9. **Additional discussion as requested by the membership**
    a. None

10. **Passing of the CA-ASA Gavel to Incoming President** (Florence Cassel to Daniel Geisseler)

11. **Thanking of Outgoing President, Michelle Leinfelder-Miles** (Daniel Geisseler)

12. **Business meeting adjourned** (2:00 PM PST, Daniel Geisseler)
    Motion to adjourn: Sharon Benes
    Second: Karen Lowell
    Vote to approve meeting adjournment: Motion approved by majority

Evaluation Form 2024 Plant and Soil Conference

American Society of Agronomy
California Chapter

https://na.eventscloud.com/website/58588/

Please send evaluation form or any suggestions about the conference to Daniel Geisseler (djgeisseler@ucdavis.edu) or Mark Cady (mark.cady@cdfa.ca.gov).
Thank you!

Overall Conference Evaluation

	Disagree				Agree
Conference fulfilled my expectations	1	2	3	4	5
Session topics were timely and important	1	2	3	4	5
Presentations were useful and informative	1	2	3	4	5
Amount of time for presentations was about right	1	2	3	4	5
I intend to use what I learned at this conference	1	2	3	4	5
Conference provided good contacts	1	2	3	4	5
Conference poster session was valuable	1	2	3	4	5
Book of Abstracts was useful	1	2	3	4	5
Break sessions were adequate to network	1	2	3	4	5

I attended: ☐ *Both days* ☐ *Day 1 only* ☐ *Day 2 only*

Why did you attend the conference?

How did you learn about the conference?

What did you learn at the conference that you can use?

What session did you value most?

What session topics do you recommend for future conferences?

Please suggest professional agronomists who would be good future board members. Board members identify critical issues to address and help find respected speakers for the conference.

Who would you suggest the Chapter honor in future years? The person should be nearing the end of their career or already retired. Please provide their **name and a brief statement regarding their contribution to California agriculture**. If possible, also provide the name of a person who could tell us more about your proposed honoree.

Additional comments to improve Conference (including facilities, food, participation, environment, other):