California Plant and Soil Conference

Tuesday-Wednesday, February 7-8, 2023

DoubleTree by Hilton Fresno Convention Center

Faces of Conservation, Partners in Stewardship

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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1st Year	Hossein Zakeri	Associate Professor, CSU – Chico hzakeri@mail.csuchico.edu

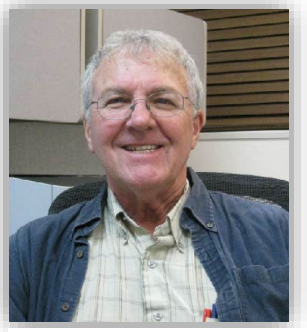
California Chapter Honorees

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

2023 Honorees

Bob Hutmacher

Presented by Steve Wright



Bob Hutmacher, Cooperative Extension Specialist Emeritus, University of California

Bob's parents moved from the Midwest to California right after WWII, settling in Contra Costa County. When he was in elementary school, you could still ride a bicycle out into open range land and small- scale farms growing vegetables, tree crops and grapes before so much of the area was filled in with housing developments. His interest in Plant Sciences grew in Junior High and High School, so he was really excited to be able to go to UC Davis and earn a B.S. in Plant Sciences/Agronomy in 1977. Davis provided so many valuable learning experiences, and even better, he met his wonderful wife, Kay in the dorms at UCD, and they were married in 1977.

Bob worked as a Field Assistant for Farm Advisors Jack Williams and Dave Chaney at the Yuba Sutter UCCE offices. Bob said that "those early UCD opportunities, and associations and learning experiences with UCCE Farm Advisors provided a chance to learn about many aspects of farming operations and solidified his interest in field research and Cooperative Extension."

A move to Texas for graduate school offered a chance to learn about row crop agriculture, soil science and plant physiology. Bob earned his M.S. degree at Texas A&M University, Soil Physics – Agronomy in 1979. While there he especially remembered teachers and mentors Jack Runkles, Terry Howell, Charlie Wendt, Trey Harbert. Bob received his Ph.D. Plant Physiology in 1983 at Texas Tech University, Lubbock, TX. He especially appreciated Texas Tech Univ. Professors Daniel Krieg, Norm Hopper, Jack Gipson, Richard Zartman, and many others including fellow graduate students Terry Kirk, Sid Perry for the practical skills they taught, plus their support.

Bob returned to California in 1983 where he worked with USDA-ARS as a research scientist. His research was focused on plant water status responses, gas exchange, nutrient uptake and growth responses to irrigation and nutrient management in multiple agronomic and horticultural crops, including processing tomatoes, melons, cotton, corn, and almonds. Focus areas of USDA-ARS research conducted included: (a) nitrogen and phosphorus fertilizer management under drip irrigation; (b) salinity management and crop water use in the presence of shallow groundwater; (c) high frequency subsurface and surface drip irrigation management and crop physiological responses to water deficits; and (d) alternative disease management practices to replace traditional fumigants in row crops. Bob credits his success to great bosses and scientists at the USDA-ARS Water Management Lab who offered so many opportunities on cooperative projects and taught him so much (Claude Phene, Jim Ayars, Harry Nightingale), friends and co-workers (Sue Vail, Richard Mead, Merle Peters, Rick Schoneman, David Clark, and many students). Bob became Cooperative Extension Cotton Specialist and AES Agronomist, UC-ANR and UCD Plant Science Department in 1997. Bob also served as Center Director at the UC West Side Research and Extension Center from 2006 until 2022. His research focused on screening work for disease (*Fusarium oxysporum*) resistance in cotton as part of cooperative work with USDA-ARS in CA and Texas. Research included plant breeding and germplasm development, work with "Sticky Cotton", and defoliation/harvest aids, cotton management practices related to deficit irrigation and nutrient

management. A series of projects funded through Cotton Inc. and CDFA-FREP focused on field studies to evaluate cotton nitrogen requirements, yield responses to N fertilization, and soil nitrate-N use of cotton in different soils and field conditions. A more recent study has focused on determining Pima cotton nitrogen uptake and removal under subsurface drip versus furrow irrigation under field conditions.

Bob was primarily responsible for cotton production, but also worked in irrigation and nutrient management in other agronomic crops, including sorghum, wheat, corn and biofuel crops. variety evaluations in sorghum, irrigation mgmt.in crops including, switchgrass, sorghum, corn, sweet sorghum and other potential biofuel crops including winter oilseeds. Bob worked on responses of a range of potential biofuel and alternative forage crops to irrigation management, including deficit irrigation practices. Crop responses to saline water irrigation and crop production under salinity stress has been another research focus in alfalfa and sorghum. Field trial work included identifying potential interactions between production practices and pest management, alternative cropping systems including deficit irrigation and shorter season management, crop responses to and potential nitrogen losses under range of N management practices in cotton and other crops. All these projects were possible and greatly enhanced by having great staff and cooperators, including Mark Keeley, Raul Delgado, Jorge Angeles, Tarilee Frigulti, Mauricio Ulloa, Steve Wright, Lalo Banuelos, Larry Godfrey, Merf Solorio and too many others to list here. Hard-working, eager to learn students and graduate students from multiple institutions (CSU, Fresno, CSU Bakersfield, Cal Poly SLO, and West Hills Colleges, as well as UC), also contributed greatly to many projects.

Bob has written numerous publications and received the Beltwide Cotton Specialist of the year award. Bob was given a meritorious “Award of Excellence” from the CA Cotton Ginners and Growers Association. Bob was on the organizing committee for the World Cotton Conference and an International Drought Conference. He served as an Advisor on multiple industry boards, including the CA Cotton Ginners and Growers Assoc., San Joaquin Cotton Board, the CA Cotton Pest Control Board, multiple committees of the National Cotton Council, representative to multiple USDA Regional Committees. Serving on the Board of the CA Chapter of the CA Society of Agronomy Plant and Soil Conference provided so many great experiences, including the chance to work with a great volunteer board, so many excellent students and supportive industry groups. Bob was a speaker for numerous California, national, and international cotton, agronomy, CAPCA, FREP, and Nitrogen Management Training programs.

After 39 years as an agronomist/plant physiologist with USDA-ARS and then UC Cooperative Extension/ UC-ANR, Bob retired June 30, 2022. He said, “What made his career enjoyable were to be a part of so many cooperative team efforts that tried to address important research and extension needs.” Hutmacher said “On these many projects, we were given the chance to work with and learn from so many farmers who were generous with their time and gave great support and access to their staff and farms. Similar valuable opportunities were offered through work with commodity groups such as the CA Cotton Ginners and Growers Association, pest control advisers and crop consultants, CDFA Quality Cotton and FREP programs, private industry seed companies, the San Joaquin Valley Cotton Board, the San Joaquin Quality Cotton Growers group at Shafter. All these groups added to our ability to work with a great group of USDA-ARS, CSU Fresno, and UC researchers, students, and county staff over the years.

In retirement, Hutmacher and his wife Kay plan to remain in Visalia at least for now, spending at least some time easing out of work responsibilities and “finishing up” a range of projects. They hope to have new travel adventures, and best of all, have more time with family including their three daughters and their spouses plus four granddaughters.

Brock Taylor

Presented by Timothy Jacobsen

Brock Taylor, President, Brock Taylor Consulting

Brock was raised in North Eastern Colorado in a long-time farming family who grew dry land wheat and cultivated other irrigated row crops in both Nebraska and Colorado. From an early age, Brock was passionate about farming and wanted to continue working in agriculture. He obtained his B.S. degree in Agronomy from Colorado State University and later on, received his MBA from Stanislaus State University in Turlock.

Brock started his California career in 1977 with a four-month summer internship in Fresno with J.M. Lord. He was in charge of collecting tissue and soil moisture samples, and quickly learned how to schedule irrigations. Before the end of the summer, he already had four clients of his own and was responsible for scheduling irrigation on their entire farm. The next year, Brock helped the company open an office in Stockton and expand the clientele, while continuing to focus on improving irrigation scheduling on farms.
After graduation in December of 1978 from Colorado State University, Brock started an 18-year career with Vaquero Farms, managing ranches in Firebaugh, Tracy, and Brentwood, CA. He always had many ideas on how to increase yields and soon became a pioneer in the adoption of new practices and technologies on commercial farms. One of Brock's first changes was to sprinkle-irrigate tomatoes after layby. The second change was to address compaction and limited infiltration along the tractor tire rows in three-row tomato fields with extra irrigations each week. Both of these strategies greatly increased tomato yields and were adopted as standard practice on the Firebaugh ranch.

In the early 80's, thanks to Brock's foresight, Vaquero farms also adopted drip as their main irrigation method for processing tomatoes. This new practice, which led to the first 60 tons/ac yields, was then embraced by most tomato growers who also switched to a five-row planting configuration at the time. In the mid-90's, his advocacy for drip also led Brock and his family to their first international, four-month consulting opportunity in Australia, where Brock was involved in the implementation of the first drip irrigated systems for tomato production in New South Wales.

In 1997, Brock began his own consulting business with the help of his friend Ken Day. At the time, with the advent of Global Positioning tracking Systems, new technologies and practices were emerging around auto-guided systems, plant mapping, and variable rate applications. Brock was involved with each of those, primarily in cotton, and collaborated alongside many researchers at CSU, UC, USDA, and with various companies that were developing remote sensing and variable application products. For instance, Brock worked with the Australian company Beeline Technologies that introduced one of the first GPS auto steering products in California. He also was part of the Ag 20/20 research project, which represented a large cooperative program effort aimed at developing, testing, and demonstrating remote sensing technologies on Ted Sheely's Azcal Farms operation. In 2001, he started conducting variable rate seeding research with Florence Cassel at CSU Fresno and other scientists at USDA-ARS. He also collaborated on variable rate gypsum and variable rate nitrogen research with R.E. Plant at UC Davis through a FREP grant. Bruce Roberts and Brock also carried out variable rate defoliation research for Azcal Farms when Bruce was the Kings County cotton Farm Advisor. In addition, Brock was involved with Blair Ag Services in one of the first variable rate program for aerial applications of plant growth

regulators (Pix) in California. “The plane flew one-half mile and made 13 variable rate pix decisions at 125 mph in 30 seconds”, explains Brock.

As the precision farming agronomist for Azcal Farms, Brock also collaborated with Ken Hood at InTime and quickly transferred these technologies from research to large commercial implementation in all cotton fields. Around the same time, Tom Kirby and other UC Farm Advisors also introduced the idea of plant mapping for cotton, “which made growing cotton fun”, highlights Brock. Cotton yield mapping then became standard practice in the Valley.

Over the years, Brock has continued to be a strong proponent of subsurface drip irrigation, variable rate application and remote sensing technologies. He has greatly contributed to the advancement and early implementation of these technologies and practices in the Central Valley. His efforts have always focused on improving yields through enhanced irrigation efficiency and precision management. He is most proud of helping growers reach their 75 tons/ac tomato yields with double row 66-inch bed configuration by 2005 and two years later, 80 tons/ac on 80-inch beds working with Bob Anderson in Huron and Carlton Duty in Lemoore. Another highlight of his career was managing Netafim’s new tomato irrigation scheduling program and 2000 acres of tomatoes for Morning Star. He is very thankful for all the collaborations and long-time working relationships he has established over the years with growers, industry partners, and researchers at UC, CSU, and USDA.

Throughout his career, Brock has contributed to his profession in various positions. He has served the California Chapter of the American Society of Agronomy for several years. He became a board member in 1991 and served as president in 1994. Since then, Brock has attended the Plant and Soil conference every year, and always looks forward to learning about new advancements in the industry and meeting with long-time friends and colleagues. Brock was also on an 11-year membership with the CDFA Fertilizer Ag Advisor Board from 1991 to 2002.

In addition, Brock has been involved with the Nuffield International Farming Scholars program since 2002, hosting the California week-long tours. Through a network of farmers and agri-professionals from around the world, the program provides annual scholarships to a handful of professionals to develop leadership skills and encourage international farming awareness through conferences and international travel experiences. Brock became a member of the Nuffield USA Board of Directors in 2018 and was happy to see that the two of the last scholars were Californians.

Brock is so passionate about his work he is only semi-retired and still consults with clients on asparagus, almonds, garlic, pistachios, olives, wine grapes, tomatoes, and cotton, all grown on drip. He is aided by two full-time employees. When not in the fields, Brock enjoys spending time with his family, particularly his five grandchildren. He is also an avid gardener who enjoys planting flowers and vegetables and sharing harvest from his garden.

David F. Zoldoske

Presented by Florence Cassel

It is a great honor to introduce Dr. David F. Zoldoske, one of the 2023 California Chapter of the American Society of Agronomy honorees. David's exceptional career has contributed to the betterment of the irrigation industry and California agriculture. Through his outstanding achievements and the development of the water centers at California State University, Fresno, he has put the Central Valley on the international map when it comes to irrigation technology, water policy, and new business ventures.

Director, Center for Irrigation Technology, California State University, Fresno

David Zoldoske was born and raised in Fresno, California. He graduated from California State University, Fresno with both a BS and MS in Agricultural Business and Economics, later earning his doctorate at the University of LaVerne. He began his irrigation career on the Fresno State campus as a student research assistant with the Center for Irrigation Technology (CIT) before being hired as a full-time research technician in 1983. One of his many passions was the testing of new irrigation equipment and disseminating the results to growers and end users.

David's career flourished while at CIT for over 35 years, quickly climbing the ladder from researcher to the leadership team. In 1994, he was named Director of the Center and continued serving in that capacity until his retirement in 2018. During his tenure, CIT became an internationally recognized independent testing laboratory, applied research facility and educational resource. David led and worked with hundreds of researchers and students in advancing the adoption of irrigation technology and water management. Most notably, he transformed Fresno State into a key institution for water and irrigation, creating several new institutes and centers.

David played a key role in establishing the California Water Institute (CWI), working with state legislators to obtain initial funding from the 2001 water bond. The CWI has actively worked on water policy with a special interest in disadvantaged communities. David also helped create the Water, Energy and Technology (WET) Center at Fresno State to provide technical, business, and financial support to startup companies in the water, energy, and the ag-tech space. In addition, he established Fresno State as a founding member of the Irrigation Innovation Consortium (IIC), along with the University of Nebraska, Kansas State University, Colorado State University and Texas A&M, all working collaboratively to advance irrigation research nationally.

In 2008, David was asked by then Chancellor Reed to establish the Water Resources and Policy Initiatives (WRPI) for the California State University system and served as its first Executive Director. This position required working with all 23 CSU campuses and over 250 faculty researchers to collectively address California's most critical water issues challenging agriculture, urban areas, and the environment.

Given his valuable expertise and extensive network, David was often called to serve with state, national, and international organizations and committees. He enjoyed the challenge of bringing like-minded people together to create high performing teams. David has been active in developing irrigation policy, testing protocols, and equipment standards. He has authored or co-authored over 100 publications in both technical journals/proceedings and industry publications.

On the legislative side, David spent significant time on irrigation-related issues and decisions in Sacramento. He co-chaired the California Department of Water Resources (CDWR) strategic planning caucus for New Water Technology: Objective 11, an effort which became part of the California 2013 State Water Plan. He was also a member of the A2 technical subcommittee which is part of CDWR SBx7-7 Agriculture Stakeholder Committee. David was Vice-Chair of the AB2717 State Task Force on Landscape Irrigation that established the Model Landscape Ordinance. He also served as a member of the California Department of Food and Agriculture (CDFA) - Nitrogen Tracking and Reporting Task Force that was initiated by CDFA and the State Water Quality Control Board.

Internationally, David served as the Project Director to establish the Zimbabwe Irrigation Technology Center in Harare, Zimbabwe and was a visiting Scholar at the Dzhambul Institute for Irrigation, Land Reclamation and Civil Engineering (DICI), in Dzhambul, Kazakhstan. He was also appointed by the American National Standards Institute (ANSI) as the United States delegate to the ISO/TC23/SC18 Committee on irrigation equipment in Aix-en-Provence, France and gave a Keynote Address to the Fourth International Micro-Irrigation Congress, Albury-Wadonga, Australia.

Given his impressive contributions to the advancement of irrigation technologies and the development of water policies, David received many recognitions and held numerous service positions throughout his career. David was recognized as the Person of the Year by both the California Irrigation Institute and the national Irrigation Association. He always credits his success to his staff and all the people who have worked and collaborated with him throughout his career. David is also a Fellow with the California Council on Science and Technology. He served as President of the Irrigation Association, an organization of more than 4,000 members representing industry, academia, and the public sector. David also served the California Chapter of the American Society of Agronomy for several years, first on the Governing Board and then on the Executive Board, taking on the role of President in 2002.

Today, David is fully retired and spends his time with his wife Danae enjoying a slower-paced life. You might find them on the water fishing, traveling to England to visit their daughters and granddaughter or somewhere in between.

Agenda

Tuesday, February 7

9:30 AM	Michelle Leinfelder-Miles, CA-ASA President, Introduction
Main Session	Chair: Michelle Leinfelder-Miles
9:45	**Economic and Ecological Justifications for Conservation Agriculture in California–**Jeffrey Mitchell, UC Davis
10:20	**Partnering for Conservation Outcomes – Panel Discussion** • **Jeff Borum,** East Stanislaus Resource Conservation District • **Karen Lowell,** USDA-NRCS • **Jeffrey Mitchell,** UC Davis • **Tawny Mata,** CDFA Office of Environmental Farming and Innovation
11:00	**Building On-Farm Resilience – Grower Panel Discussion** • **John Diener,** Red Rock Ranch • **Dino Giacomazzi,** Giacomazzi Almond Company, Inc. • **Scott Park,** Park Farming Organics
12:00 PM	Lunch Break

SALON C		***SALON D***	
Session 1 – Soil Management for Climate-Smart Agriculture Chairs: Lauren Hale, Sultan Begna 1.5 CEU		**Session 2 – Integrated Pest Management and Biodiversity** Chairs: Sarah Light, Ian Grettenberger, Nick Clark 1.5 CEU	
1:25	Introductory Remarks	1:25	Introductory Remarks
1:30	**Kerri Steenwerth**, USDA-ARS, *Climate-Smart Agriculture: Process and Practice*	1:30	**Katherine Waselkov**, CSU Fresno, *Herbicide Resistance in the Central Valley (ALS Inhibitors + Glyphosate for Palmer amaranth, waterhemp, and chickweed)*
2:00	**Christina Lazcano**, UC Davis, *Supporting Soil Health in Winegrape Production: Knowns and Unknowns*	2:00	**Ricky Lara**, CDFA, *Classical Biological Control of Ag Pests in California*
2:30	**Rebecca Ryals**, UC Merced, *Transforming Wastes into Resources to Advance Circular Agricultural Economies*	2:30	**Daniel Karp**, UC Davis, *Co-managing Fresh Produce Farms for Bird Conservation, Pest Control, and Food*
3:00	Break		

SALON C		***SALON D***	
Session 3 – Cover Crops: Environmental Benefits and Beyond Chairs: Gina Colfer, Hossein Zakeri 1.5 CEU		**Session 4 – Crop Management** Chairs: Mae Culumber, Mark Cady 1.5 CEU	
3:25	Introductory Remarks	3:25	Introductory Remarks

3:30	**Margaret Smither-Kopperl**, NRCS Plant Materials Center, *Termination and Management of Insectary Cover Crop Mixes for Almond and Walnut Orchards and Vineyards*	3:30	**Kat Jarvis-Shean**, UCCE, *Impacts of a Changing Climate on Tree Crop Production*
4:00	**Alyssa Devincentis**, Vitidore, Inc., *The Effects of Winter Cover Crops on Soil Moisture and Succeeding Cash Crop*	4:00	**David Holden**, Holden Research and Consulting, *Methodologies for Setting Up and Conducting On Farm Trials for Practical Data*
4:30	**Eric Brennan**, USDA-ARS, *Cover Crops in Central California and Complying with Ag Order 4.0*	4:30	**Patrick H. Brown**, UC Davis, *Advances in Off-ground Almond Harvest Equipment and Technology*
5:00	**Poster Session and Evening Social** (beverages and hors d'oeuvres served) ***SALON A***		

Wednesday, February 8

SALON C		*SALON D*	
Session 5 – Water Management Chairs: Mark Cady, Mae Culumber 1.5 CEU		**Session 6 – Plant Breeding** Chairs: Sultan Begna, Lauren Hale 1.5 CEU	
8:25	Introductory remarks	8:25	Introductory remarks
8:30	**Mark Battany**, UCCE, *Using Satellite Data to Aid Irrigation Management*	8:30	**Pat J. Brown**, UC Davis, *Selecting for Reduced Chill Requirement and Increased Salinity Tolerance in Walnut and Pistachio*
9:00	**Michael Cahn**, UCCE, *Tools and Approaches for Assessing and Improving Irrigation Efficiency on the Farm*	9:00	**Summaria Riaz**, USDA-ARS, *USDA-ARS Efforts in Grape Breeding Research at the San Joaquin Valley Ag Center in Parlier, CA*
9:30	**Isaya Kisekka**, UC Davis, *Multi-site Evaluation of Stem Water Potential Sensors in Almonds*	9:30	**Bao-Lam Huynh**, UC Riverside, *Varietal Improvement of Fresh-Market Long Bean to Overcome Biotic Stresses and Expand Production*
10:00	Break		
SALON C		*SALON D*	
Session 7 – Nutrient Management **Chairs: Daniel Geisseler, Marja Koivunen** **1.5 CEU**		**Session 8 – Organic and Regenerative Production Systems** **Chairs: Hossein Zakeri, Gina Colfer** **1.5 CEU**	
10:25	Introductory remarks	10:25	Introductory remarks
10:30	**Richard Smith,** UCCE, *The Value of Residual Soil Nitrate for Crop Growth*	10:30	**Matt Grieshop,** Cal Poly SLO, *Reevaluating Organic Agriculture through a Regenerative Lens*
11:00	**Daniel Geisseler,** UC Davis, *Nitrogen Mineralization in Fields Under Annual Crops*	11:00	**Eric Morgan,** Braga Farm, *Evaluating Regenerative Farming Principals in Cool Season Vegetable Production*
11:30	**Douglas Amaral, UCCE,** *Citrus Nitrogen Management Practices and Recommendations*	11:30	**Cindy Daley,** CSU Chico, *Environmental and On-farm Benefits of Regenerative Soil Health Systems*

CA-ASA Business Meeting and Awards Luncheon	**Michelle Leinfelder-Miles presiding**
12:00 PM	Opening Business Items
12:30	Announcement of Student Scholarship Awards
12:40	Announcement of Student Poster Awards
1:05	Presentation of Awards to 2023 Honorees
1:25	Closing Business Items

Main Session

Chair: Michelle Leinfelder-Miles

Economic and Ecological Justifications for Conservation Agriculture in California

Jeffrey Mitchell, UC Davis

Scott Park, Park Farming

The prediction that economic incentives aimed at improving soil health and the entire agroecosystem will play an increasingly important role in determining how food crops are produced is confirmed by several highly visible recent trends and initiatives. We provide evidence from a unique long-term annual crop study in the San Joaquin Valley and several farms throughout the state that the combined use of reduced disturbance, surface residue retention, and cover crops improves soil health compared to conventional practices common to the region. Our data suggest that farmers stand to gain multiple synergistic benefits from the coupled use of these practices by increasing soil structural stability, water infiltration and storage, and agroecosystem biodiversity, and improving the efficiencies of the carbon, nitrogen and water cycles of their production systems. Additionally, lower pest pressure, better resilience to weather extremes, and lower production costs, resulting in higher profitability have also been seen. We further document the "common sense economics" of these systems and provide examples of market-based initiatives that are forming to broadly incentivize the scaling-up of these production system principles, practices, and outcomes.

Partnering for Conservation Outcomes – Panel Discussion

Jeff Borum, East Stanislaus Resource Conservation District
Karen Lowell, USDA-NRCS
Jeffrey Mitchell, UC Davis
Tawny Mata, CDFA Office of Environmental Farming and Innovation

This panel discussion will detail how agencies and organizations partner with growers to achieve conservation outcomes. Panelists will describe programs that support growers in their conservation goals. They will discuss achievements that derived from rewarding partnerships. The panelists represent federal, state, and local groups.

Jeff Borum is the Research and Restoration Director for the East Stanislaus Resource Conservation District. In this position, he collaborates with partners to design, implement, and coordinate state- and valley-wide field trials focusing on comprehensive, systems-based approaches to agricultural management. He also helps to coordinate and implement riparian restoration and monitoring in the San Joaquin Valley. Jeff was born in Ventura County, but went to school and worked in several regions of the U.S. He returned to California and obtained a B.S. in Environmental Science, with a minor in Physics, from Humboldt State University. Jeff continues to travel around the diverse state in his pop-up camper as he engages interested communities desiring assistance with conservation-based practices and systems.

Karen Lowell, Ph.D., Certified Crop Advisor, is an Agronomist with the USDA's Natural Resources Conservation Service. She is based in Salinas and her service area covers 15 counties in CA, including the Central Coast, the Bay Delta region and Modesto and Stockton in the Central Valley. Karen provides

Agronomy support for NRCS staff and works with individual farmers, as well as a wide range of public and private partners supporting farmers as they manage conservation challenges in a complex production, market and regulatory climate. She is focused specifically on creating user-friendly decision support tools for growers and conservation professionals to facilitate best management outcomes on working lands.

Jeff Mitchell is a Professor of Cooperative Extension and a Cropping Systems Specialist in the Department of Plant Sciences at the University of California, Davis. He came through UC Davis for both his Master's and Ph.D. degrees. He has had the good fortune to work with 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. Before beginning his graduate studies, he was a teacher and served as a U.S. Peace Corps Volunteer in Botswana, in Southern Africa. He also has taught courses on agronomic and vegetable crop systems at the University of California, Davis.

Dr. Tawny Mata has pursued a lifelong goal of contributing to sustainability through science. In 2013, Dr. Mata was awarded an American Association for the Advancement of Science (AAAS) Science and Technology Policy Fellowship at the U.S. Department of Agriculture (USDA) Office of the Chief Scientist. During her tenure as an AAAS Fellow and later as the USDA Partnership Coordinator for the U.S. Pollinator Health Task Force, Dr. Mata worked on several major initiatives to protect wildlife, build climate resilience, and enhance food security. In 2016, she joined the Foundation for Food and Agriculture Research as a Scientific Program Director, and continued through 2017 as a consultant, managing a grant portfolio that spanned education, conservation, and plant health with an aim of finding evidence-based, practical solutions to challenges in food and agriculture. In 2021, she joined the California Department of Water Resources as an Environmental Program Manager supporting the sound management of native and endangered species impacted by the State Water Project. She is thrilled to return to the agricultural community in her home state and advance California's environmental goals through investments in food and agriculture. Dr. Mata received her B.A. in Biology from Pomona College and her Ph.D. in Ecology from UC Davis.

Building On-Farm Resilience – Grower Panel Discussion

John Diener, Red Rock Ranch
Dino Giacomazzi, Giacomazzi Almond Company, Inc.
Scott Park, Park Farming Organics

This panel discussion will detail the conservation ethic and innovation of California growers. Panelists will describe the practices they have employed to enhance and conserve natural resources, including challenges they have faced and adaptations to their practices and goals. Panelists will discuss how their practices may improve farm resilience and longevity. The panelists farm across regions of the Sacramento and San Joaquin Valleys.

John Diener, Red Rock Ranch, was born in Five Points, a small farming community on the westside of Fresno County, CA. His uncle Frank first came to the area in 1927 and were followed by John's parents, Vince and Amelia Diener, in 1927. John grew up working on his father's and uncle's farms. John graduated from the University of California, Davis with a BS in Agricultural Economics and Business Management. He married Georgene Werstler, and they have four children: Justin, Anne Marie, Mark, and Craig. John started farming for himself on the Westside in 1980. Today, he farms approximately

3,000 acres of conventional and organic crops, including almonds, processing tomatoes, garlic, wine and table grapes. John has been very active in conservation and reclamation efforts. He developed a pilot Integrated On-Farm Drainage Management prototype by tiling saline land and recycling water through a series of fields. He has also implemented center pivots for irrigation. John has been awarded the UC Extension Conservationist of the Year Award, Leopold Conservation Award, and the CA Agricultural Leadership Program's "Profile in Leadership", among other awards.

Dino Giacomazzi is CEO of Giacomazzi Almond Company, Inc. He is the fourth generation to manage his family's farm in Hanford, CA (Kings County), which was founded in 1893 by his Swiss-Italian great-grandfather. The operation consists of 700 acres of almonds, 300 acres of corn, wheat and alfalfa, and two miniature donkeys. The Giacomazzis were dairy farmers for 126 years and were the oldest continuously operating dairy farm in California at the time of their dairy herd sale in 2019. Dino has managed his family farm since 2002. He is a promoter of sustainable farming practices, was the 2012 Leopold Conservation Award recipient for California for his work on strip-tillage in forage crops, and he was named Sustainable Ag Champion by the U.S. E.P.A. in 2010. He is currently utilizing highly-efficient automated irrigation systems and implementing regenerative agricultural practices in his almond operation.

Scott Park, of Park Farming Organics, is a first-generation farmer who began farming in 1974 and started transitioning fields to soil health in 1986. Currently, the farm in Meridian, CA (Sutter County) – which is 1400 acres spread over 10 miles on 23 fields – is regeneratively organic certified (ROC), the first ROC certification for a diversified row crop farm in California. Scott now consults for his son, Brian, who grows 15-20 different crops per year with emphasis on processing tomatoes, fresh market squash and watermelons, sunflower for oil, seed crops, corn, wheat, rice, and alfalfa. The farm relies heavily on soil health to solve most of a farm's problems. The soil is kept healthy by the addition of 10-15 tons of biomass (e.g. cover crop, compost, crop residue) to every acre plus a thoughtful crop rotation, targeted tillage and minimal inputs. The farm's mantra is "solve problems before they happen".

Session 1: Soil Management for Climate-Smart Agriculture

Chairs: Lauren Hale and Sultan Begna

Climate-Smart Agriculture: Process and Practice

Kerri Steenwerth, USDA-ARS Crops Pathology and Genetics Research Unit, Davis

The topic of Climate-smart agriculture (CSA) as a process to address climate change and as a practice in vineyards will be examined. CSA employs principles of agricultural sustainability to integrate adaptation and mitigation into agricultural policies, programs and investments. CSA is an iterative process, involving approaches to improve resource use efficiency, conserve natural resources, enhance rural livelihoods, increase system resilience and reduce environmental risks from climate change, and establish effective governance. The CSA concept originally emerged from work by the UN Food and Agriculture Organization in 2010, when sustainable agricultural development and its role in food security and production was unclear; yet, agriculture was facing increasing pressures from our changing climate. CSA was promoted broadly through the Global Alliance on Climate-Smart Agriculture (GACSA), and it was later adopted by the US as a concept when it joined the GACSA in 2014. In this talk, examples of CSA concepts, programs and practices in California will be discussed, with a focus on research studies on soil management and resulting improvements in soil health and carbon storage in vineyards and adjacent landscapes.

Supporting Soil Health in Winegrape Production: Knowns and Unknowns

Cristina Lazcano, Department of Land, Air and Water Resources, UC Davis

The use of soil conservation practices is becoming common in wine grape production in response to an increased awareness of the value of soil health to maintain crop productivity and environmental quality. However, little information is available on the meaning of soil health within a viticultural context, and what soil properties should be targeted to achieve both the agronomic and environmental goals of wine grape producers. Conservation practices lead to increases in soil organic matter which may improve soil water retention, and increase soil C content therefore constituting a potential avenue to adapt to droughts and sequester C. Well-known management practices such as the use of cover crops, compost or no-till, although effective, seem to result in highly variable outcomes in soil organic matter and other soil health indicators. This variability is likely associated to the application of the practices in different soils and climates. Thus, integration of soil health building practices needs a thorough understanding of their efficacy under different conditions. This presentation will provide an overview of recent research carried out in close collaboration with the wine grape industry to provide a better definition of soil health that is specific to this crop. Furthermore, the efficacy of conservation practices to build soil health relative to potential tradeoffs, such as the emissions of greenhouse gasses or reductions in grape quality, will be evaluated. Finally, the stacking of practices will be discussed as an avenue to maximize benefits to soil health and reduce environmental tradeoffs, as proposed in the framework of regenerative farming.

Transforming Wastes into Resources to Advance Circular Agricultural Economies

Rebecca Ryals, UC Merced

Brendan Harrison, Si Gao, Melinda Gonzales, Gerardo Diaz, and Teamrat Ghezzehei, UC Merced

Broken nutrient and carbon cycles in food systems waste vast quantities or organic resources and contribute to climate change and soil degradation. Closing these cycles are essential for achieving climate goals, fostering circular economies, and improving the resiliency of agroecosystems. Recent state-level policies mandate diversion of organic residues from landfills, ban agricultural burning, and provide funding for carbon farming. These policies incentivized the capture and transformation of wasted organic resources into soil amendments. Here, we present new research on a novel strategy to couple local waste streams and quantify climate and agricultural benefits. Dairy manure management is the state's largest source of methane, which is produced under anaerobic conditions like slurry ponds or stockpiles. We measured the methane and net greenhouse gas reduction potential of dairy manure co-composted with biochar derived from forestry and agricultural residues. Adding a small amount of biochar to dairy manure composting reduced methane emissions by 84% and significantly lowered the life-cycle global warming potential compared to stockpiling or composting alone. Gaseous emissions that contribute to malodor and local air pollution were also significantly reduced. As a soil amendment in winter wheat cropping system, biochar co-compost reduce nitrate leaching losses and soil greenhouse gas emissions and increased soil water retention and plant production compared to compost or biochar alone. Our results suggest that biochar co-composting is one untapped strategy that could be implemented in the Central Valley to help advance a circular agricultural economy.

Session 2: Integrated Pest Management and Biodiversity

Chairs: Sarah Light, Ian Grettenberger, and Nick Clark

Herbicide Resistance in the Central Valley (ALS Inhibitors and Glyphosate for Palmer, amaranth, waterhemp, and chickweed)

Katherine Waselkov, Associate Professor of Biology, California State University, Fresno

Anil Shrestha, Professor of Plant Science/Interim Director of Viticulture and Enology Research Center, California State University, Fresno,

Since the beginning of the 21st century, herbicide resistant weeds have been increasing in prevalence in the Central Valley of California, in both annual and perennial cropping systems. While the genetic basis of resistance to different herbicide chemical modes of action has been discovered for many weed species in other parts of the U.S. and the world, the mutations underlying resistance in the Central Valley are still unknown in most cases. Graduate and undergraduate students at Fresno State University are researching resistance to two common herbicides modes of action in increasingly problematic Valley weeds, including Palmer amaranth (*Amaranthus palmeri*), waterhemp (*A. tuberculatus*), and chickweed (*Stellaria media*), using greenhouse dose-response assays and genetic screening experiments. Previous studies on Palmer amaranth and waterhemp have found that resistance to glyphosate (Roundup©) is usually caused by possessing multiple copies of the gene encoding this chemical's target enzyme, 5-enolpyruvateshikimate-3-phosphate synthase (EPSPS). Other work has identified several very common single nucleotide mutations (found across weed species) in the gene acetolactate synthase (ALS), targeted by many ALS inhibitor herbicides such as rimsulfuron (Matrix©). Students in the Waselkov lab have been performing polymerase chain reaction (PCR) tests for these common ALS gene mutations, and quantitative PCR (qPCR) tests for EPSPS gene amplification in the three species mentioned above. Preliminary results suggest that although both *Amaranthus* species exhibit ALS inhibitor resistance in greenhouse trials, this resistance is not due to common target-site mutations; ongoing work sequencing the entire ALS gene will resolve whether any target-site mutations are causing resistance, or if non-target site resistance mechanisms such as changes in herbicide metabolism are likely to be involved. Furthermore, qPCR experiments have yielded evidence for EPSPS gene amplification in some individuals of Central Valley Palmer amaranth, although greenhouse trial results do not always align with genetic results. Discovering the prevalence of resistance and the underlying genetic mutations that cause this resistance can help growers and other land managers tailor their chemical applications and other pest management strategies to best control these weeds.

Classical Biological Control of Ag Pests in California

Ricky Lara, CDFA Biological Control Program, Sacramento, CA

Chris Borkent, Viola Popescu, and Vincent Maiquez, Biological Control Program, California Department of Food and Agriculture

Invasive insect pests and noxious weeds continually threaten California's agricultural and natural resources. Historically, classical biological control has provided long term solutions to deal with existing and emerging pest problems in the state. This session will provide an overview on the current application of classical biological control for invasive species management. Progress of active cooperative research projects targeting brown marmorated stink bug, diamondback moth, and yellow starthistle in will be covered.

Co-managing Fresh Produce Farms for Bird Conservation, Pest Control, and Food

Daniel Karp, Department of Wildlife, Fish, and Conservation Biology, UC Davis

Fear that birds may damage crops and carry foodborne pathogens has created strong pressure on produce growers in California to remove habitat around their fields. Yet birds play diverse roles on farms. Though some may consume crops or carry pathogens, others control damaging insect pests, benefiting farmers. We established a network of 27 organic strawberry and 30 organic lettuce farms in California's Central Coast to study how diversifying (or homogenizing) agricultural landscapes affects the multiple benefits and harms associated with birds in produce fields. Specifically, we used point counts to measure bird diversity, exclusion experiments to quantify impacts of birds on pests and crop yields, and mist nets to capture birds, collect their feces, and then sequence fecal DNA to detect foodborne pathogens and build diet profiles. We found that birds' diverse diets complicate efforts to classify which species are beneficial versus harmful, with species often consuming crops, beneficial insects, and pest insects at the same time. As a result, the net effects of wild birds on strawberry yields were largely neutral. Nonetheless, farms with more seminatural habitat in the surrounding landscape were associated with more diverse and multifunctional bird communities that provided more benefits and fewer costs to farmers. Specifically, birds were less likely to damage crops and exact economic damage on farms with more surrounding habitat. Though foodborne pathogens were overall quite rare in wild birds, food-safety risks were also higher in bird communities associated with expansive monoculture farms and lower on farms with surrounding habitat. These results suggest efforts to remove habitat around farms to mitigate food-safety risks are misguided. Instead, our work suggests that maintaining seminatural vegetation in and around farm fields may represent a win-win-win for bird conservation, food production, and food safety.

Session 3: Cover Crops: Envrionmental Benefits and Beyond

Chairs: Gina Colfer and Hossein Zakeri

Termination and Management of Insectary Cover Crop Mixes for Almond and Walnut Orchards and Vineyards

Margaret Smither-Kopperl, USDA-NRCS, Lockeford Plant Materials Center

Permanent crops such as tree nuts and fruits, and vineyards are widely grown in California. Insectary cover crops, both reseeding annuals and perennial species, provide habitat for pollinators and beneficial insects. Several barriers exist to wider implementation, including cost and knowledge of methods for management and termination. This study used four insectary cover crop mixes, developed by the Xerces Society, for almonds, vineyards, and walnut orchards economical mixes contained both native species and annual cover crop species such as crimson clover, bell bean and brassica species. The variables were time of mowing and termination by mowing or disking. Assessments were made of species present including seeded species and weeds, percent cover and plant height over three years. The insectary cover crop mixes were planted in strips 10 feet wide by 400 feet in length. Each cover crop mix was a separate randomized complete block design with four replications. In fall of 2017, a commercial almond pollinator mix, and economical mixes designed for almonds, vineyards and walnuts were broadcast with belly grinders onto a firm seed bed. The estimated seeding rate was 30-35 seeds per square foot and a cultipacker ensured good soil to seed contact. No irrigation was applied over the course of the trial. Over three years, planted species declined each year due to weed competition, especially from annual invasive grasses. The maximum percentage of seeded species present after 3 years was about 50% in the economical almond and walnut mixes, 40% in the vineyard mix and less than 30% in the standard almond mix. Termination by disking increased the incidence of large-seeded legume species in following years, likely because the seeds were buried during disking. The most effective treatment for reestablishment over the three years of the trial was an early 6-inch mow in February followed by a termination mow after seed set in April or May. Management of pollinator cover crop species is compatible with early mowing to control for potential frost damage.

The Effects of Winter Cover Crops on Soil Moisture and Succeeding Cash Crop

Alyssa DeVincentis, Vitidore, Inc.

Samuel Sandoval, Anna Gomes, Sloane Rice, Helaine Berris, Paul Skinner, Daniele Zaccaria, Jeffrey Mitchell

The future of California's specialty crops is threatened by extreme and harmful climate change impacts, including drought and heat waves. Sustainable agricultural management practices, such as cover cropping, can play an important role in mitigating these impacts, however a barrier to adoption has been uncertainty around how cover crops impact a farm's water balance and water availability for the subsequent cash crop. To address this knowledge gap, we present field-level data from a variety of specialty crop systems growing both annual winter cover crops and perennial conservation cover. Data were collected on experimental blocks with two treatments: 1) winter cover crop or conservation cover and 2) a comparable control without winter time ground cover. Data includes water holding capacity, winter time soil moisture, winter time evapotranspiration, soil temperature, and subsequent cash crop water status. Results show that generally winter cover crops can be grown without depleting winter time soil moisture, but winter cover crops' impact on subsequent season cash crop water status is

variable across space and time with 50% of sites showing no difference in stem water potential (SWP) and 50% having higher SWP in vines with perennial conservation cover established. This variability may be outweighed by advantageous impacts on soil temperature during critical agronomic periods. These preliminary results can inform grower decision-making around adopting winter cover crops to support their adaptation to the climate change impacts felt in California's specialty crop systems.

Cover Crops in Central California and Complying with Ag Order 4.0

Eric Brennan, USDA-ARS

Winter cover cropping is a best-management practice in sustainable vegetable production because it can help to reduce nitrogen leaching to ground water, reduce runoff and soil erosion, suppress weeds, harbor beneficial insects, and provide lots of benefits to the soil by adding organic matter to the soil food web. Historically, cover crop adoption in the Central Coast region of California has been low because cover crops can complicate management in tillage intensive, high-value, vegetable crop rotations. But a new, game-changing regulation known as Ag. Order 4.0 – that is focused on protecting and improving ground and surface water quality in 540,000 acres of irrigated land in the Central Coast region – will likely increase cover crop adoption here because it will give farms nitrogen scavenging credits for some types of cover crops. Cover crop nitrogen scavenging credits will help farms to meet the regulation's nitrogen discharge limits, particularly as the limits gradually decline over time. Nitrogen discharge is essentially calculated as the difference between applied nitrogen (fertilizers, irrigation water, compost, etc.) and removed nitrogen (in harvested product). Cover crops that are eligible for the credit are nonlegumes (like cereals or mustards), that grow for at least 90 days from October to April and produce at least 4500 pounds per acre of oven-dry shoot biomass. The amount of the cover crop nitrogen scavenging credit that farms can get will range from 30 pounds per acre, to several times more if the cover crop meets a carbon to nitrogen ratio (C:N) requirement of 20:1 or more. This interactive presentation will highlight on-going research at the USDA-ARS organic research farm in Salinas and from on-farm trials in the Central Coast region to provide growers with simple and fast ways to know when their cover crops have met the biomass and C:N ratio requirements in Ag. Order 4.0 so that they can get cover crop nitrogen scavenging credits.

Session 4: Crop Management

Chairs: Mae Culumber and Mark Cady

Impacts of a Changing Climate on Tree Crop Production

Kat Jarvis-Shean, UCCE, Impacts of a Changing Climate on Tree Crop Production

Many of the Central Valley's orchard crops (e.g. cherries, pistachios, walnuts) have high winter chill requirements. Multiple recent winters have fallen short of the chill needed for a vigorous bloom, pollinizer overlap and tight, economical bloom timing in these crops. Scientists expect such winters to be more frequent in the future. Though lower chill varieties are in development, the industry needs tools to support varieties that are currently in the ground for the next 20-40 years. Many products have been shown to compensate for inadequate chill in other crops and other countries but few have been thoroughly vetted in California until recently. This presentation will review projected changes in winter chill in the Central Valley in the next 20-40 years (a typical orchard lifespan) and recent research to help tree crop production adapt to these changing conditions, with a particular focus on walnuts.

Methodologies for Setting Up and Conducting On Farm Trails for Practical Data

David Holden, Holden Research and Consulting

Growers and PCA/CCA consultants are quite often asked to "test" a new product without much information on how to validate said product in their environment. What can be done to help users to glean data that is useful to their operations in designing an on-farm research trial that goes beyond the "here's the product, give it a try" pitch? In this presentation we will

- Look to simplify the process of researching a product for the grower/consultant
- Design a trial that can give valid data based on the claims of the product
- Keep data collection to what is needed
- Provide examples of this type of trial
- Help to provide real world answers

It is the goal of this presentation to give end users some additional tools to evaluate new products that are presented to them that goes beyond "here is a sample and let me know what you think."

Advances in Off-ground Almond Harvest Equipment and Technology

Stavros Vougioukas, Biological and Agricultural Engineering, UC Davis

Patrick H. Brown, UC Davis, Department of Plant Sciences, UC Davis

Yield is the primary driver of nitrogen (N) and potassium (K) demand in nut crops and balancing N demand/supply is required under Irrigated Lands Regulatory Program (ILRP) N guidelines. Currently, most growers make only a single yield estimate in a given orchard and base N/K application upon that average. Since variability exists in all orchards, any decision that is made on the basis of averaged whole orchard data is a compromise, resulting in the undersupply of nutrients to the highest performing trees while oversupplying lower performing trees. Providing uniform water and nutrient to an entire orchard is standard practice but it is wasteful.

To improve efficiency of input management, growers must have mechanisms to identify and manage field variability. The goal of this project is to provide the capability for single tree yield monitoring and

tree identification at full commercial harvest speed. This precision-harvester will immediately provide rationale and context for sub-orchard management and nutrient optimization. The ability to easily measure single tree yield also represents a revolution for research and will improve the use of remote, soil/plant sensors by providing the ground truth data and relationship to field variability.

We will present information on the development of precision yield monitoring and share early results demonstrating the extent of yield variability present in Almond fields.

Session 5: Water Management

Chairs: Mark Cady and Mae Culumber

Using Satellite Data to Aid Irrigation Management

Mark Battany, UCCE Water Management and Biometeorology Advisor, San Luis Obispo County

Satellite NDVI measurements have been conducted by American and European agencies for many years, offering a valuable imagery for aiding farm management. The global coverage, high frequency of imagery acquisition, and access to historic measurements make this a uniquely capable tool. In the past the access to this satellite data was very cumbersome and impractical, but more recent advances in user-friendly websites have made this public information easily accessible by anyone with an Internet connection, at no cost to the user.

In this presentation I give an overview of the satellite NDVI data that is available to farmers and how they can use this to understand what is happening with their crops with respect to irrigation management. I will show how we can use archived data to help diagnose and correct irrigation related problems, how we can assess current management with spatial patterns in the NDVI, and how we can incorporate satellite NDVI into our irrigation scheduling calculations. The examples in the presentation will be taken from the IrriSAT website (https://irrisat-cloud.appspot.com/), which itself is an excellent example of a farmer-friendly satellite NDVI source.

Tools and Approaches for Assessing and Improving Irrigation Efficiency on the Farm

Michael Cahn, UCCE Irrigation and Water Resources Farm Advisor, Monterey County

To achieve a high efficiency, irrigation systems must be well designed, operated correctly and maintained so that water is uniformly applied to the crop. Additionally, the timing and amount of water applied with each irrigation needs to match the water used by the crop for evapotranspiration (ET). This talk will cover tools and approaches that growers and consultants can use to assess where to concentrate efforts to improve irrigation efficiency. Evaluating the application uniformity and pressure of drip systems can often identify design and operational limitations. Auditing sprinklers for worn nozzles, leaky gaskets and pipes, and assessing application uniformity and pressure can also expose where improvements are needed. Using soil moisture sensors, estimates of crop ET, and flowmeters to compare the scheduling of irrigations with crop needs is an effective approach to determine if water can be saved during the season. After the assessment phase, a discussion with irrigation staff and farm managers may reveal more information about how the irrigation system is typically operated, and provide an opportunity to come to a consensus on the next steps that can be taken to improve irrigation management. Assisting staff with piloting new technologies, or changes in system design and/or operational procedures can help with the on-farm implementation of practices that lead to increased water use efficiency.

Multi-site Evaluation of Stem Water Potential Sensors in Almonds

Isaya Kisekka, Department of Land, Air, and Water Resources, UC Davis

Srinivasa Rao Peddinti, Peter Savchik, Liyuan Yang, Kelly Moyers, Mae Culumber, Luke Milliron, and Kenneth Shackel

Climate change and increased regulation of groundwater use through the Sustainable Groundwater Management Act (SGMA) continue to limit irrigation water supplies. Growers need innovative technologies to help them refine irrigation scheduling decisions. Stem water potential (SWP) sensors (e.g., osmometers and micro tensiometer sensors) can help growers determine when irrigation should be triggered. Almond growers are interested in knowing how the new automated SWP sensors perform versus the industry standard pressure chamber (bomb). The study objective was to evaluate the performance of SWP sensors compared to the pressure boom as the benchmark in several almond orchards across the Central Valley. Micro tensiometer-based SWP sensors e.g., operate based on the same principle as traditional soil tensiometers but with a much smaller liquid volume and 100-200 times greater range in pressure. Osmometer-based SWP sensors e.g., Saturas operate based on osmosis in which water moves across a semipermeable membrane. This results in a change in pressure in the osmotic solution chamber which is related to tree SWP. The locations of the research sites were Esteve farms near Corning, Nickels Soil Lab near Arbuckle, Westwind farms near woodland, Jasleen Farms near Woodland, Sharma Farms near Vacaville, Kearney REC, and Clark's ranch near Fresno. SWP from the pressure bomb was collected at weekly intervals on each almond tree where SWP sensors were installed. Preliminary results show that measurements from SWP sensors are comparable to the pressure chamber (bomb) measurements if the sensor is properly installed and calibrated. Across most sites, RMSE ranged between 1 and 4 bars. However, the technology is relatively new and continues to improve and additional validation is needed to confirm the robustness of the sensors under different orchards (e.g., the impact of shacking on sensor performance) and irrigation management practices (e.g., interactions between irrigation and temperature effects on osmometer sensor performance).

Session 6: Plant Breeding

Chair: Sultan Begna and Lauren Hale

Selecting for Reduced Chill Requirement and Increased Salinity Tolerance in Walnut and Pistachio

Pat J. Brown, Department of Plant Sciences, UC Davis

This presentation will introduce the UC Davis breeding programs for walnut and pistachio scions and rootstocks, including scion screens for winter chill requirement and rootstock screens for salinity tolerance. New scion varieties should be winter-hardy, yet flower promptly and vigorously following low-chill winters. I will discuss how we are attempting to screen for this by cutting dormant sticks periodically through the winter and forcing them in a greenhouse. New rootstocks should be able to exclude or sequester salt, to allow continued use of existing scion varieties as water quality declines. I will discuss variation in salt sequestration in the UCB-1 population of pistachio rootstocks, and its contrasting effects on short-term greenhouse performance and long-term performance in the field.

USDA-ARS Efforts in Grape Breeding Research at the San Joaquin Valley Ag Center in Parlier, CA

Summaira Riaz, United States Department of Agriculture-Agricultural Research Services, Parlier, CA

Table grape and raisin grape breeding history at the San Joaquin Valley Research Center (SJVRC) date back to 1923. Multiple generation of breeders has contributed to the release of over 25 varieties of table grapes and raisins that have revolutionize the industry. The current focus of the breeding program is to develop table grape and raisin cultivars with durable field resistance to Pierce's disease (PD) caused by the bacterium Xylella fastidiosa (Xf), natural resistance to grape powdery mildew (PM), retain high fruit quality, commercial production standards, and productivity to provide competitive edge to the grape industry. Molecular markers linked to two PD and six PM resistance loci are used at seedling stage. Use of DNA based markers has allowed breeder to stack multiple resistance loci in single line that enhance breeding efficiency, reduce costs and time to develop new perennial crop cultivars. Identification of selected lines that are deemed worthy of varietal introduction based on unique fruit quality, improved production, disease resistance to PD and/or PM and field trials are carried out in collaboration with California Table Grape Commission (CTGC). New varieties are selected for commercial production in California by consensus based on production and fruit quality data, growers' input, and subjective visual appearance after a prolonged period of postharvest storage.

Varietal Improvement of Fresh-Market Long Bean to Overcome Biotic Stresses and Expand Production

Bao-Lam Huynh, Dept. of Nematology, UC Riverside

Ruth M. Dahlquist-Willard, UC Cooperative Extension, Fresno County; Antoon T. Ploeg, University of California, Riverside, Dept. of Nematology; Philip A. Roberts, University of California, Riverside, Dept. of Nematology

Long bean (asparagus bean, Asian yardlong bean) is the vegetable type of cowpea; a climate-resilient and nutritious food legume grown by Southeast Asian farmers in the Central Valley of California and marketed to Asian immigrant communities across the United States. Insect pests are major threats,

reducing yield and quality of all current cultivars. Modern plant breeding protocols and extension activities are implemented to develop resistant varieties. Sources of natural resistance found in African cowpea germplasm and existing knowledge of marker-trait associations for aphid and root-knot nematode resistance are applied in marker-assisted breeding. Local cultivars with stacked resistance genes have been developed. Novel resistant bush-type long bean varieties have also been developed to enable scaling up production and improving nematode management in commercial farming. The improved germplasm is being evaluated by controlled experiments along with outreach activities to enable adoption. More information about this research can be found at https://uslongbeanbreeding.ucr.edu/

Session 7: Nutrient Management

Chairs: Daniel Geisseler and Marja Koivunen

The Value of Residual Soil Nitrate for Crop Growth

Richard Smith, Vegetable Crop Farm Advisor. UCCE, Monterey, Santa Cruz and San Benito Counties

Soil nitrate comes from a variety of sources: mineralization of soil organic matter and crop residues as well as from fertilizer and irrigation water. Residual soil nitrate is the term we use to describe the "pool" of nitrate from these sources. This pool of nitrate can be measured, and if levels are high enough, the quantity of fertilizer needed for optimal crop growth can be reduced accordingly. To measure residual soil nitrate, a composite soil sample to a depth of the crop roots is collected: for lettuce - 12 inches is adequate and for deeper rooted crops such as tomatoes or broccoli sampling the second foot is also helpful. Soil nitrate can be determined by the use of a quick test (https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=4406) or laboratory analysis. Soil nitrate-N level of 20 ppm is roughly equivalent to 77 lbs N/A (depending on soil bulk density). This amount of N is typically sufficient to supply sufficient N to a fast growing crop like lettuce during the period of maximum N uptake for 10 to 14 days. Crops like broccoli exemplify the importance of residual soil nitrate; this crop takes up over 300 lbs N in crop biomass, but on average on the Central Coast only 180 to 220 lbs of fertilizer N is applied. The remainder of N taken up by the crop from residual soil nitrate in the top three feet of soil. For a grower to learn to use residual soil nitrate for optimal crop growth it is important to begin on a small scale to gain confidence and experience before expanding this practice on large planting. Growers are under pressure to reduce nitrate leaching and effective utilization of residual soil nitrate is a key tool for improving nitrogen use efficiency in crop production.

Nitrogen Mineralization in Fields Under Annual Crops

Daniel Geisseler, University of California, Davis

Efficient utilization of nitrogen (N) fertilizer in crop production requires an accurate assessment of the availability of non-fertilizer N. While residual soil nitrate and nitrate in the irrigation water can be measured relatively easily, determining the potential of a soil to mineralize N from soil organic matter is much more challenging. A better understanding of the amount of N mineralized during the growing season is crucial to determine N fertilizer application rates that ensure high yields whilst minimizing losses to the environment. In this presentation, I will discuss results from several studies where we used different approaches to determine net N mineralization in fields under annual crops in the Central Valley. The results of these studies shall be incorporated into decision support tools for growers and crop advisers.

Citrus Nitrogen Management Practices and Recommendations

Douglas Amaral, Farm Advisor, UCCE Kings County

Patrick Brown, Professor, UC Davis

Environmental legislation is forcing a change in farming practices because of many years of excess N application and loss of N below the root zone and consequent contamination of water resources. One of the main opportunities to optimize nitrogen fertilization is to synchronize applications with plant crop demand and apply N coincident with root uptake. Recent UC research has allowed the development of

improved nitrogen management practices for citrus growers. Nutrient budget curves were developed and data on timing and quantity of N uptake and removal from orchards was derived. Budget curves quantify the time course of nutrient uptake and total plant demand as determined by tree yield and nutrients required for growth. Yield potential determines fertilizer strategy and there is a large negative impact on overall efficiency that occurs in years or orchards of poor yield in which standardized fertilization strategies are used. Fertilizing accordingly to predicted yields will dramatically enhance nutrient use efficiency. As a best management practice fertilizer in a citrus orchard should be based on expected yield estimated at flowering and fruit set followed by analysis of leaves to diagnose any deficiency. The combination of nutrient budget determination, nutrient response information, improved sampling and monitoring strategies, and yield determination provide a theoretically sound and flexible approach to ensure high productivity and good environmental stewardship.

Session 8: Organic and Regenerative Production Systems

Chairs: Hossein Zakeri and Gina Colfer

Reevaluation Organic Agriculture through a Regenerative Lens

Matthew Grieshop, Director, Grimm Family Center for Organic Production and Research, Cal Poly San Luis Obispo

Is regenerative agriculture Organic 2.0 or does it represent an entirely new sustainable agriculture movement? A variety of regenerative agriculture definitions and schemes have been developed over the decade. The initial focus of regenerative practices were structured around promoting or "regenerating" soil health but more recently regenerative agriculture concepts encompass social welfare of growers and farm workers. In addition, some regenerative practitioners argue that certified organic production is largely focused on practices and inputs, while regenerative production emphasizes practices as well as tangible environmental and social outcomes. Yet others see regenerative as a "third" way between the "anything goes" conventional mindset and technologically restricted certified organic mindset. Looking back at the origins of organic agriculture, however, demonstrates that the core ethos of the organic movement focused on many of the same concepts as the regenerative movements. Soil health, the law of return, composting, livestock integration and diversified planting systems were all part of the original organic vision put forth by Howard, Balfour, Rodale and others. Questions raised by this history include: how might the application of regenerative practices vary by production system and region? Are certifications based on outcomes (rather than practice) economically viable? And, are regenerative or organic production schemes scalable to an increasingly globalized food system?

Evaluating Regenerative Farming Principals in Cool Season Vegetable Production

Eric Morgan, Vice President Environmental Science and Resources, Braga Fresh and Manager, Soil Health Lab LLC

Cool season vegetable production is heavily reliant on inputs to achieve robust yields. Current and forthcoming environmental regulations are impacting the standard practices which vegetable growers rely on. Nitrogen discharge to surface and groundwater, sediment discharge from farm fields to waterways, pollinator health and vitality, nitrous oxide emissions, and the loss of noenicitinoids and pyrethroids are among the primary concerns. Braga Fresh is attempting to stay ahead of these hurdles by evaluating regenerative farming practices through on farm trials. Growing cool season vegetables regeneratively can reduce reliance on inputs and increase resilience in this cropping system. The trials are focused on elimination of nearly all standard tillage and presence of vegetative cover on fields year-round. In our standard system, we've incorporated Merced rye, vetch, and clover as an in-crop companion planting. We aim to discover additional, scalable regenerative practices as a step toward carbon neutrality and access to carbon markets.

Environmental and On-farm Benefits of Regenerative Soil Health Systems

Cynthia Daley, Director Center for Regenerative Agriculture & Resilient Systems

As soil transitions between full tillage and standard inputs regenerative practices (No-till and multispecies cover crops), key changes take place in the soil microbial communities which impact soil health. These biological changes set the stage for improvements in soil function, water infiltration, water holding capacity, plant productivity, soil carbon accrual, and ultimately net return per acre. Within the

first year of transition, the soil microbial community shifted to a fungal dominant when No Till soil management was combined with multispecies cover crops. This included significant increases in beneficial mycorrhizal fungi and saprophytic fungi. As soils transitioned to fungal dominance, soil aggregate stability improved along with changes in bulk density and water infiltration. Permanganate-oxidizable carbon (POXC) improvements were also observed within the first year of transition, followed by total soil carbon (TOC) in the 2nd and 3rd year of testing. As soil carbon levels improve, nutrient cycling is enhanced, along with water holding capacity and water use efficiency. Within the third year of transition, an 80% reduction in nitrogen application resulted in similar crop yields to the 100% N application suggesting improvements in nutrient cycling within the regenerative farming system.

Student Posters

Assessing Candidates for Biocontrol Options of Grapevine Trunk Disease (GTD)

Eric Antrim, California State University, Fresno

Global grape production is adversely affected by several fungal pathogens that compromise vine vascular systems, leading to grapevine trunk disease (GTD), resulting in the reduction of grape quality, yield, and an overall decline in grapevines. A lack of chemical controls for GTD has increased the interest in biocontrol options that can suppress instances and severity of disease. While infections may occur at any life stage, the latent phase in which disease expression is significantly reduced commonly has a duration of multiple years. When symptoms or signs of the disease are observed in the proceeding pathogenic phase, they oftentimes can be misdiagnosed as other diseases or nutrient deficiencies, leading to ineffective and unnecessary applications of fungicides and nutrients in vineyards that negatively affect the environment. Various species of Trichoderma Pers. have been shown to be effective biocontrol agents (BCAs) in several agronomic crops. Therefore, the goal of this study was to assess how two endophytic isolates of Trichoderma from grapevine tissues in the SJV interact with four causal agents of GTD, *Neofusicoccum parvum, Diplodia seriata, Eutypa lata,* and *Phaeoacremonium minimum* to evaluate their respective potential to mitigated GTD. In vitro competition bioassays were used to evaluate mean linear growth of the pathogens and necrosis in inoculated vines were measured. The biocontrol isolates significantly reduced the mean linear growth of the pathogens and reduced the amounts of necrosis surrounding vascular tissues in the vines but varied on a species-to-species basis. More studies comparing these biocontrol isolates are necessary to validate the consistency of their respective control.

Cucumber Tree Project

Douglas Armour, California State University, Chico

Dendrosicyos socotranus (Cucumber Tree), the only member of the cucurbitaceae family that grows in tree form. The Cucumber Tree is native to the island of Socotra in Yemen where the average temperature never reaches below 60 F year round and can get well into the 100's during its warmer seasons. The climate consists of high humidity and very limited rainfall all year with soils ranging from very sandy to very compact leading into the island and having most of its composition made of limestone. One interesting way the Cucumber Tree combats these conditions is by storing large amounts of water within its tissues during the rainy season to use for producing fruit the rest of the year with little to no more irrigation. This ability leads to the Cucumber Tree having an enlarged stem without the need of a deep root system while tolerating increasingly high temperatures. These qualities make the Cucumber Tree the perfect candidate for a, potentially successful, crossbreeding with the *Citrullus lanatus* (Watermelon). Though, the phylogenetic charts for the cucurbitaceae family show the *Cucumis melo* (Cantaloupe) to be the more qualified parent to cross with the Cucumber Tree, as it was more closely related (cousins), it can still be utilized as a Syngameon (Genetic Bridge) between the Cucumber Tree and Watermelon. Currently, there are some Cucumber Trees growing at the Chico State University Farm and when they reach maturity, in 3-4 years, they will be crossed with the Cantaloupe in hopes of producing a viable, non-sterile hybrid using a series of backcrosses, with both parents, while crossing between different varieties of Cantaloupe, if required, to find the most suitable, genetic match.

Summer Cover Crops: Potentials as Forage and Possible Residual Impacts on Succeeding Crops

Peyton Arnold, California State University, Chico

Celina Philips, Kyle Brasier, and Hossein Zakeri, California State University, Chico

Maintaining soil health is a key element of sustainable agriculture, it is essential for environmental quality. California growers increasingly adopt cover crops into cropping systems to reduce soil erosion, increase water infiltration, and improve nutrient cycling in the soil. Depending on their goal, a variety of cover crop mixes are incorporated into rotations. Summer cover crops often consist of sudangrass (*Sorghum x drummondii*) and soybean (*Glycine max*) for soil protection and biological nitrogen fixation. Identifying economic benefits and possible negative impacts of cover crops on succeeding crops can help growers select crop species that maximize their benefits.

We sampled soybean and sudangrass from a summer cover crop mix grown at the Chico State Farm. The samples were used to compare soybean and sudangrass for their: 1) In Vitro True Dry Matter Digestibility (IVDMD), and 2) possible allelopathic effects on germination of tomato *(Solanum lycopersicum*) and bell pepper (*Capsicum annuum*) in two separate projects. For the first project, rumen inoculum was collected and the standard protocol for the ANKOM® Daisy Incubator was followed. Cover crop materials were dried, ground, and added to the artificial rumen; declining rates of both samples were recorded over 72 hours. For the second experiment, plant materials were dried, ground, and soaked overnight. The materials were centrifuged, filtered, and used to make 25, 50, and 75% concentration solutions. The solutions were applied to tomato and bell pepper seeds in petri dishes, creating a factorial experiment. Germination rate and seedling vigor are recorded at the end of the experiment. The result details will be presented in the poster. The information is expected to help producers make rational decisions on cover crop selection.

Determination of Nitrogen Rate and Timing on Yield of Garbanzo Beans (*Cicer arietinum* L.) Grown Under Sub-Surface Drip Irrigation System

Diego Arriaga, California State University, Fresno

Ranjit Riar, California State University, Fresno; Nicholas E. Clark, U.C. Cooperative Extension; Dave Goorahoo, California State University, Fresno; Diego Arriaga, California State University, Fresno.

Garbanzo beans (*Cicer arietinum* L.), also known as chickpeas, are a major pulse crop produced around the world. Recently there has been an interest to revisit nitrogen management under subsurface drip irrigation systems in California. The use of sub-surface drip irrigation allows the application of nitrogen through the system in a liquid form. This has the potential to increase nitrogen use efficiency by allowing a better timing of the nitrogen availability and matching of the peak nutrient uptake stages of the crop. This study evaluates several treatments of nitrogen application rates and times under a subsurface drip irrigation system. Treatments include no inoculation and no nitrogen (control), inoculation plus no nitrogen (treatment B), inoculation plus 80lbs of nitrogen at early irrigation (treatment C), inoculation plus nitrogen split in 50lbs early and 30lbs late (treatment D) irrigations, inoculation plus 160lbs of nitrogen at early irrigation (treatment E), and inoculation plus nitrogen split 100lbs at early and 60lbs late (treatment F) irrigations. The garbanzo yield and harvest index were determined at the end of the season. The results of the first-year trial will be presented in this poster. The second-year trial may further elucidate differences in treatment responses.

Investigating the Relationship of Maize Yield with Sentinel 2 Time Series Data Over Hundreds of Fields in the USA

Beau Attride, University of California, Riverside

Amninder Singh, University of California, Riverside; Peter Ellegard, AquaSpy, San Diego, CA; Andres Bernal, AquaSpy, San Diego, CA; Konstantinos Karydis, University of California, Riverside; Todd H Skaggs, USDA-ARS, US Salinity Laboratory, Riverside; Elia Scudiero, University of California, Riverside and USDA-ARS, US Salinity Laboratory, Riverside

High-resolution remote sensing imagery is useful for characterizing spatiotemporal variability of crop status. This project aims to understand the response of Sentinel 2 NDVI to maize (Zea mays L.) yield using crop data from hundreds of fields in the USA. This paper presents the data harmonization process needed to compare crop growth time series across different states, soil types, and management practices. The harmonized NDVI time series are then compared to maize yield scores obtained by surveying collaborating farmers. The strength of the NDVI-yield relationship will be discussed. Temporal within-year variability in the NDVI-yield relationship will be discussed. The potential contribution of environmental factors and water availability will also be discussed.

Short Vectorization Approach for Data Integration and Correction

Jayanta Banik, University of California, Riverside

Amninder Singh, Dimitrios Chatziparaschis, Konstantinos Karydis, University of California ;Todd H. Skaggs, USDA-ARS, US Salinity Laboratory, Riverside, Elia Scudiero, University of California, Riverside and USDA-ARS, US Salinity Laboratory, Riverside

On-the-go plant and soil sensing are a rapid means of characterizing field-scale spatial and temporal variability in agricultural systems. We propose a method for on-the-go data integration and correction while using a multisensor mobile survey platform with streams of data coming from different sensors with different operational frequencies. The experiment uses streams of data coming from a GPS device and a PoLRa sensor, although the method can be extended to other similar sensors. The need for data correction arises since the sensor is not mounted, but placed nearby the GPS module, which offsets the recorded readings. Using small vectors to interpolate the reading of the two data streams, we propose the correction of the GPS coordinates and creating a continuous regression from discrete data points. This methodology can be used to collect, correct, and integrate data on the go for mobile survey platforms such as ATVs or Drones.

Evaluation of Lettuce Varieties for Tolerance to Pythium Wilt

Tyler Barton, California State University, Monterey Bay

Karla Jasso, California State University, Monterey Bay; Tricia Love, UCCE Monterey; Kelley Richardson, USDA ARS Salinas; Richard Smith, UCCE Monterey; Yu-Chen Wang UCCE Monterey; and JP Dundore-Arias, California State University, Monterey Bay

Pythium wilt of lettuce is recognized as the most serious root rot pathogen of lettuce, causing catastrophic production losses in 2020 and 2022 in the Salinas Valley. Anecdotal field observations suggest that tolerance in plant varieties may represent the most promising control strategy. Tolerance to Pythium wilt was evaluated among 53 commercially available and advanced lines of lettuce under

field natural disease pressure conditions. Disease incidence was monitored throughout the season by counting the number of plants with foliar symptoms. Plants exhibiting wilting were sampled on weeks 6 (8/30/22) and 7 (9/6/22) after planting and samples were processed in the laboratory for confirmation of Pythium wilt. On the last week of the trial, plants from all varieties were sampled regardless of the presence or absence of foliar symptoms. Root tissues were washed, cut, surface sterilized, and plated onto semi-selective media, then microscopy observations were used to determine presence of *Pythium* and it was found that all varieties had the presence of *Pythium*. *Pythium* spp. was consistently isolated from symptomatic plants collected on the two evaluation dates. While microscopy observations revealed the presence of *Pythium* spp. structures (oospores and sporangia) in the roots of nearly all tested varieties, 7.5% of the varieties showed some tolerance to *Pythium* as they were asymptomatic both above and below ground. Contrarily, nearly 70% of varieties showed enhanced susceptibility to Pythium wilt determined by the presence of severe above and belowground symptoms, while the remaining 22.5% showed mild to medium tolerance with all plants showing either symptomatic above-, or below-ground. *In vitro* assays are underway to further characterize tolerance and susceptibility profiles of selected varieties.

Yield Potential and Economic Benefits of Common Vegetable Microgreens

Abel Bernal, California State University, Chico

Microgreens are young seedlings falling between a sprout and baby green stages that are consumed raw as vegetables. Microgreens have higher bioavailability of essential nutrients and beneficial health phytochemicals such as iron, zinc, magnesium, vitamins, and antioxidants than non-germinated seeds. Their enhanced nutritional value, the rapid growth cycle of two to three weeks, and ease of use have gained popularity in restaurants and community dishes.

The global microgreens market was estimated at $1.4 billion in 2021, and it is expected to increase by $3.6 billion by 2030. This rapidly growing industry offers potential for vertical farming in urban areas where arable land is scarce.

In this project, we compared the production potential of 11 vegetable varieties including cress, radish, arugula, amaranth, basil, basic salad mix, spicy salad mix, cabbage, kale, mustard, and broccoli as microgreens. A greenhouse experiment is carried out at California State University- Chico University Farm. The experiment compares natural light with supplemental lights using 80w Full Spectrum LED Grow Lights. Days to germination, days to reach marketability, seedling length at harvest time, and total production and sale of the microgreen will be recorded. The results will be presented in the poster.

Nitrogen Dynamics Following the Implementation of Compost and Cover Crops in San Joaquin Valley Orchards

Ariadne Castaneda, University of California, Merced

Alexia Cooper MS; School of Engineering, Environmental Systems Graduate Group, Rebecca Ryals Ph.D.; School of Natural Sciences, University of California, Merced

California is facing several soil health problems like drought, depleted soil, and expensive and environmentally damaging fertilizers contaminating the land and water. As a huge producer of almonds and pistachios, studies on integrative soil health practices and nutrient availability in California orchards

are more important than ever. Especially the impact that compost and cover crops can have on nitrogen availability in the soil for orchards in the San Joaquin Valley. In this study, cover crops and compost were put into five orchards, with methods varying on orchard specifics. Soil samples were collected and analyzed through KCL extraction and Synergy HTX plate readings for nitrogen availability in the form of nitrogen-available compounds nitrate and ammonium. We hypothesized an increase in these compounds would indicate the efficiency of this integrative application as a regenerative way to increase nitrogen availability and soil health in Central Valley almond orchards. With the integration of compost and cover crops, we saw an increase in nitrogen available compounds that the orchard trees can take up. This suggests that the treated soils had microbiomes capable of providing essential nutrients through nitrogen fixation. Further studies will take place on these orchards to determine biological activity and water retention.

The Effects of Rhizobia Inoculants on Bean Nodulation and Nitrogen Fixation in California Alley Cropping Systems

Yasmeen Castro Guillen, California State University, Chico

Hossein Zakeri and Kyle Brasier, California State University, Chico

California's orchard production is estimated to cover about 1.25 million acres of land. Conventional orchard management includes groundcover removal by mechanical and chemical methods. Recent concerns over the negative impacts of clean orchard floor, such as soil erosion and groundwater pollution, has encouraged growers to adopt conservation practices of growing cover or cash crops between orchard alleys. A small group of growers in northern California grow beans between orchard alleys in the first 2 years of orchard establishment. However, inoculation of beans with rhizobia is not common among them. We studied the effect of inoculation of yellow and cranberry beans with Exceed® Powdered Peat *Rhizobium leguminosarum* on nitrogen fixation and yield in a grower's field in Durham, CA.

Averaged over the treatments, yellow and cranberry beans produced similar dry mass (~ 1500 g m^{-2}), and had similar %Ndfa (~ 25%). Inoculation with rhizobia did not have substantial effects on nodulation, %Ndfa and biomass production. The %Ndfa of inoculated and non-inoculated beans were 14.5 and 31.1% for cranberry and 24.9 and 30.8 for the yellow bean. Both bean types had a similar pattern of partitioning of dry mass and N in different plant organs independent of the inoculation treatment. The majority of dry mass and N were found in pods and leaves and roots had the minimum ratio of biomass and N. The results are in agreement with other studies that bean %Ndfa is lower than other pulse crops.

Nursery Citrus Growth Response to Smart Lighting Techniques

Gabrielle Celaya-Finke, California State University, Fresno

Gur Reet Brar, Sharon Benes, and John Bushhoven, California State University, Fresno; Hardeep Singh, UCCE; Masood Khezri, MR Research Institute

California greenhouse nurseries are under pressure to produce commercial citrus stock at higher capacities in insect exclusion facilities due to pressure by Asian Citrus Psyllid and its ability to vector huanglongbing (citrus greening disease). Light supplementation has been well studied as a factor of growth regulation, however in the context of heat substitution, more can be learned about the effects of photoperiodic adjustment and carbohydrate allocation efficiency with the use of low heat LED lights.

This experiment was designed to examine the effects of supplemental lighting techniques with high efficiency low heat lights on the growth of nursery citrus. In one experiment, 5 lighting treatments were deployed using 12 trees each of unbudded Carrizo rootstock, Carrizo rootstock budded early fall with Clementine mandarin and Carrizo rootstock budded late fall with Clementine mandarin. The rootstock plants were significantly affected by the lighting treatments in several growth parameter areas. However, the plants budded with mandarin were far less responsive to the treatments. In a secondary experiment, 5 lighting treatments were deployed using 8 trees each of unbudded Carrizo rootstock and Carrizo citrange rootstock budded with Meyer lemon. The Meyer lemon plants responded significantly to some of the treatments versus control in height and trunk diameter. The trifoliate plants showed much greater variability between blocks and therefore less significance could be derived from the data. However, for the parameter of height, there were significant differences between the lighting treatments and the control for 2 of the 3 blocks. In both plant types, there was a strong correlation of effects between root volume and biomass.

Estimating Soil Apparent Electrical Conductivity in Orchards with Mobile Robots

Dimitrios Chatziparaschis, University of California, Riverside

Elia Scudiero, USDA-ARS, US Salinity Laboratory, Riverside; Konstantinos Karydis, University of California, Riverside

Measuring soil apparent electrical conductivity (ECa) is a key process in precision agriculture. Obtaining proximal ECa estimates with an Electromagnetic Induction (EMI) sensor, following proper calibration with soil salinity determined via physical soil sampling, often takes place manually either by walking with the sensor over a field or by driving it around with a tractor. These can be quite laborious and/or costly over large orchards. Robot-assisted ECa measurements, in contrast, may offer a scalable and cost-effective solution. We present one solution that involves a ground mobile robot retrofitted with a customizable platform that can hold different sensors (herein an EMI sensor) to perform semi-autonomous and on-demand ECa measurements. The platform is re-configurable in terms of sensor placement. We offer a realistic simulation environment and associated support tools to emulate a physical field and spawn realistic objects (like trees) as well as the (customizable) mobile robot(s) in an effort to evaluate multiple sensor placement setups for terrain traversability in a scalable and time- and cost-effective manner. This software suite can help narrow down possible robot-sensor setups that are then validated in physical experiments, and it is a general tool that can extend to various forms of robot, sensor, and environment setups. Further, results from physical experimentation with the EMI sensor lead to identification of sensor placement that strikes a balance between two opposing metrics, traversability (the closer to the robot the better) and electromagnetic interference (the farther the better). Field experiments show that the obtained robot-assisted ECa measurements are of high linearity compared to ground truth (data collected manually by a handheld EMI sensor) by scoring more than 90% in Pearson correlation coefficient.

Biomass Production and Nitrogen Fixation of Cowpea and Sunn Hemp Summer Cover Crop in Northern California

Maia Crummett, California State University, Chico

Seth Vicochea, California State University, Chico; Margaret Smither- Kopperl, Plant Material Center, Lockeford; Kyle Brasier, California State University, Chico; Annie Edwards, Plant Material Center, Lockeford; and Hossein Zakeri, California State University, Chico

This study quantified the total biomass and biological N fixation (BNF) of three cowpea (*Vigna unguiculate*) varieties and one sunn hemp (*Crotalaria juncea*) variety. The 'Chinese Red,' 'Red Ripper,' 'Iron & Clay' and 'Tropic Sun' were planted in a randomized complete block design with four replications as leguminous summer cover crops. The study was conducted at the Lockeford Plant Material Center (PMC) in mid-July 2022. The plots were sampled in early September for biomass and N content. Due to irrigation malfunction, the plots were watered unevenly, resulting in two distinguished groups of stressed and non-stressed plants in each plot. While sampling, two sets of samples were taken from each plot to account for the stressed and non-stressed plants. These samples were dried, weighed, ground, and processed for their N and δ15N composition. On average, the three cowpea varieties produced more biomass and accumulated more N than the sunn hemp variety. The well-watered plants produced an average of 4000 kg ha^{-1} of aboveground biomass and 400 kg ha^{-1} of root biomass while the stressed plants produced 2200 kg ha^{-1} and 220 kg ha^{-1}, respectively. Similarly, non-stressed and stressed plants had 50 and 53% Ndfa, accumulated 135 and 82 kg N ha^{-1} in aboveground biomass, and contributed 68 and 43 kg N ha^{-1} to the soil N, respectively. The highest biomass, N content, and N contribution to soil belonged to the cowpea Red-Ripper. In response to uneven irrigation and drought stress, Iron-Clay (cowpea) and Tropic-Sun (sunn hemp) had less biomass production than the other two varieties. The results suggest that with adequate water, both legumes can incorporate 47-76 kg N ha^{-1} into the soil from the BNF.

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

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Harmanpreet Sharma, Susana Lopez, John T. Bushoven, Sharon E. Benes, and Ranjit Riar; California State University Fresno.

Alfalfa is an important forage and the most valued hay crop 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 varieties. In this 2-year experiment, four alfalfa (*Medicago sativa*) cultivars were evaluated at five irrigation water salinity levels (0.5, 5, 10, 15, 20 dS/m EC_w, mixed salt solution) in a split-plot design. The cultivars include two newly licensed varieties from Barkley Seed, Inc. (B6604-0588F, B6269 SR), a salt-tolerant (AZ90NDCST), and a public (CUF101) control. At seed germination, V3 (B6269) and V4 (B6604) were much superior to V1 (CUF 101) and V2 (AZ90NDCST). Although the salinity x variety interaction for dry matter (DM) yield was not statistically significant, even at higher salinities, the following numerical comparisons can be made. V2 (AZ90) was the most salt tolerant based on absolute and relative yield at 10, 15, and 20 dS/m EC_w; however, V3 yields were fairly comparable. Furthermore, V3 (one of two new commercial varieties) showed a good salinity tolerance combination based on seed germination and relative yield at the established plant stage. All varieties showed tolerance at saline irrigation up to 10 dS/m EC_w, maintaining close to 80% relative yield. At 20 dS/m, relative yields were 47 to 60% across the varieties. Results support our field trials with a much larger number of varieties, suggesting that alfalfa is much more salt tolerant than established guidelines suggest. Dry matter yield, shoot Na^+ and K^+, and seed germination data will be presented.

Nitrogen Mineralization as Influenced by Temperature and Organic Fertilizer Source

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Dr. Charlotte Decock and Lily Elola, California Polytechnic State University, San Luis Obispo

As more growers seek to implement organic farming practices, knowledge about when and how much soil microorganisms will mineralize organic nitrogen (N) sources to plant available forms is increasingly pertinent. Studies have previously found that as temperature increases, N mineralization rates can increase exponentially. Our work seeks to further understand how N mineralization rates are affected by temperature and fertilizer input. We hypothesized that 1) N mineralization rates will increase with increasing temperature and 2) that the effect of temperature on mineralization rate will depend on fertilizer source. We assessed mineralization rates of twelve fertilizer sources varying in feedstock, N content, and C:N ratios at five incubation temperatures: 5, 10, 15, 20, and 25° C. Each treatment combination was repeated 4 times and incubated for a total of five weeks. There was a trend of increasing N mineralization with increasing temperature up to 20° C, but at 25° C a slight downturn was observed. Immobilization occurred more at 10 and 5° C than at other temperatures. The two fertilizers which contained the lowest N content followed a similar mineralization curve to the control throughout all five temperatures. For other fertilizers, effects of temperature on mineralization rates varied. We plan further analyses to understand the role of fertilizer properties in the response of N mineralization to temperature changes.

Using Drone Multispectral Imaging for Weed Discrimination: A Case Study from Riverside, CA

Hovanness Dingilian, University of California, Riverside

Elia Scudiero, University of California, Riverside and USDA-ARS, US Salinity Laboratory, Riverside; Alex Putman, Ahmed Kayad, Milt McGiffen, University of California Riverside

Weed detection is a relatively new and up and coming application of drone technology. However, little information is available on how drones can be used to detect weeds in annual crops in California. The purpose of this study was to evaluate the use of drones for identifying and discriminating weeds in a vegetable field. A cantaloupe crop was established during the 2022 summer season in a 0.2 ha field located in Riverside, CA, United States. After weeds grew naturally over the study field a drone flight captured imagery that was stitched into a composite orthomosaic and a total of six weed species (*Portulaca oleracea, Tribulus terrestris, Malva parviflora, Datura wrightii, Sonchus oleraceus and Chenopodiastrum murale*) were considered for further analysis. Polygons were created of the cantaloupe plants and the six weed species through ArcGIS software using a set of high-resolution ground images collected from the field at the same day of the drone flight, which were used as reference points. Averages of raw reflectance values and vegetation indices were calculated for each polygon, and then analyzed across all plants in the field for each plant species. Preliminary results showed that cantaloupe plants can be distinguished from the weeds at certain band lengths and vegetation indices. However, the six weed species could not be distinguished using these band lengths and vegetation. The study shows promise for the use of drones in identifying weeds in vegetable crops.

Machine Learning with Landsat Satellite Data for Crop Mapping in the Yuma Valley Region of the Lower Colorado River Basin

Jordan Guillory, UC Riverside, USDA-ARS US Salinity Lab

Ramesh Dhungel, USDA-ARS; Elia Scudiero, University of California, Riverside and USDA-ARS, US Salinity Laboratory, Riverside; Ray G. Anderson, USDA-ARS and University of California, Riverside

The impacts brought by climate change and a growing population increase food scarcity, thus monitoring crop acreage is important to forecast potential scarcity. However, surveying cropland has historically been labor intensive as it has usually relied on ground-based surveys or manual classification of aerial imagery to identify the type and development of crops. The development of satellite crop mapping is key to solving this problem. To demonstrate the potential of satellite crop mapping, we applied machine learning techniques for crop classification in the Yuma Valley Region of the lower Colorado River Basin using satellite imagery from Landsat. We present preliminary work illustrating the types of imagery and unique ground-truthing data available in this region and discuss how these techniques can be used to advance the identification of specialty crops that are critical for human nutrition.

CIWA: A Novel Deep Learning-based System to Support Precision Irrigation

Jacob Hampton, California State University, Fresno

Athanasios Aris Panagopoulos, Minas Pantelidakis, Eric Kor, Konstantinos Mykoniatis, Orestis P. Panagopoulos, Shawn Ashkan

We propose an Expert System for precision irrigation to provide water to plants in a timely and precise way. The backbone of our approach is Deep Learning and in particular a Convolutional Neural Network (CNN) technique for segmenting sunlit leaves in visible-spectrum images. We show that CNNs can improve the accuracy and precision of sunlit-leaf segmentation by over 100% and 350%, respectively, when compared to the state-of-the-art. By using only sunlit leaves the Expert System can support watering the areas that are under the most stress which leads to significantly more precise irrigation. Through cloud computing and data analytics the system allows the user to monitor the irrigation needs in real time with minimum input, and generate routine and ad-hoc reports as needed.

Above- and Below- Ground Interactions of Legume and Grass Species in Cover Crop Mixes

Kimberly Holguin, California State University, Chico

Aubrey Teckam, Hossein Zakeri, Kyle Brasier, California State University, Chico

Belowground and aboveground biomass of soybean (*Glycine max*) and millet (*Pennisetum glaucum*) in single and mixed cropping was quantified in a controlled experiment. The treatments included growing soybean and millet alone (single) and together (mixed). Plants were established in 72-cm tubes during the summer of 2022 and harvested after 52 days. Roots were washed and cut into three 24-cm segments, separated by species. The leaf area was measured and then the biomass dried and weighed.

Averaged over the treatments, millet and soybean produced 69.2 and 5.2 g plant^{-1} root mass. The majority of roots were in the top 24 cm, where millet and soybean had 42.6 and 4.6 g plant^{-1} root mass.

In the 24-48 and 48-72 cm layers, soybean had 0.5 and 0 g and millet had 23 and 3.6 g plant^{-1} root mass. In response to the treatments, root mass of soybean and millet was 8.5 and 78.6 g plant^{-1} in the single crop treatment and 1.8 and 59.8 g plant^{-1} in the double cropping treatment. In terms of aboveground biomass, both crops produced similar dry mass (5.4g plant^{-1}) and had similar height (40.3 cm); however, millet had a higher leaf surface area (348 cm^{2}plant^{-1}) than soybean (212 cm^{2}plant^{-1}). Mix cropping reduced the leaf surface area by 240 cm^2 (soybean) and 216 cm2 (millet). The sum of leaf area of soybean and millet in the mixed treatment was 335 cm^{2}plant^{-1}, which was similar to the soybean leaf area (331 cm^2) and less than millet leaf area (453 cm^{-2}). The results suggested that competition between the two species reduced the above- and below-ground production of both species under the experiment conditions.

Nodulation of Pigeon Pea, Lab Lab and Cowpea in Response to Different Rhizobia Strains

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Winter and summer cover crop mixes often have one or more legume species to improve soil N. They are especially important in organic production systems, where N sources are limited. The composition of cover crop mixes determines their potential benefits to the soil. In this study, we quantified nodulation and nitrogen content of three legume species: lablab, also known as Hyacinth Bean and Indian Bean (*Lablab purpureus*), pigeon pea (*Cajanus cajan*), and cowpea (*Vigna unguiculata*). The plant species were inoculated with *Rhizobium leguminosarum* (pea inoculant) and *Bradyrhizobium japonicum* (soybean inoculant). Plants were terminated 55 days after planting. Roots were harvested and washed, and nodules were counted and weighed. Above-ground biomass was dried, weighed, and ground for nitrogen analysis by Leco CN Analyzer. Pigeon pea, lablab, and cowpea grew 36 cm, 56.9 cm, 48 cm tall, produced 0.86, 4, and 2.75 g plant^{-1} dry biomass, had 0, 5, 48 nodules plant^{-1}, which weighed 0, 0.025, 0.65 g plant^{-1}, respectively. The N concentration of the plant materials were 1.89, 1.07, and 1.48%, respectively. Overall, the results showed that only cowpea nodulated well in response to the inoculant rhizobia. Notably, cowpea had higher nodules when it was inoculated with soybean inoculant than pea inoculant.

Using Gamma-ray Surveys to Predict Soil Properties in Perennial Cropping Systems

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Proximal remote sensing techniques (including gamma-ray soil scanning) can quickly assess crucial soil properties such as texture at field scales as well as the impact of management approaches (e.g. regenerative agriculture and organic inputs) that modify soil physical and chemical properties. However, the relationship of gamma-ray observations to these properties has not been well studied in arid zones or perennially-cropped agroecosystems. Therefore, in this study we compare gamma-ray surveys to measured soil properties at three commercial vineyards in the Temecula Valley, California. These vineyards have similar underlying NRCS soil series classifications, but they have contrasting

management practices, with one vineyard under regenerative farming practices, one in transition from conventional to regenerative practices, and a conventional vineyard that serves as a control. We will compare surveyed gamma-ray counts to soil texture, electrical conductivity, and other properties to see if the relationships between these properties are stronger in arid zones than in more humid climates and to evaluate the potential for gamma-ray surveys for large scale sampling in Californian agricultural systems.

Using ECa-directed Soil Sampling from EM38 Soil Surveys and ArcGIS post-processing to Determine Temporal Changes in Soil Salinity in Forage Fields under Long Term Irrigation with Saline Drainage Water

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Saline waters are increasingly used for irrigation due to a declining irrigation water supply in California. Reliable-field specific data on salinity levels within and near the root zone is critical to the long-term management of forage production with saline water. This project aims to compare EM38 soil survey data collected in 2017 and 2021 at the San Joaquin River Improvement Project (SJRIP), a 6,500-acre saline water reuse facility in western Fresno County, to determine spatial-temporal changes in soil salinity at the field scale. Four fields sown to 'Jose' tall wheatgrass were selected (10-6, 13-1, 13-2, and 13-6). The EM38 sensor was walked along 20 to 25 transects per field (~30 meters apart) after which 12 soil sampling locations for ground-truthing were generated using the ESAP-RSSD software. Soil samples taken in 30 cm increments to a depth of 120 cm were analyzed for gravimetric water content, saturation percentage, pH, and soil salinity (ECe). ESAP-Calibrate software was used to convert the ECa (apparent electrical conductivity) data from the sensor to ECe for all survey points and the change detection function in ArcGIS was then used to compare soil salinity in 2017 and 2021. In field 10-6 soil with good natural drainage, soil salinity averaged over the field did not change appreciably from 2017 to 2021, although the western half increased in salinity while the middle portion decreased. In field 13-1 which had minimal irrigation in summer 2021, approximately 75 % of the field fell into the 20 – 24 dS/m class in 2021, as compared to 2017 when a similar percentage of the field was in the 16 – 20 dS/m class. Spatial-temporal patterns in soil salinity can inform irrigation management under saline conditions.

Utilizing Remote Sensing Technologies to Monitor and Quantify Spider Mite (*Tetranychus spp.)* Damage in California Almonds (*Prunus dulcis*)

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Spider mites *(Tetranychus spp.)* are known to infest almond (*Prunus dulcis*) orchards throughout the summer months in California's Central Valley. They feed on the intercellular contents of leaves using piercing-sucking mouthparts causing stippling, necrosis, defoliation and yield reductions in the years following severe damage. While almond acreage in the Central Valley has nearly doubled over the past

decade, spider mite monitoring methods remain largely unchanged, emphasizing time consuming *in situ* counts under a hand lens. Cameras mounted to Unmanned Aerial Vehicles (UAVs) have generated special interest among pest management professionals, as their high spatial resolution allows for the rapid detection of arthropod damage over extensive landscapes. Here we demonstrate the utilization of RGB (Red Green Blue), Multispectral, and Thermal sensors equipped to aerial UAVs to detect sider mite damage in almond blocks under differential spider mite feeding pressure. Correlation and regression analysis between drone imagery and ground truthing metrics, were conducted to link relevant ground truthing metrics with drone imagery. Preliminary analysis reveals that low resolution RGB sensors are sufficient in the detection of spider mite damage in almonds, additionally, analysis of multispectral imagery is to follow. Considering these conditions, a monitoring protocol using drones equipped with sensors capable of detecting spider mite damage could provide a more efficient spider mite monitoring method. However, this approach will likely require sophisticated cameras capable of detecting spectra beyond the visual bandwidths.

Creating a Rapid GIS Workflow to Correct On-the-go Gamma Ray Soil Spectrometry Data According to Survey Speed

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On-the-go soil sensing is a rapid and inexpensive method for characterizing spatial variability of soil properties at the field scale. Gamma ray spectrometry is typically used for soil texture and clay mineralogy mapping as it senses the gamma radiation emitted from clay minerals in the topsoil. Gamma-ray spectrometry is often carried out in stop-and-go surveys. However, such surveys are slow and only measure gamma ray radiation at relatively few locations. Contrarily, on-the-go measurements can rapidly collect thousands of measurements in a single field. In on-the-go surveys, tractor speed plays a role in the amount of gamma radiation measured on a specific footprint over time. In other words, slower speeds can render higher quality data, so a similar vehicle speed is needed for surveys. Since we are measuring on-the-go, we need a rapid way to calculate the speed of the survey. We aim to do this in order to remove bias from varying vehicle speed across our study sites. We will discuss a rapid GIS method to calculate the speed of the survey. The developed data correction method, as well as its application in a study case, will be presented.

Pesticide Trial Against Citrus Mealybug *Planococcus citri*, Risso 2022

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Citrus mealybug, *Planococcus citri* Risso, is an increasing issue in the San Joaquin Valley. Infestations can result in yellowing leaves, reduced tree vigor, stunting, fruit contamination, and tree death. A field trail conducted in the summer of 2022 evaluated efficacies of 20 pesticide treatments in 12-year-old spring navel oranges. The trial involved single tree applications with six replicates in a complete randomized pattern throughout the block. Applications were made on March 29 (15 treatments tested) and on July 5 (16 treatments tested). Each tree received second application of similar or a different product. Application rates and volumes followed manufacturer recommendations and grower standards. All

applications included a 0.5% oil and Exit® or Nu fil 17®, except Lime sulfur Ultra and Sulforix®. Pretreatment counts were done a week before the applications and post treatment counts were done 7 days, 14 days, 21 days, and 28 days after treatment. All treatments significantly reduced mealybug populations, with Aza-direct®, Sequoia® CA, and Danitol® providing the most comprehensive control for up to 4 weeks. Implications of pesticide trial data on citrus mealybug management in the San Joaquin Valley citrus are discussed. Research supported in part by CRB 5500-501 and industry gifts of pesticides and funding.

Applications for Black Soldier Fly Frass and Exoskeleton Powder in Agriculture

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As commercial agriculture faces new challenges, including rising prices of nitrogen fertilizers 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 organic substrates including food and agricultural waste in mass rearing facilities. BSF rearing can recycle nutrients back into agriculture through BSF frass (BSF-F) and BSF exoskeleton powder. Previous studies showed that BSF-F, consisting of minerals, organic matter, and chitin, can be applied to soil to improve maize productivity. BSF-F was approved in California as a soil amendment, but we lack information about appropriate doses and benefits for crops. BSF exoskeleton powder contains nutrients, chitin and chitosan that prime plant defenses but lacks broad testing for potential plant benefits. To address knowledge gaps, we evaluated BSF-F as a nitrogen source for cantaloupe plants relative to synthetic NPK, chicken manure, and no fertilizer control. We monitored effects of each amendment on soil chemical and biological properties, including nutrient levels, carbon, and microbiomes. We hypothesized BSF-F and BSF exoskeleton powder will positively affect cantaloupe growth and yield metrics and could supplement or replace conventional fertilizers. Results suggested that amendment with 471 kg N/Ha of BSF-F is a suitable replacement for synthetic NPK. We also conducted a BSF exoskeleton powder trial and compared performance with commercial chitin, chitosan, and negative control, all treatments received standard fertilizer. Observations suggest amending soil with 2g/kg of BSF powder is a more suitable plant growth supplement compared to other treatments.

Tillage, Drainage, and Residue Effects on Soybean Growth and Soil Characteristics

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Fabian Fernández, Seth Naeve, University of Minnesota, Saint Paul

Although soybean is considered a highly competitive and resilient crop, early-season growth and development are crucial to output maximization. As early planting is vital, early spring vigor and growth rates dictate production potential. In other words, planting dates have minimal effect on soybean yields, but emergence dates and early season vigor show significant results. Precipitation variations can disturb a wide range of ecological processes, especially if they occur faster than animal and plant species can adapt. Like last year, Minnesota experienced a catastrophic drought due to chronic rainfall deficits mixed with above-normal temperatures across the state, emphasizing the importance of effective crop management studies. Famers have different ways to use and manage their land and crops to improve the growth, development, and yield, such as crop rotation, drainage, tillage, crop residue, and cover

crop management. Minnesota soybean growers typically implement drainage in their soils, fall tillage, and the increasing management of cover crops. Thus, this work aims to study the primary effects on a wide range of contemporary crop management scenarios to examine spring soil conditions affecting soybean planting, emergence, and vigor. By incorporating the crop management treatments indicated above, it is also possible to examine all two and three-way interactions on soybean yield and seed quality and the main and interacting effects on soil chemical and physical parameters. Performing a thorough physical, chemical, and biological analysis of the site in order to assess the long-term impact of drainage and tillage on Minnesota soil productivity. Preliminary results suggest a significant improvement in the quality of recommendations for fall tillage, cover crop management, and planting management in both well-drained and poorly-drained soils.

Biomass Production and Biological Nitrogen Fixation by Fababean (*Vicia faba* L.) in Various Cover Crop Mixes

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In recent years, environmental quality, biodiversity, and agricultural production have declined significantly due to conventional agricultural practices such as intensive tillage, short or no fallow, monocultures, leaching, and excessive use of inorganic fertilizers (Dabney et al., 2010). Moreover, an expenditure of $3.6 billion yearly on herbicides (Pimentel and Levitan, 1986), has not resulted in the reduction of weeds, and reduced output by 10% (Shaw, 1982). Soil degradation from intensive cropping production and resultant losses in productivity requires the use of rejuvenating practices to rebuild soil health and crop productivity potential. Therefore, cover crops are now recognized as an important component of sustainable production in most areas of California because of their potential for biological nitrogen fixation and biomass addition into the soil. The production of fava bean biomass is typically higher than most other legumes, achieving 20-40 tons per acre, with a nitrogen fixation rate of 90 to 200 lbs. per acre (Hickmam and Canevari, 2018; Jensen et al., 2010). In this experiment, the biological nitrogen fixation and biomass addition are examined in various crop mixes in a split-plot design. The crops include fababean (*Vicia faba* L.), oat (*Avena sativa*), mustard (*Brassica* sp.), radish (*Raphanus sativus*), pea (*Pisum sativum*), and vetch (*Vicia* sp.) with different seed rates. Five best-performing fababean lines (En 39, Bell Bean, En 3, SSN-1, and En-15) were selected from a panel of 63 previously tested fava bean germplasm lines and were examined for various parameters such as root length, shoot length, nodule count, dry weight of nodules, and leaf area. N derived from the atmosphere (%Ndfa) and total N will be presented.

The Influence of Cover Crops on Nitrogen Dynamics during Agricultural Managed Aquifer Recharge

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Central Valley growers rely on groundwater to sustain their crops. However, the lack of sufficient groundwater recharge has led to environmental problems. Agricultural managed aquifer recharge (Ag-MAR) offers a potential solution. This practice involves flooding an agricultural field with excess surface

water during the winter or early spring. The floodwaters percolate down and recharge the groundwater. However, agricultural fields often contain high nitrate levels. The challenge, therefore, is to increase recharge without contaminating the groundwater. Grass cover crops can reduce nitrate leaching by taking up excess nitrogen from the soil and sequestering it in their biomass. This project analyzed the effects of planting a cover crop on nitrogen dynamics during a two-week flooding event in a vineyard in Fresno County. The field crew planted triticale, a grass cover crop, in November 2021. In early March 2022, they mowed and disked half of the cover crop plots before flooding the 2-acre vineyard for two weeks. After flooding, the field crew terminated the remaining triticale. Before, during, and after flooding, we collected the following types of samples to track the nitrogen and carbon cycles: pore water samples from lysimeter stations (depths: 20, 60, and 100 cm); greenhouse gas samples from static flux chambers; soil samples (depths: 0-10, 10-20, 50-60, and 90-100 cm); and triticale biomass samples. The results demonstrate the complexity of nitrogen dynamics during a flooding event. The triticale did not reduce the initial amount of nitrate in the soil samples. The nitrate concentration in the pore water samples dropped to 0 within the first five days of continuous flooding, indicating leaching. More study is needed to determine best practices for minimizing nitrate leaching during Ag-MAR.

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?

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As the San Joaquin Valley continues to face drought and rising temperatures, 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 time series model of tall wheatgrass growing seasons using satellite images and vegetation indices. Using four fields ranging from 70 – 88 acres, satellite images from Sentinel-2 will be analyzed, and Normalized Difference Vegetative Index (NDVI) values 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.

Water Use Efficiency (WUE) and Drought Tolerance Traits of Fava Bean in Relation to the Plant 13C Isotope Composition

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Kyle Brasier and Hossein Zakeri, California State University, Chico

Faba bean (Vicia faba) is grown in winter cover crop mixes in California. In this study, we compared agronomic performance and physiological traits related to WUE and drought tolerance of several fava bean lines in a pot study over two growing seasons (2020-2022). A panel of 63 fava bean lines was evaluated for their 13C composition in four environments. 7 lines with extreme 13C values were selected and studied for their drought tolerance and WUE traits under full-irrigation and drought treatments in a pot study. $\Delta^{13}C$ (‰) was found to correlate strongly with plant dry matter, sub-stomatal CO2 concentration (µmol mol^{-1}), and WUE_{leaf} in the 2021-2022 under both watering conditions. In 2020-2021, faba bean lines in the drought treatment condition produced a range of 16.8 to 28.7 g $plant^{-1}$ grain, and 34.9 to 55.8 g $plant^{-1}$ dry biomass (with grain). Faba bean lines in the 2021-2022 growing season produced a range of 15.1 to 26.8 g $plant^{-1}$ grain, and 33.3 to 46.6 g $plant^{-1}$ dry biomass. Lines in the fully-watered condition produced a range of 18.4 to 49.8 $plant^{-1}$ grain, and 50.2 to 72.7 g $plant^{-1}$ dry biomass in the 2020 growing season, while plants in the 2021 growing season 18.1 to 54.9 plant-1 grain, and 34.8 to 133.1 g $plant^{-1}$ dry biomass. On average, fully watered plants transpired a range of 19.3 to 29.0 L water $plant^{-1}$, and stressed plants had a range of 7.4 to 15.8 L $plant^{-1}$ transpiration during the 2020-2021. Fully watered plants in 2021-2022 transpired a range of 18.0 to 33.5 L water $plant^{-1}$ and stressed plants had a range of 6.88 to 9.52 L $plant^{-1}$.

Evaluation of Anaerobic Soil Disinfestation and Pathogen Suppressive Microbial Inoculants for Allium White Rot Management

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Grace Hardy and Dr. Jose-Pablo Dundore Arias, California State University, Monterey Bay

Allium white rot (AWR), caused by the fungal pathogen *Sclerotium cepivorum,* is a major challenge to garlic and onion production around the world, leading to devastating yield losses and increasing production costs. The pathogen produces small survival structures called sclerotia, which can remain dormant and viable in the soil for several decades, even in the absence of a suitable host. Current treatments in commercial production include applications of fungicides or organic and synthetic compounds aimed at stimulating pathogen germination before planting. These costly methods have shown inconsistent results, hence the need for an alternative that is more sustainable and effective. The main goal of this project is to evaluate the efficacy of anaerobic soil disinfestation (ASD) for the management of AWR, and the potential synergistic effect of ASD combined with commercial biocontrol products (RootShield WP) consisting of pathogen-antagonistic *Trichoderma spp.* to further suppress sclerotia survival in the soil. Sclerotia density and survival were assessed through controlled pot trials in which field-collected soil was treated with and without ASD and RootShield. Results obtained have demonstrated a consistent effect of ASD reducing sclerotia density on average by 21.2% in comparison to the negative control (No ASD with no RootShield). Treatment consisting of ASD + RootShield resulted in an even further reduction of sclerotia, decreasing 40.2% compared to the negative control. Results from this research project provide further evidence of the efficacy of these non-chemical strategies to reduce *S. cepivorum* survival in the soil, and their potential for limiting AWR-caused yield losses and enhancing soil health.

Interactions of Fava Bean and Oat in Mixed Cropping Systems with and without Mycorrhizal Inoculation

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Kyle Brasier and Hossein Zakeri, California State University, Chico

Cover crops are often made of multiple species that together provide a wide spectrum of benefits to soil and the environment. Grass species are known to reduce erosion, legumes improve soil nitrogen (N), and plants of the brassica family can improve soil infiltration and reduce pest and disease pressures. While the collective effects of cover crop mixes are beneficial, the belowground interaction of cover crop species and their responses to beneficial organisms is not well understood. We have established a study in a controlled condition to quantify above- and below-ground growth of bell bean (*Vicia faba*) and oat (*Avena sativa*) in single and mixed cropping systems with and without mycorrhizal inoculation. Seeds were started in the greenhouse. Half of the seeds received Mykos Pure Mycorrhizal Inoculant (Xtreme Gardening, CA) and the other half remained inoculated. Seedlings were transplanted into 3-ft tubes filled with sand and a slow-release fertilizer. In a factorial experiment, two factors of intercropping (fava only, oat only, and fava-oat) and mycorrhiza (inoculated and non-inoculated) are being studied. At the fava bean's podding stage, plants will be harvested and plant growth traits such as height, leaf surface area, and dry mass will be quantified. The tubes will be cut to three parts (1 ft each) and roots will be extracted from each segment. Root surface area, nodulation of fava bean, and root infection rate with mycorrhizal fungi will be quantified. The results will be presented in the poster.

Development of an Inoculation Technique for Rapid Evaluation of Pythium Wilt of Lettuce

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Alex Imperial and JP Dundore Arias, California State University, Monterey Bay

Pythium wilt of lettuce (*Pythium uncinulatum*) is threatening the sustainability and future of lettuce production in the Salinas Valley. As an emerging disease, very little is understood about the biology and ecology of the disease, in particular, disease occurrence since symptoms are often misdiagnosed or overlooked during the early stages of the infection. The goal of this study was to advance our understanding of Pythium wilt by developing an inoculation method with the goal of characterizing disease progression and symptom development. Four inoculation methods commonly used in the study of other Pythium root rot diseases were tested, including i) root dipping, ii) soil drench, iii) addition of the pathogen in agar plugs, and iv) an oat-V8-vermiculite inoculum. These methods were tested with three Romaine lettuce varieties (Duquesne, Patton, and 22PT/02) which were inoculated with a mixture of three *P. uncinulatum* isolates previously isolated from infected plants and compared against mock-inoculated plants. Drench treatment resulted in a higher frequency of infected plants, faster symptom development, and lower plant biomass compared to the other inoculated treatments or mock-inoculated plants that remain asymptomatic. Symptomatic plants were sampled and observed under the microscope to confirm the presence of *P. uncinulatum* spores. While treatment effects varied among lettuce varieties, the most inconsistent inoculation effect was observed with the Vermiculite treatment. Selected treatments will be further assessed in future studies on plants at different developmental stages and used to evaluate lettuce genotypes for tolerance to Pythium wilt under controlled conditions.

Improving *Fusarium oxysporum* f. sp. *Vasinfectum* race 4 Detection with the Development of a New Quantitative PCR Assay

Michael Urner, California State University, Fresno

Mala To, and Margaret L. Ellis, California State University, Fresno

Fusarium oxysporum f. sp. vasinfectum (FOV) is a pathogenic soil borne fungus responsible for Fusarium wilt in cotton (Gossipyum spp.). In California, FOV race 4 is of economic importance, and can currently be detected using conventional PCR and race specific primers. However, the current protocol is time consuming, requiring isolation of the fungus from soil or plant tissue, followed by DNA extraction, before confirmation with PCR. Therefore, our goal was to improve the speed and accuracy of detecting FOV race 4 by developing a quantitative PCR (qPCR) assay. FOV race 4 specific primers were developed based on the unique Tfo1 insertion event at the N-acetyl transferase gene (NAT) locus. The primers were able to amplify all three unique genotypes of FOV race 4. FOV race 3 and Fusarium solani were used as controls to determine specificity of the primers to preclude false positives. Once the specificity of the FOV race 4 primers was determined a qPCR assay was developed using SYBR Green technology. Additional work is currently being conducted to determine the utility of the qPCR assay in detecting and quantifying FOV race 4 from plant tissue and soil samples from commercial fields in CA.

Comparison of Two Deficit Irrigation Strategies on Physiological Traits of Fava Bean

Seth Vicochea, California State University, Chico

Erik Spitzer, Kyle Brasier, and Hossein Zakeri, California State University, Chico

Deficit irrigation (DI) is the process of reducing irrigation below the plant's water need to improve water use efficiency. Although DI causes drought stress and reduces plant growth, some strategies can mitigate the negative effects of DI on leaf turgor, photosynthesis, and crop yield. Partial Root Drying (PRD) is a DI approach in which every other crop row is alternatively irrigated, reducing applied water by approximately 50%. Compared to less frequent irrigation strategy, the PRD keeps 50% of the root zone moist, which may reduce the drought effect on plant growth and yield. We studied the effects regular DI (less frequent irrigation) and PRD on stomatal conductance, photosynthesis, and root growth of fava bean (*Vicia faba*).

Fava bean was planted in the middle of 20-G divided containers filled with a 1:1 soil- sand medium. Three treatments of fully watered, drought stress and PDR were applied. The fully watered plants were constantly kept at filed capacity, drought stressed containers were watered when plants showed visible signs of stress, and plants in the PDR treatment received water on alternate sides, commencing upon irrigation of the drought stress treatment. The results, including plant photosynthesis rate, leaf surface area, and root surface area will be presented in the poster.

Effect of Alley Cropping on Soil Moisture and Fruit Tree's Water Potential

Steven Wallin, California State University, Chico

In 2021, the cultivation of almond and walnut in CA reached 1,640,000 and 445,000 ac, respectively. This along with other orchard types offer the potential to grow annual cash crops between orchard rows (alley cropping). Our previous study in Durham CA suggested that growing dry bean between young almonds can generate up to $1500 /ac, and benefit the grower about $900 /ac. In addition to economic benefits, alley cropping can reduce soil erosion and increase the ecological diversity of an operation. However, lack of knowledge about this practice, and concerns about the effects on trees' long-term productivity limits this practice. In this poster, we'll present 1) the effect of alley cropping on soil moisture and tree leaf water potential of almond, and 2) demonstrate a new low-cost tool to study mix cropping in orchards.

Our measurements during the 2022, 2021, and 2020 growing seasons suggest that growing beans between young trees is less likely to impact soil moisture, and the trees' leaf water potential. In a second experiment, we have designed a low-cost lysimeter that allows studying mixed cropping in young orchards. The system includes growing trees in 44-gallon containers equipped with a float valve and reservoir system which facilitates automatic and monitored irrigation events. The system also includes soil moisture sensors to monitor soil moisture. Currently, we are using the system to test the effects of ground cover (bare, alfalfa, and red clover) and whole orchard recycling (with and without wood chips) on ET, leaf water potential, and soil moisture content. Details will be presented in the poster by Steven Wallin.

Cover Cropping with Strip Tilling Reduces Herbicide use in Silage Corn

Robert Willmott, California State University, Fresno

Jennifer Valdez-Hererra, California State University, Fresno; Jeffrey Mitchell, UC Agriculture and Natural Resources; Anil Shrestha, California State University, Fresno

Cover crops are becoming widely used in California. Furthermore, growers and researchers are exploring the potential of terminating cover crops with a roller-crimper. A study was conducted in a center pivot irrigated field at Fresno State, Fresno, CA. Cover crops (5 treatments) were planted in November, roller-crimped in April, and silage corn (Roundup + glufosinate ready variety) was strip-till planted in the residue. The experimental design was an RCBD with three replications and conducted in 2021 and 2022. A tank-mix of glyphosate + glufosinate was applied in early June. Soil cover, weed cover, cover crop kill, and silage corn yield data were taken. The study showed that cover crops eliminated the need for a pre-emergence herbicide and one application of post-emergence herbicide was sufficient. Corn silage yield was similar between the treatments and similar to the conventional treatment. It can be concluded that roller-crimped cover crops have the potential for silage corn production in the Central Valley.

Assessment of Small Seed Faba Bean Lines in California Cover Crop Mixes

Gabe Worthington, California State University, Chico

Hossein Zakeri and Kyle Brasier, California State University, Chico

Faba bean (Vicia faba) is the main component of winter cover crop mixes in California due to its capacity to fixate large quantities of Nitrogen from the atmosphere. Bell bean is a medium-seed faba bean with

100KW of about 45g that is commonly grown in winter cover crop mixes. We are investigating the effect of faba seed size and faba bean ratios in cover crop mixes on nitrogen (N)benefits of legumes in winter cover crop mixes. Plant Introduction (PI) Accessions 254006 (100KW-49g), 317500 (100KW-29g), and 655340 (100KW-29g) were compared with Bell Bean in different mixes containing oat, mustard, radish, pea, and vetch.

At termination on February 18th average fixed N of Bell Bean, PI254006, PI317500, and PI655340 were 18, 7.6, 9, and 8.6 kg/ha, respectively. Although Bell bean appeared to have the highest Nitrogen fixed, it was not significantly different from any of the small-seeded lines. The highest N fixation of faba bean was measured in the oat-faba mix where the proportion faba bean N from fixation was 86 %. It was also found that Faba fixed significantly more Nitrogen in the oat-faba mix, fixing 31 kg/ha.

Potential of Fava Bean Cover Crop Varieties in Southern California

Aaron Fox, Cal Poly Pomona

Hossein Zakeri and Kyle Brasier, California State University, Chico; Zach Aceves, Kevin Corona, and Adrian Rios, Cal Poly Pomona University

Fava bean (*Vicia faba*) is a promising crop that can be incorporated in cool season cover crop mixes for California farmers. Varietal trials started at Chico State University were expanded to Cal Poly Pomona in Los Angeles County. The purpose of the study is to gather data on agronomic quality of six fava cultivars over a two-year period. The first variety trial was planted in December 2021 in a randomized complete block design consisting of six varieties replicated in three blocks for a total of 24 plots (5ft by 3ft each). Fava beans were planted with a mix of other cover crop seeds, including vetch, pea, mustard, and radish. The trial at Pomona was irrigated regularly. In March 2022, measurements were taken on total above ground biomass. Mustard and radish cover crops outcompeted all other species, including the fava beans. However, one variety of fava bean still produced higher biomass than other varieties.

Evaluation of Nitrogen Uptake and Applied Irrigation Water in Asian Vegetables: Bok Choy & Lemongrass

Jessica Kanter, UC Agriculture and Natural Resources

Sukhmony Brar, Hardeep Singh, Lilian Thaoxaochay, Sara Qaderi, Jose Paz, Jackson Dias, Aparna Gazula, and Ruth Dahlquist-Willard, UC Agriculture and Natural Resources

Asian specialty vegetables are valued at $79 million per year (California County Crop Reports, 2015) and grown intensively in open fields around Fresno County. In Fresno, these crops are grown primarily by limited-resource, small-scale Hmong and other Asian immigrant farmers. Information is currently lacking on nitrogen uptake in many of these crops. With proposed regulations under the Irrigated Lands Regulatory Program (ILRP) by the Central Coast Regional Water Quality Control Board (CCWQCB) and the Central Valley Regional Water Quality Control Board (CVRWQCB) to control N application, it is important to understand N uptake and removal in crops that have significant acreage but do not have commodity board support. The purpose of this project is to provide detailed measurements of total nitrogen uptake and nitrogen uptake patterns of bok choy and lemongrass. Randomized control trials were established at the Kearney Agricultural Research and Extension Center (KARE) comparing two levels of fertilizer treatment and an unfertilized control in lemongrass and bok choy. Bok choy was planted in the spring of 2022 and again in the fall of 2022. Biomass samples were taken throughout the growing season and analyzed for total nitrogen content. Lemongrass was planted in May and biomass samples were taken through August. By collecting above-ground biomass, biomass N and soil nitrate, nitrogen uptake curves will be generated. Soil moisture data and crop canopy data were also collected and will be used for further development of crop canopy and irrigation monitoring tools. Preliminary data from these trails will be shared.

Is Regenerative Agriculture the Path Forward for Wine Grape Production

Cristina Lazcano, University of California Davis

Kerri Steenwerth, USDA-ARS, Davis; Charlotte Decock, California Polytechnic State University, San Luis Obispo; Mallika Nocco, University of California Davis; Amelie Gaudin, University of California Davis; Elisabeth Forrestel, University of California Davis; Patricia Skinkis, Oregon State University; Kristopher Covey, Skidmore College; Mutez, A. Ahmed, University of California Davis; Mark Battany, UC Agriculture and Natural Resources; Ellen Bruno, University of California Berkeley; Corinne Butler, California Polytechnic State University, San Luis Obispo; Connie T.F. Wong, University of California Davis; Amanda Rodriguez, University of California Davis; Axel M Herrera, University of California Davis; Imane Slimani, University of California Davis

Wine grape producers are looking to increase soil health using regenerative agriculture (RA) practices, as they are aware of the importance of soils for climate change mitigation and consumer demands for sustainability. Soil health is directly associated with soil organic matter (SOM) and carbon (C) content, constituting a pathway for soils to serve as a C sink in climate change mitigation. Increased SOM may also improve soil water holding capacity, helping drought adaptation. Increasing soil C stocks could be economically advantageous for growers, allowing them to participate in C markets and facilitating access to certifications. Nonetheless, the rate of C and SOM build up in different soils is not known and presents uncertainties as to how this will affect grapevine yield and fruit/wine quality. With support from the Foundation for Food and Agriculture Research and the California Department of Food and Agriculture, our project is determining the efficacy of RA to build soil C and improve soil health and the long-term environmental and economic resiliency of the wine grape industry. We are using a multi-scale approach ranging from high-density soil C sampling within single vineyards to large-scale sampling across 100 vineyards combined with twelve field trials across edaphoclimatic gradients from Oregon to California. This project will generate, 1) a protocol with the minimum sampling intensity needed to accurately estimate soil C stocks in a specific area; 2) an estimate of the C abatement potential of RA in vineyards, positioning the wine grape industry in the rapidly growing landscape of C markets and incentives programs for climate mitigation; 3) site-specific best management practices for RA in wine grapes including improved understanding of the impacts of livestock integration on vineyard soil health; 4) understanding of the effects of RA practices in vine yield and nutrition; 5) realistic targets and expectations of the benefits and cost of RA, and 6) educational materials for growers to measure soil health and understand its costs and benefits.

Comparing Plant Essential Macronutrient Concentrations of Various Manure Sources form California Dairies

Alexis M. Martinez, University of California, Davis

Joyce Pexton, University of California, Davis; Nicholas E. Clark and Deanne Meyer, University of California, Agriculture and Natural Resources

Dairy manure contains many essential plant nutrients in various forms. Dairy manure in California (CA) itself comes in various forms and must undergo annual intensive sampling and reporting to comply with the Central Valley General Order for Existing Milk Cow Dairies. Annual reports from 63 dairies were used to extract results of nutrient analysis of solid (n=275) and liquid (n=585) manure samples. Solid manure was further sub-categorized by type by the operator: corral, separator, compost and scraped solids. Data were used to calculate average plant essential macronutrient concentrations. These nitrogen (N), phosphorus (P) and potassium (K) concentrations serve for comparison. Solid manure nutrient

concentrations vary by source (Table 1) with scraped material tending to have less TKN (1.1 % dry basis) and compost more P (0.7 % dry basis) compared with other sources. Tremendous variability exists within type of manure and may be explained in part by self-attestation to manure type. Liquid manure samples averaged 65% ammoniacal N (Table 2). Reviewing farm specific manure nutrient data can identify outlier analyses, trigger when additional samples are needed for agronomic consideration and allow more precise data for agronomic recommendations.

Table 1. Nutrient composition of solid manure samples by source of manure.

Type	TKN	P	K
	Mean (standard deviation) kg/100kg dry basis		
Corral	1.6 (0.5)	0.6 (0.2)	2.0 (1.0)
Separator	1.2 (0.4)	0.3 (0.2)	0.6 (0.4)
Compost	1.4 (0.2)	0.7 (0.2)	2.2 (1.0)
Scraped Material	1.1 (0.2)	0.5 (0.1)	0.8 (0.2)

Table 2. Nutrient composition of liquid manure samples.

	TKN	NH4-N	P	K	EC (umhos/cm)	TKN:NH4-N	TKN:P	TKN:K
	-----Mean (standard deviation) mg/L-----							
Liquid Manure	384 (268)	242 (153)	71 (45)	603 (377)	5923 (2537)	1.6:1	5.4:1	0.6:1

Groundwater Protection Targets

Kenneth Miller, Central Valley Irrigated Lands Water Quality Coalitions

John Dickey, Central Valley Irrigated Lands Water Quality Coalitions

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 submitted in July of 2022, 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.

Collective Implementation of Management Practices to Achieve Groundwater Protection Targets

Kenneth Miller, Central Valley Irrigated Lands Water Quality Coalitions

John Dickey, Central Valley Irrigated Lands Water Quality Coalitions

Groundwater Protection Targets are a requirement under the Central Valley Irrigated Lands Regulatory Program (ILRP) and represent collective (i.e., Township-scale) nitrate loading targets for irrigated agriculture intended to protect groundwater quality. To achieve Targets, management practices may need to be adjusted in certain Townships to collectively reduce the estimated amount of nitrate leached to groundwater from irrigated agriculture. Moreover, concerted efforts will be needed within these Townships to increase the adoption and implementation of protective management practices that minimize nitrate losses to the environment while sustaining productive systems. Often, protective management practices rely on data and information to support decision making, including tools that integrate multiple important factors like crop dynamics, soil properties and processes, and climate. Outreach and education from public and private entities will play an essential role in achieving the goals laid out by the ILRP.

CalAgroClimate – Web-based Decision Support System for Managing Agriculture Under Weather and Climate Risks

Tapan B. Pathak, University of California, Merced

Steven Ostoja, Prakash Jha, Lauren Parker, Ning Zhang, Robert Johnson, Shane Feirer

Climate change is a major threat to California's diverse and high value agricultural systems. To provide a competitive edge to California's agriculture under increased climatic risks, there is a clear and immediate need for developing locally relevant interactive tools that can help growers to make crop-management decisions in a way to reduce production risks and damages associated with climate variability and change. To meet the needs, CalAgroClimate.org, web-based decision support system was developed that translates high resolution gridded weather data and forecast information into decision support tools designed to provide crop specific information for managing risks. The tools are designed to be user-friendly and are based on the needs and priorities of agricultural stakeholders. We have four tools — Heat Advisory, Frost Advisory, Crop Phenology and Pest Advisory and we are in the process of developing more tools according to the needs of the growers and stakeholders. For the heat and frost advisory tools, users can select location and temperature threshold based on their crop-specific heat and frost tolerance levels and the tool will provide a customized map of heat and frost risk for next seven days for that location, including the number of consecutive days with temperature above or below the identified threshold. Crop phenology and pest advisory tools are based on high-resolution (800m) PRISM dataset to provide near real-time crop phenology and pest specific information to users. This tool will inform growers about their crop development and pest generations in current season, and they can also compare it with previous years, which can be helpful in planning activities specific to critical growth stages.

Legacy Effects of Cover Crops and Resident Vegetation in a Non-bearing Almond System

Vivian Wauters, University of California, Davis

Bradley J Hanson, University of California, Davis; Amanda Hodson, University of California, Davis; Peter Geoghan, University of California, Davis; Hannah Kim, University of California, Davis; Steven Haring, University of Oregon; Amélie Gaudin, University of California, Davis

Cover crops and resident vegetation have both been shown to address common orchard challenges, such as compaction and limited water infiltration, and to increase soil ecosystem multifunctionality. Non-bearing orchards may be a good opportunity for cover crop implementation, but they may have limited effects in a fertile young almond system, and the marginal benefits of increased vegetation quantity and diversity remain unknown. We hypothesized that 1) cover crops grown for multiple years in a young, fertile orchard positively impact soil ecosystem functions; 2) differences in cover crop biomass and functional diversity affect the extent of benefits; and 3) soil biological indicators are sensitive to cover crop presence within a single year. We evaluated two cover crops mixes: 1) a low diversity mix of brassicas, and 2) a high diversity mix of grasses, legumes, and brassicas. The treatments were compared to spontaneous resident vegetation. We measured cover crop biomass accumulation, weed biomass accumulation, soil water infiltration, and soil ecosystem functionality via biological, chemical, and physical indices. We measured soil indices at two timepoints: 1) at cover crop termination in April and 2) again at almond hull split in July. Cover crop biomass was highest in the diverse species mix and lowest in the unplanted resident vegetation. In preliminary analysis, most soil physical and chemical metrics did not differ among the treatments, nor did soil biology measurements. Microbial biomass decreased from spring to summer, while labile carbon and nitrogen increased, indicating that microbes processed the nutrients supplied by vegetation in the orchard alley. These results further indicate that, despite differences in biomass, annual cover crops and spontaneous vegetation in a young, fertile, conventional orchard system have similar effects on soil ecosystem functionality. Multivariate analysis may reveal differences in soil ecosystem functionality, and further investigation of perennial vegetation or more consistent organic matter additions to the soil may have more sustained benefits for soil biodiversity throughout the season.

Precision Farming for the San Joaquin Valley

Daniel Wiens, CropView Consulting

Charles Hughes, CropView Consulting

Managing a farm for sustainability involves more than economic viability. Both environmental and social concerns are equally important. We are responsible to pass on to our lineage a result that is better than the one we inherited. Future generations deserve clean available water, clean air and a world that is pollution free. Every time a farmer decides to apply an input (fertilizer, water, pesticide) he knows that in spots he is applying to too much and other areas too little. Too much in the wrong place, damages the environment – too little can have serious economic impacts. So, dividing a farm into sub-areas (management zones) that are alike and managing these areas separately achieves the goal of more closely matching needs with requirements. A 5-step process is presented to show development of a precision farming program using management zones. Vegetation vigor is the quantity of green leaves and the quality of that vegetation to produce food is chlorophyll. Both vegetation vigor and chlorophyll are mapped into discrete areas called management zones. Additionally, the change of both vegetation vigor and chlorophyll in these zones are mapped between time intervals. Vegetation zones tell us about

the soil, chlorophyll zones tell us about the relative health of the leaves. Changes in both Vegetation and Chlorophyll over time give us a heads up to observe and take samples to quantify irrigation, nutritional and other needs of these zones. A clustering technique is used to manage within zone variability for sampling. Once sampled and analyzed a precision management plan is developed to address agronomic issues and develop a site-specific fertility and amendment program that is smart, sensible and sustainable.

APPENDICES

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		
1994	Brock Taylor		
1995	Jim Oster		
1996	Dennis Westcot		
1997	Terry Smith		
1998	Shannon Mueller		
1999	D. William Rains		
2000	Robert Dixon		

2023 Business Meeting Agenda

California Chapter of the American Society of Agronomy
February 8, 2023, 12:00 PM

1. **Call to Order** (Michelle Leinfelder-Miles, President, California Chapter ASA)

2. **Recognizing a moment of silence** (M. Leinfelder-Miles)

3. **Approval of attached business meeting minutes from the 2022 CA-ASA Plant and Soil Conference** (M. Leinfelder-Miles)

4. **Financial Report** (Nick Clark, Secretary-Treasurer)

5. **Action Item: Announcement of new Executive Committee Member and Nominations of new Governing Board Members for membership vote** (M. Leinfelder-Miles)
    a. Lauren Hale to serve on the Executive Committee
    b. Nominations of new persons to serve on the Council of Representatives
        i. Mark Bolda, UC Cooperative Extension
        ii. Wendy Rash, USDA-NRCS
        iii. Sonia Rios, Bayer Crop Science

6. **Announcement of Student Scholarship Award** (Mae Culumber, Chair of student scholarship committee)

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

8. **Presentation of Awards to 2023 Honorees** (Florence Cassel, Past President)
    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**

10. **Passing of the CA-ASA Gavel to Incoming President** (M. Leinfelder-Miles to Daniel Geisseler, First Vice President)

11. **Thanking of Outgoing President** (D. Geisseler)

12. **Business meeting adjourned** (D. Geisseler)

Persons nominated by the Executive Committee to serve on the Governing Board

Mark Bolda has been working in strawberries and caneberries since 1996, when he started working with Plant Sciences, Inc. as a contract researcher. He joined UC Cooperative Extension in 2002 as a Farm Advisor of Strawberries and Caneberries. His current areas of concentration are fumigation alternatives, management of invasive and endemic pests, plant nutrition and economics of berry culture. He is also working on building competence in Controlled Environment Agriculture for berries. Mark has also served as the County Director for UCCE Santa Cruz County since 2012.

Wendy Rash is a State Water Quality Specialist with the USDA-NRCS in California. Wendy has been working at the intersection of agriculture and conservation for more than 20 years in California; as a graduate student, a farm worker, Resource Conservation District (RCD) employee and NRCS conservationist. With NRCS, she has served as a Soil Conservationist, District Conservationist, and now focuses on water quality issues statewide as California NRCS's State Water Quality Specialist. Wendy served for six months as the Executive Officer of the National Drought Resilience Partnership, a working group of federal agencies focused on drought response and adaptation strategies. Wendy is a graduate of UC Davis with master's degrees in International Agricultural Development and Soil Science. Wendy has been a Certified Crop Adviser since 2010.

Sonia Rios is a Crop Protection Technical Development Representative in Southern and Central Coast California and Western Arizona for Bayer Crop Science managing IPM research in primarily vegetables and horticulture crops. She received her B.S. in Plant Science with an emphasis in Pest Management from Cal Poly Pomona. She received her M.S. in Plant Science from Fresno State in which her thesis research focused on searching for glyphosate resistance or tolerance in Palmer amaranth in the San Joaquin Valley. Prior to working with Bayer, she worked for the University of California Cooperative Extension for over 12 years. Her most recent position, she served as a Subtropical Horticulture Farm Advisor in Riverside in San Diego Counties for just over eight years and conducted research and extension in all aspects of production in avocados, citrus, dates, and other tree crops. Rios also holds a Pest Control Advisor license. She is currently a Board member for the Western Society of Weed Science and was also a member of their Diversity and Inclusion Ad-hoc committee. She has also served on the Community Alliance with Family Farmers (CAFF) conference steering and Emergency Farmer Relief grant committees, and on the CDFA Ad-hoc Small Farm Advisory committee. Sonia has also volunteered in the Farmer-to-Farmer Program and was assigned to help Malawi Macadamia growers with creating an IPM and Pesticide Safety program. In 2021, she was awarded the Early Career Achievement Award from the National Association County Agriculture Agents (NACAA).

2022 Business Meeting Minutes

California Chapter of the American Society of Agronomy
Chapter Annual Business Meeting
February 2, 2022, 1:00 – 2:30 PM
Meeting Minutes

1. Call to Order (Florence Cassel, President, California Chapter ASA)

2. Approval of attached business meeting minutes from the 2021 CA-ASA Plant and Soil Conference (F. Cassel)

Motion to approve minutes: Sharon Benes
Second: Ranjit Riar

3. Financial Report (Mark Cady, Cal ASA Secretary - Treasurer)
In 2021, through UCANR, the Conference took in a total of $16,820 and incurred $5,943.18 in expenses, leaving $10,876.82 in the account.

The Wells Fargo account was used last year for donations, scholarships, and awards. For calendar year 2021, the beginning balance was $32,821.63, the ending balance for the year was $33,518.15.

Motion to accept budget report: Nick Clark
Second: Eric Ellison

4. Action Item: Announcement of new Executive Committee Member and Nominations of new Governing Board Members for membership vote (F. Cassel)

Nick Clark is nominated to serve on the Executive Committee
Nominations of new people to serve on the Council of Representatives

i. Ian Grettenberger, UC Davis
ii. Hossein Zakeri, Associate Professor, CSU Chico
iii. Sultan Begna, Research Agronomist, USDA-Agricultural Research Service

Motion to accept nominations: Ranjit Riar
Second: Mae Culumber

5. Announcement of Student Scholarship Award (WPHA) (Jacob Wenger, Chair of student scholarship committee) This year's student scholarship was awarded to two undergraduate scholars. Aaron Guerra, UC Davis, and Omar Abulghanam, CSU Fresno. Each student gave a short speech expressing their gratitude to the sponsor, the committee, and their academic advisors.

6. Announcement of Student Lightning Presentation Awards (Nick Clark, Chair of student lightning presentation committee) Three students were presented awards:

First: Samantha Jackson, CSU Chico
Second: Loren Marigliano, UC Davis
Third: Aaron Guerra, UC Davis

7. Presentation of Awards to 2022 Honorees (Eric Ellison, Cal ASA Past President)

a. Blake Sanden (presented by Bob Beede)
b. Bruce Roberts (presented by Phillip Smith)

8. Additional discussion as requested by the membership
No discussion topics were requested.

9. Passing of the CA-ASA Gavel to Incoming President (F. Cassel to Michelle Leinfelder-Miles)

10. Thanking of Outgoing President (M. Leinfelder-Miles)

11. Business meeting adjourned (M. Leinfelder-Miles)
Motion to adjourn the meeting: Sarah Light
Second: Daniel Geisseler

The meeting adjourned at 2:30 pm

2023 Plant and Soil Conference

THANK YOU FOR ATTENDING!

Evaluate this year's conference:

UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

American Society of Agronomy
California Chapter