American Society of Agronomy
California Chapter

Co-Sponsored by the Western Plant Health Association

2020 Conference Proceedings

California Plant and Soil Conference

http://calasa.ucdavis.edu

February 4 & 5, 2020

DoubleTree Hotel & Fresno Convention Center
2233 Ventura Street
Fresno, CA 93721

THANK YOU

TO OUR CONFERENCE SPONSORS!

WPHA
Western Plant Health Association

DELLAVALLE®
Laboratory, Inc.

FGL
ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

WILBUR-ELLIS

MID VALLEY
AGRICULTURAL
SERVICES, INC.

AR
Bennett
WE HELP GROWERS FEED THE WORLD

Valley Tech
AGRICULTURAL LABORATORY SERVICES

TABLE OF CONTENTS

2020 PROCEEDINGS
CALIFORNIA PLANT AND SOIL CONFERENCE

ORAL PRESENTATIONS

(Abstract page number shown in parentheses)

American Society of Agronomy
California Chapter

Tuesday, February 4, 2020 **General Session and Introduction by CA-ASA President, Karen Lowell** **9:30 A.M. – 11:45 A.M., Location: *SALON B***	
What Do Cover Crops Have To Offer California Cropping Systems? Opportunities and Challenges Chair: **Karen Lowell** 2.0 CEU (CCA-SW)	
9:30	**Karen Lowell**, USDA-NRCS, *Introductory remarks.*
9:45	**Amélie Gaudin**, UC-Davis, *Cover crops in almond systems: myths, benefits and potential tradeoffs. (26)*
10:25	**Richard Smith**, UCCE, *Managing for cover crop benefits in Coastal vegetable crops. (27)*
11:05	**Tim Bowles**, UC-Berkeley, *Perceptions of cover cropping challenges and opportunities in California's complex socioeconomic and climate environment. (28)*

LUNCH – 11:45 – 1:00 P.M. (SALON C)

Tuesday, February 4, 2020 **Concurrent Breakout Sessions: 1:25 P.M. – 3:00 P.M.**			
SALON B		***SALON D***	
Session 1 – Cereal Crop Nitrogen Management Chair: **Eric Ellison** 1.5 CEU (CCA-NM; CURES-N mgt.)		**Session 2 – Subsurface Drip Irrigation** Chair: **Khaled Bali, Dan Munk** 1.5 CEU (CCA-SW)	
1:25	Introductory Remarks	1:25	Introductory Remarks
1:30	**Bob Hutmacher**, UC-Davis, *Forage sorghum and corn responses to nitrogen and SDI irrigation rates. (29)*	1:30	**Umair Gull,** UC-Davis, *Subsurface drip irrigation on alfalfa. (32)*
2:00	**Bruce Linquist**, UC-Davis, *Use of remote sensing to determine mid-season nitrogen needs in rice systems. (30)*	2:00	**Domonic Rossini**, Netafim, *Lagoon water application via subsurface drip irrigation systems. (33)*
2:30	**Mark Lundy**, UC-Davis, *Measuring and managing nitrogen to optimize efficiency in California small grains. (31)*	2:30	**Aliasghar Montazar**, UCCE, *Subsurface drip irrigation for organic baby spinach production. (34)*

3:00 – 3:25 p.m. COFFEE BREAK

Tuesday, February 4, 2020 **Concurrent Breakout Sessions: 3:25 P.M. – 5:00 P.M.**			
SALON B		***SALON D***	
Session 3 – Soil Amendments Chairs: **Michelle Leinfelder-Miles, Mae Culumber** 1.5 CEU (CCA-SW)		**Session 4 – Water Quality Regulatory Updates** Chair: **Mark Cady** 1.5 CEU (CCA-SW)	
3:25	Introductory Remarks	3:25	Introductory Remarks
3:30	**Sanjai Parikh**, UC-Davis, *Evaluating biochar use in agriculture. (35)*	3:30	**Debra Dunn**, Kings River Conservation District, *Creating a pilot nitrate management zone: Helping growers while providing safe drinking water. (38)*
4:00	**Brent Holtz**, UCCE, *Whole orchard recycling increases soil organic matter, soil fertility, and second-generation almond tree growth and yield. (36)*	4:00	**Sarah Bragg-Flavan**, CCRWQCB, *Central Coast Agricultural Order 4.0 development. (39)*
4:30	**Bob Hutmacher**, UC-Davis, *Gypsum and sulfur amendments: Dealing with infiltration problems and salinity/sodicity issues. (37)*	4:30	**J.P. Cativiela,** Dairy Cares Coalition and Central Valley Dairy Representative Monitoring Program, *Central Valley dairies – from groundwater monitoring to recommendations for solutions and upgrades. (40)*

5:00 p.m. POSTER SESSION AND EVENING SOCIAL (see pp 5-13 for poster titles)
Beverages and hors d'oeuvres served in SALON A

Wednesday, February 5, 2020 **Concurrent Breakout Sessions: 8:25 A.M. – 10:00 A.M.**			
SALON B		***SALON D***	
Session 5 – Best Management Practices for Controlling Pesticides in Agriculture Runoff Chair: **Michael Cahn** 1.5 CEU (CCA-SW) 1.5 CEU (PCA-Other)		**Session 6 – Plant Breeding** Chair: **Jeff Dahlberg** 1.5 CEU (CCA-CM)	
8:25	Introductory remarks	8:25	Introductory remarks
8:30	**Anson Main**, CDPR. *DPR surface water protection program: an overview of agricultural monitoring throughout California. (41)*	8:30	**Lam Bao Huynh,** UC-Riverside, *California cowpea blackeye-grain and cover-crop improvement program. (44)*
9:00	**Bryn Phillips**, UC Davis. *Integrated approaches to mitigating pesticides in agricultural runoff. (42)*	9:00	**Thomas Gradziel**, UC-Davis, *Genetic and epigenetic selection in almond breeding. (45)*
9:30	**Parry Klassen**, CURES. *Neonicotinoid product stewardship program targeting Central Coast vegetables. (43)*	9:30	**Roger Chetelat**, UC-Davis, *Accessing crop wild relatives: interspecific incompatibility mechanisms and introgression line breeding in tomato. (46)*

10:00 – 10:25 p.m. COFFEE BREAK

Wednesday, February 5, 2020 **Concurrent Breakout Sessions: 10:25 A.M. – 12:00 P.M.**			
SALON B		***SALON D***	
Session 7 – Pest Management Chair: **Nick Clark** 1.5 CEU (CCA-PM); 1.5 CEU (PCA-Other)		**Session 8 – Organic Production** Chair: **Ehsan Toosi**, **Daniel Geisseler** 1.5 CEU (CCA: 0.5 NM, 0.5 SW, 0.5 PM) 0.5 CEU (CURES-N mgt./Lloyd)	
10:25	Introductory remarks	10:25	Introductory remarks
10:30	**Greg Douhan**, UCCE, *Monitoring and quarantine of HLB and BMP's for control of ACP in CA. (47)*	10:30	**Gina Colfer**, Wilbur-Ellis Company, *Principles of insect pest management utilizing IPM in an organic system. (48)*
11:00	**Ian Grettenberger**, UC Davis, *Current status and mitigation of insecticide resistance of alfalfa weevil. (47)*	11:00	**Margaret Lloyd**, UCCE, *Nitrogen management in organic systems. (49)*
11:30	**Ruth Dahlquist-Willard**, UCCE, *Pest management challenges in diversified specialty crop rotations. (48)*	11:30	**Ehsan Toosi,** True Organic Products, *Soil health in organic systems, a field-based example. (50)*

12:00 – 1:45 P.M. CA-ASA BUSINESS MEETING AND AWARDS LUNCHEON

NOTES:

POSTER PRESENTATIONS

NOTES:

2020 Executive and Governing Board Members California Chapter – American Society of Agronomy		
EXECUTIVE BOARD MEMBERS		
Position	**Name**	**Title and Affiliation**
President	Karen Lowell	Agronomist Natural Resources Conservation Service karen.lowell@ca.usda.gov
1st Vice President	Eric Ellison	Agronomist Plant Response, Inc. eric.ellison.calasa@gmail.com
2nd Vice President	Florence Cassel Sharma	Associate Professor CSU – Fresno, Dept. Plant Science fcasselss@csufresno.edu
Secretary-Treasurer	Michelle Leinfelder-Miles	Farm Advisor UCCE – San Joaquin County mmleinfeldermiles@ucanr.edu
Past President	Daniel Munk	Farm Advisor UCCE – Fresno County dsmunk@ucanr.edu
GOVERNING BOARD MEMBERS		
Term	**Name**	**Title and Affiliation**
3rd Year	Daniel Geisseler	Associate Specialist UCCE, UC – Davis djgeisseler@ucdavis.edu
3rd Year	Ehsan Toosi	Director of Research and Development True Organics Inc. ertoosi@gmail.com
3rd Year	Mae Culumber	Farm Advisor UCCE – Fresno County cmculumber@ucanr.edu
2nd Year	Mark Cady	Senior Environmental Scientist CDFA mark.cady@cdfa.ca.gov
2nd Year	Jeff Dahlberg	Director UC Kearney Ag REC jadahlberg@ucanr.edu
2nd Year	Khaled Bali	Irrigation Water Management Specialist UC Kearney Ag REC kmbali@ucanr.edu
1st Year	Michael Cahn	Farm Advisor UCCE – Monterey County mdcahn@ucanr.edu
1st Year	Nick Clark	Farm Advisor UCCE – Kings/Fresno/Tulare Counties neclark@ucanr.edu
1st Year	Jacob Wenger	Assistant Professor CSU – Fresno, Dept. Plant Science jawenger@csufresno.edu

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		
1991	Dennis J. Larson		
1992	Roland D. Meyer		
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		

CALIFORNIA CHAPTER HONOREES

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

2020 BUSINESS MEETING AGENDA

California Chapter of the American Society of Agronomy
February 5, 2020, 12:00 PM

1. **Call to Order (**Karen Lowell, President, California Chapter ASA)

2. **Approval of business meeting minutes from the CA-ASA Plant and Soil Conference** (K. Lowell)

3. **Action Item: Announcement of new Executive Committee Member and Nominations of new Governing Board Members for membership vote (**K. Lowell)
   a. Daniel Geisseler to Executive Committee
   b. Nominations of new persons to serve on the CA-ASA Council of Representatives
      i. Mae Culumber, Nut Crops Farm Advisor, Cooperative Extension Fresno County
      ii. Gina Colfer, Accounts Manager, Wilbur-Ellis, Salinas, CA
      iii. Lauren Hale, USDA-Agricultural Research Service, Soil Scientist, Water Management Research Unit, San Joaquin Valley Agricultural Research Station

4. **Financial Report** (K. Lowell)

5. **Action Item: Membership Vote on Proposed Revised By-Laws** (see copy in Proceedings) (K. Lowell)

6. **Presentation of awards to 2020 honorees** (K. Lowell introduce presenters)
   a. Louise Jackson (presented by Jeff Mitchell)
   b. Steve Orloff (presented by Steve Wright)
   c. Steve Wright (presented by Bob Hutmacher)

7. **Announcement of Student Scholarship Award (WPHA) (**Jacob Wenger, Chair of student scholarship committee)

8. **Announcement of Student Poster Awards (**Daniel Geisseler, Chair of Poster Committee)
   a. Undergraduate awardees
   b. Masters awardees
   c. PhD awardees

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

10. **Passing of the CA ASA Gavel to Incoming President** (K. Lowell to Eric Ellison)

11. **Thanking of Outgoing President** (E. Ellison)

12. **Business meeting adjourned** (E. Ellison)

Please complete conference evaluation forms and return name tag holders.

2019 BUSINESS MEETING MINUTES

California Chapter of the American Society of Agronomy
February 6, 2019 12:00 PM

1. **Call to Order and welcoming remarks offered** by Dan Munk, President, California Chapter ASA

2. **Acknowledgments**
   a. 2019 Meeting Sponsors
      i. Western Plant Health Association, Ag Laboratory and Consulting, Dellavalle Laboratory, Simplot, Valley Tech Ag, Fruit Growers Laboratory
   b. Board Members (all stood to be acknowledged)
   c. Assistance at registration desk and CEU sign in
      i. Kathy Lustig, Janet Robles, Mala To, Julie Pedraza, Robert Ullo

3. **Approval of business meeting minutes from the 2018 CA ASA Annual Meeting**

   (*Moved, 2nd, approved by majority vote)*

4. **Action Item: Announcement of new Executive Committee Member and Nominations of new Council of Representative members for membership vote (**D. Munk)
   a. Michelle Leinfelder-Miles to Executive Committee
   b. Nominations new persons to serve on the CA-ASA Council of Representatives
      i. Mae Culumber, Nut Crops Farm Advisor, Cooperative Extension Fresno County to complete term that Andre Biscaro could not complete.
      ii. Michael Cahn, Farm Advisor, Irrigation and Water Resources, UCCE Monterey/Santa Cruz/San Benito, Salinas, CA
      iii. Nick Clark, Farm Advisor, Field Crops and Nutrient Management, UCCE Kings/Fresno/Tulare, Hanford, CA
      iv. Jacob Wenger, Asst. Prof. Entomology, Dept. Plant Science, CSU Fresno

   All nominations approved by membership

5. **Financial Report** (Florence Cassel-Sharma)
   a. Beginning balance on 7/6/2018 was $44,730.71. Since then there have been $32,714.92 in credits and $44,413.66 in debits.
   b. 2019 Meeting Expenses
      i. Meeting hotel expenses were $19,258, about $200 higher than 2018. We also made purchases to Valley Iron and Lamvin for new poster boards totaling $4258 and paid a website developer to update CA Chapter ASA website.

   Report approved by membership

6. **Presentation of awards to 2020 honorees** (D. Munk introduced presenters)
   a. Jim Ayers (presented by Bob Hutmacher)
   b. Mary Bianchi (presented by Karen Lowell)
   c. Gene Miyao (presented by Anne Burkeholder)

7. **Student Scholarship Award (WPHA) (**Eric Ellison, Chair of student scholarship committee)
    a. Ignacio Mendoza $750
    b. Aaron Alvarez $750

8. **Student Poster Awards (**Daniel Geisseler, Chair of Poster Committee)
    a. Undergraduate student winners
        i. Miriam Espinosa, $400 1st place
        ii. Liliana Reyes Solorio and Tiffany Frnzyan, $300 2nd place
        iii. Amanda Cox, $200 3rd Place
    b. Masters student winners
        i. Travis Woods, $400 1st place MS
        ii. Beth Hellan, $300 2nd place MS
        iii. Daniel Syverson, $200 3rd place MS
    c. PhD student winners
        i. Patricia Lazicki, $400 1st Place PhD
        ii. Alyssa DeVincentis, $250 2nd place PhD (tie)
        iii. Justine Beaulicu, $250 2nd place PhD (tie)

9. **Additional discussion as requested by the membership**
    a. Gene Miyao suggested we consider awarding members who are still active in their careers rather than after retirement, perhaps a mid-career award.

10. **Passing of the CA ASA Gavel to Incoming President** (D. Munk to Karen Lowell)

11. **Thanking of Outgoing President** (K. Lowell)

12. **Business meeting adjourned** (K. Lowell)

2020 CA-ASA Honoree: LOUISE JACKSON

Professor and Cooperative Extension Specialist

Louise Jackson was a faculty member at UC Davis from 1989 to 2016, initially in the Dept. of Vegetable Crops, and later in the Dept. of Land, Air and Water Resources. As a Professor and Cooperative Extension Specialist, she balanced her time between classroom teaching on ecology and ecosystems, research on vegetable farms and upland rangelands, and outreach to a wide range of stakeholders on soil quality, agricultural biodiversity, and adaptation to climate change.

Louise Jackson, Professor and Cooperative Extension Specialist, UC-Davis

Louise grew up in the Santa Clara Valley in the 1950s and 60s. Her father was a geologist with the US Geological Survey and her mother was from a Basque ranching family. Her degrees are in Biology from UC Santa Cruz, and in Botany from the Univ. of Washington. Her PhD research was in the High Sierra, where she described the unique adaptations to drought in alpine plants, camping for months each summer near treeline.

In the 1980s, Louise recognized the opportunity to use her ecological training to solve environmental problems on farms and ranches. She had a NATO fellowship to study California's annual rangeland grasses in their Mediterranean homeland. She then was a Lecturer at UC Berkeley, and with a group of soil scientists, showed that soil microbes were excellent competitors with plants for nitrogen in rangelands. An unexpected outcome was highly efficient recycling of soil nitrogen and very little overall loss.

Louise next moved to UC Davis, shifting to work on high-input crops. Through the next 30 years, the physiology and ecology of tomatoes were a mainstay of her research program aimed at sustainable soil management and productivity. The availability of genetic resources for tomato made it possible to test ideas about traits affecting yield, water use efficiency, nitrogen acquisition, and mycorrhizae. This would become the basis for many projects generated by PhD students and postdocs in her UC Davis Soil & Root Ecology Lab.

Louise began her UC Davis faculty position in the Salinas Valley at the USDA-ARS station in 1989. Local lettuce growers saw the potential for 'sustainable agriculture' and supported her collaborative research with the farm advisors in Monterey County. As an example, on-farm studies on cover crops to reduce nitrate leaching also considered the effects on yield and quality of subsequent vegetable crops, potential disease and pest problems, and economic analysis.

In 1995, back at UC Davis, her lab grew to include many talented graduate students and postdocs. The next few years were a time of intense learning and creativity, spurred on by motivated students and faculty collaborations. Using novel tools to apply ecological concepts to agricultural research, her research ranged from on-farm experiments with stable isotopes, gene

expression, and growth measurements to understand tomato root responses to nitrogen, to utilizing landscape transects and GIS to determine spatial variation in soil quality, according to the type of crop or rangeland system.

In the early 2000s, ‘ecosystem services’ was introduced as a framework for quantitatively assessing the value of natural ecosystems. Louise’s interest was in participatory approaches within communities to evaluate biodiversity and ecosystem services across agricultural landscapes. She led an international network on agrobiodiversity for the DIVERSITAS program for many years.

Meanwhile, the state of California initiated an assessment program to forecast climate change and identify ways to decrease greenhouse gas emissions. For several years, Louise led a group of colleagues in a series of projects showing the vulnerability of agriculture to increased temperature and drought, and the value of preserving farmland to minimize greenhouse gas emissions and support agricultural communities. This work was a justification for creation of the Sustainable Agriculture Land Conservation Program, which allocates several million dollars each year to prevent urbanization of agricultural lands. She also contributed to the development of California’s climate change programs for agriculture, recognizing the potential for win-wins for both agriculture and the environment.

During her career, Louise gave frequent presentations, published many scientific papers, and received several awards. She would like to express her gratitude to the dozens of farmers and ranchers who participated in field experiments, as well as to UC Cooperative Extension, NGOs, and industry for their support over the years. She is happy that young scientists in her lab group have gone on to become leaders in agricultural ecology in the West, as professors at UC Berkeley, UC Davis, Univ. of Nevada, Univ. of British Columbia, and at CDFA, USDA-ARS, and in other states and countries.

Louise retired in 2016 and now lives in the Sierra Foothills, where she is active in watershed issues. She likes to visit her family’s ranch and hike in the Sierra Nevada. She is interested in new developments in California agriculture and stays involved in minor ways.

2020 CA-ASA Honoree: STEVE ORLOFF

University of California Cooperative Extension Farm Advisor

We are honored but saddened to present this honor to Steve Orloff posthumously – an individual who had a large impact on California agriculture and is sorely missed by both friends and family. As a UCCE Farm Advisor, Steve made many contributions to agriculture over three decades, and richly deserves this recognition!

Steve Orloff (left) was a true educator and teacher, was highly respected for his knowledge and service to agriculture, and enjoyed engaging fully with audiences.

Steve was born to Marty and Carol Orloff in Hollywood, CA in 1956 and lived most of his youth in Lancaster, CA. While not born into a farm family, he developed a love for agriculture through experiences in the Peace Corps, his university training and association with UC, and especially by working closely with farmers.

It was in Southern California that Steve learned to surf the waves and became an expert surfer – a passion he continued throughout his life. Before joining UC, Steve spent two years in Central America serving in the Peace Corps, primarily El Salvador, where he worked with marginal farmers. He was transferred during the civil war in El Salvador to Honduras, where he met his wife-to-be, Islia.

Steve earned a B.S. and M.S. in Crop Science at California State University, San Luis Obispo. He started his career with UC Cooperative Extension as a Farm Advisor in the high desert region in Southern California. In the early 1990s, he became a Farm Advisor in Siskiyou County and later also served as County Director in Siskiyou and Modoc Counties until his passing in October of 2017. He served as a highly valued UC Cooperative Extension Farm Advisor for 33 years!

As a UC Cooperative Extension Farm Advisor, Steve took a special interest weed management. While working in the high desert, he developed an effective weed control program for onions and a comprehensive program for dodder control in alfalfa. More recently his research on yellow starthistle, weed control in seedling alfalfa, evaluation of the Roundup Ready system in alfalfa, and the discovery of injury to Roundup Ready alfalfa from glyphosate were major accomplishments. Because of his important work on dodder control in alfalfa, Russian thistle, and work in onions he was awarded the CWSS Award of Excellence in 1987.

Steve Orloff had a major passion for alfalfa. He published hundreds of articles reporting on his original research related to pest management, irrigation, harvest management, fertilization and variety selection for alfalfa. He was a major contributor to the California Alfalfa & Forage Symposium and Western Alfalfa & Forage Symposia, from the 1980's through 2017, the year of his passing. While he collaborated heavily with others, he also generated much of the data himself in on-farm research projects as well as research at the Intermountain Research and

Extension Center. He led the publication of "Intermountain Alfalfa Management' in the 1990s and was a major contributor to the 250 page "Irrigated Alfalfa Management for Desert and Mediterranean Zones" (2008). These are considered leading nationwide (and worldwide) references to management of irrigated alfalfa. He was honored by the California Alfalfa & Forage Association with the 'Kuhn Leadership Award' in 2011, and posthumously honored at the Argentina alfalfa meeting in 2018, where his work was deeply appreciated.

In Yreka, Siskiyou County, Steve quickly established himself as a regional expert on many crops, including specialty crops, small grains, pastures, grass hay, alfalfa, and pest management. His work has been highly valued by farmers throughout the Intermountain region as well as state-wide and nationally. Steve made his mark through his strong science, hard work, and commitment to agriculture but also through his sense of humor and his genuine care for his friends, colleagues, and especially his family.

Steve said many times that his job required a steep learning curve, but he was aided by the farmers and ranchers, PCAs, and crop specialists at UC Davis and UC Riverside who appreciated his dedication to solving important problems. He collaborated with and received mentoring from PCA Tim Hayes and Ext. Weed Specialist Dave Cudney and UC Davis Specialist Vern Marble.

Steve had a unique ability to extend information in a fun and easy to understand style. Some remember being hit by Snickers bars for having the right answer to his questions or others for not paying enough attention. Others remember joke slides at others' expense which nevertheless made his presentations a 'must attend'! He was a widely sought-after speaker at state-wide and regional events in California, but also at annual grower meetings in New Mexico, Utah, Nebraska, Washington, Arizona, Idaho, Oregon, and Nevada. He was a regular contributor to research presentations at the UC Intermountain Research and Extension Center, and at UC Davis. His thoughtful analysis and presentation of his own research data was always a highlight of any meeting, including his incorporation of humor that always enlivened the crowd. Internationally, Steve gave many talks and conducted programs in alfalfa and agricultural development, including Spain, Romania, Chile, Argentina, China and Mexico.

In addition to his impact as an agricultural scientist, perhaps Steve's most important attribute was his personal character. He was personal friends to many farmers, industry members and university colleagues. He was valued not only for his many accomplishments, but his ability to light up a room and to engage on nearly every subject. Many colleagues remember his great sense of humor, his dedication to his family, his friendship, and his immense service to agricultural science. Steve is survived by his wife Islia, sons Rob, Michael and Danny, and mother. As colleagues, we are grateful to the support of his family, since it is clear that their support contributed greatly to Steve's professional success and impact on our industry.

He is sorely missed by all. It is with some considerable sorrow, but with great respect, that we honor our valued colleague and friend Steve Orloff with the 2020 California Plant and Soil Award.

--Dan Putnam, Brad Hanson, and Steve Wright

2020 CA-ASA Honoree: STEVEN D. WRIGHT

University of California Cooperative Extension Farm Advisor

Steve Wright, UCCE Farm Advisor – Tulare and Kings Counties

Growing up in San Diego, it might have made sense for Steve to be attracted to a career on the coast or even on the ocean, but early on he developed an interest in agriculture. He came to the San Joaquin Valley and earned a bachelor's degree in Plant Sciences at CA State University Fresno State (CSUF) in 1972. Upon graduation, Steve and his wife, Neva joined the Peace Corps, and spent three years working with Guatemalan native farmers. While in Guatemala, "I did research and extension work on corn, wheat and potatoes," Wright said. "That's what motivated me to come back to California and do graduate work at CSU Fresno. I wanted to work in extension."

Steve has high praise for the opportunities afforded to him during his college days at CSU Fresno. "They had all kinds of farm projects we could do," Wright said. "I had grain, cotton and vegetable projects as a student. I was doing everything from planting to harvesting. In addition to working for the school farm and private farms, I owe a lot to the professors there, who offered the applied aspects of farming along with their teaching programs."

While finishing up his Master's degree in agronomy at CSUF in 1980, Steve started working with UC Cooperative Extension in Tulare County. His education and work experience was immediately applicable on the job, since he was hired to work with cereal crops. With the retirement of multiple UC Farm Advisors in his area in the first few years of his career, other opportunities followed to expand his research and extension efforts to include both weed management and cotton in Tulare and Kings Counties. Besides having a research focus on all aspects of cereals and cotton production, this also gave him a chance to develop expertise in a wide range of weed management projects in rangeland, irrigation districts, the first herbicide-tolerant crops and later herbicide-resistant weed management issues in both annual and permanent crops. His work also included variety evaluations in cotton, sorghum and small grains, industry-sponsored nitrogen management research in small grains and cotton, insect pest management field research, nationally-recognized work on defoliation and harvest aids in cotton, disease resistance studies in cotton, and biofuel crop studies. "The job got bigger and changed all the time," Wright said. "I enjoyed working in different disciplines, from controlling yellow star thistle in the foothills, to working with large- and small-acreage farmers in Tulare and Kings Counties. I thrived on that."

After 36 years as an agronomist/weed science advisor with UC Cooperative Extension, Steve June 30, 2016. He authored, co-authored or contributed to 117 peer-reviewed publications, 347

non-peer-reviewed articles, crop cost studies, and 11 book chapters published by UC Agriculture and Natural Resources. He sought out opportunities and volunteered for service in many other countries over the years, including China, Mexico, Congo, India, Uzbekistan and multiple countries in Central America. Steve has taught individual classes as well as courses at CSU Fresno. In service to UC and the industry, he served as a representative, then as president of UC Agriculture and Natural Resources Academic Assembly Council, as a UC ANR Program Council member, and served as President of the California Weed Science Society and has been honored as a lifetime honorary member. Locally, he is pleased to have served the California Youth Soccer Association by helping design and maintain multiple soccer fields in Visalia that may be some of the best in the state.

His career is an impressive combination of individual research and extension accomplishments plus extensive efforts to take part in cooperative team efforts in addressing important research and extension education needs. He is recognized as a cooperator who not only puts his name on cooperative projects, but one who consistently "shows up" to get the job done, and it has been appreciated by his co-workers in many projects. Even with this list of achievements, Wright has said that he counts the relationships developed with local farmers, pest control advisers, consultants, private industry, university researchers, students, UC and county staff as his greatest career accomplishments. "When I think over my career, I think of the people who I was privileged to work with more than the projects" Wright said.

In retirement, Wright and his wife Neva have remained in their long-time home city of Visalia, and so far they have enjoyed new travel adventures, and best of all, more time with family including their daughters and their spouses, and grandchildren. Long walks with both his family and his chocolate Labrador retriever are part of the plan, along with continuing assistance with a few research projects, pursuing his passion for international volunteer work and recreational outdoor activities, including camping, snow skiing, going to Morro Bay, and enjoying time with grandchildren.

ABSTRACTS: ORAL PRESENTATIONS

Cover Crops in Almond Systems: Myths, Benefits and Potential Tradeoffs

Amélie Gaudin[1], Cynthia Crézé[1], Jeffrey Mitchell[1], Brad Hanson[1], Steven Haring[1], Andreas Westphal[2], Danielle Lightle[3], David Doll[3], Mohammad Yaghmour[3], Cameron Zuber[3], Neal Williams[4], Amanda Hodson[4], Houston Wilson[5], Kent Daane[6]

[1] Department of Plant Sciences, UC Davis
[2] Department of Nematology, UC Riverside
[3] UC Cooperative Extension
[4] Department of Entomology and Nematology, UC Davis
[5] Department of Entomology, UC Riverside
[6] Department of Environmental Science, Policy and Management, UC Berkeley

Presenting author's email address: agaudin@ucdavis.edu

Although previous projects and growers' experience have shown that cover cropping is compatible with almond production, this practice is not widely adopted in California where less than 5% of Almond orchards currently have understory covers. Grower surveys show that the potential benefits of cover crops are often recognized, especially their value for pollinator forage and soil health but operational concerns, lack of cost-benefit analyses and unclear best management practices are hampering wide adoption. Over the last three years, a large interdisciplinary team has been assessing various cover crop mixes and termination dates in Almond orchards across the Central Valley precipitation gradient with the goal to optimize cover crop systems to maximize benefits and minimize tradeoffs. I will summarize results and discuss the impacts of cover crop and their management strategies on 1) soil health, 2) water use and dynamics, 3) bee visitation and pollination, 4) weed, NOW and nematode pressure and 5) almond yields and harvest conditions. Our data shows that, if well managed, cover crops have the potential to quickly improve soil hydraulic properties of compacted orchards and suppress some pests at minimum water cost while providing bee forage and clean harvest conditions.

Managing for Cover Crop Benefits in Coastal Vegetable Crops

Richard Smith
UC Cooperative Extension, Monterey County
rifsmith@ucdavis.edu

On the Central Coast of California, winter cover crops are used on about 5 percent of cool-season vegetable crop acreage. Low use of cover crops is due to high land rents and tight spring planting schedules. The lack of regular use of cover crops creates a higher risk of nitrate leaching during the winter fallow period, as well as challenges for maintaining good tilth, soil health and disease suppression. Growers can offset the lack of cover crops to some extent by using compost which can help maintain tilth and improve soil health. However, a key benefit of winter cover crops is providing significant reductions in nitrate leaching during the winter fallow, and their lack of use weakens efforts to reduce nitrate leaching in the Salinas Valley. However, studies on nitrogen uptake dynamics of broccoli showed that broccoli is deep rooted and takes up significant amounts of nitrate-N down to three feet deep in the soil. In a survey of 10 commercial broccoli production fields following a prior crop of lettuce, we observed that growers typically use moderate fertilizer applications (app. 180 lbs N/A) while the crop routinely takes up >300 lbs N/A from the soil; as a result, broccoli often scavenges >100 lbs residual soil nitrate, thereby effectively reducing the risk of nitrate leaching. In essence, the N scavenging ability of broccoli provides one of the environmental benefits of a cover crop. However, only 1/3 of the N taken up by the broccoli crop is removed in the harvested product which results in broccoli returning 200-250 lbs N to the soil in crop residue. These residues quickly mineralized following incorporation into the soil but the nitrate-N can be effectively utilized for growth by subsequent crops if careful irrigation management and soil testing to account for the residual soil N occur. However, if broccoli residue is incorporated into the soil prior to the winter fallow, the mineralized N is at risk for leaching with winter rains. The use of high C:N compost is a practice that can be used to immobilize residual soil nitrate-N and is being evaluated to reduce nitrate leaching during the winter fallow. Given the significant obstacles to the use of cover crops, it is important to maximize practices that provide some of the environmental benefits of cover crops.

Perceptions of Cover Cropping Challenges and Opportunities in California's Complex Socioeconomic and Climate Environment

Timothy M. Bowles[1], Joanna Ory[1], Liz Carlisle[2], and Alastair Iles[1]

[1] Department of Environmental Science, Policy and Management, UC Berkeley
[2] Department of Environmental Studies, UC Santa Barbara

Presenting author's email address: timothy.bowles@berkeley.edu

Statistics from the 2017 Census of Agriculture on cover cropping in California are grim, yet also show some optimistic signs. With 4.8% of "available" cropland planted to cover crops, California ties for 33rd place among the 50 states. In addition, California has one of the lowest increases in cover crop acreage between 2012 and 2017, at 2.9%. Given the potential for cover crops to play a strong role in building soil health, reducing environmental impacts of agriculture, and helping farms adapt to climate change, why has progress on increasing cover cropping acreage been so limited?

But at the same time, California ranks in the top ten states for number of operations reporting cover crop use, with a 26.5% increase in operations using cover crops over the same time period. To shed light on these trends, we examined the factors that influence adoption, no adoption, and abandonment of cover crops and other practices through a survey and interviews with growers and technical assistance providers. In 2018, we conducted a statewide survey of UCCE, RCD, and NRCS personnel, asking questions regarding which "soil health" building practices (including cover crops) are most commonly recommended, which federal and state policies discourage or encourage the adoption of particular practices, and what factors are the strongest motivators for farmers to implement such practices. We also conducted in-depth interviews with growers in two contrasting production systems, almonds and lettuce, to identify more specific factors and hear growers' experiences and stories with cover cropping.

We found that cover cropping was the most widely recommended practice by technical assistance providers to build soil health, with 33% of respondents (n = 143 with a 36% response rate) saying they always recommend cover cropping. Barriers cited by almond and lettuce growers had differing proportions of technical vs structural factors (e.g. markets, supply chain requirements, regulatory and incentive policies). Almond growers identified several main barriers, including water availability and water competition with trees, increased risk of frost damage, and challenges with harvest. For lettuce growers, the main barriers included the cost of land, tight production schedules, and perceived conflicts with food safety policies. We interpret these results in light of California's complex socioeconomic and climate environment, and identify several promising pathways that address or skirt barriers. We will also ask about your experiences implementing cover crops in California to gain further insight into future options and research priorities.

Forage Sorghum and Corn Responses to Nitrogen and SDI Irrigation Rates

Robert Hutmacher[1], Nicholas Clark[2], Jeffery Dahlberg[3], Jorge Angeles[4]

[1] UC West Side REC and Department of Plant Sciences, UC Davis
[2] UC Cooperative Extension, Kings County
[3] UC Kearney REC
[4] Department of Plant Sciences, UC Davis

Presenting author's email address: rbhutmacher@ucdavis.edu

In recent years in California, between 400,000 and 500,000 acres of corn have been grown annually mostly for dairy forage. Particularly in years with reduced irrigation water supplies, forage sorghum acreage can increase to 60,000 to 90,000 acres. With such large statewide acreage, improved understanding of corn and sorghum water and nitrogen use efficiencies can help with management decisions, particularly with limited water supplies and with water quality regulations targeting nitrate-N (NO_3^--N) pollution issues. A three-year subsurface drip irrigation (SDI) study was conducted (2016-2018) at University of CA Westside Research and Extension Center near Five Points, CA, in clay loam soil to evaluate forage corn and sorghum yield responses to varying levels of irrigation water and nitrogen fertilization. Our objectives were (1) determine forage corn and sorghum yield responses to irrigation amounts ranging from 50-60 to 100 percent of estimated corn evapotranspiration; and (2) within each irrigation level, evaluate yield responses to nitrogen (N) fertilization ranging from zero to full estimated N requirements across years. Four sorghum cultivars representing mid to late relative maturity grain and forage types as well as two corn cultivars representing early and mid-maturity were grown. Three irrigation levels were established: deficit for sorghum (about 60% corn ETc), full for sorghum (80% corn estimated ETc), and sufficient for corn as fractions of potential ET determined from an on-site CIMIS weather station. Three N levels: zero supplemental N, an amount targeted as sufficient for sorghum (about 120 lbs N/ac adjusted for residual nitrate in surface 2 feet of soil), and sufficient for corn (about 220 lbs N/ac) – were injected as split applications to match crop uptake. At harvest, two rows were chopped with small-plot harvester, and sub-samples were collected for dry matter (DM) percent. While overall interactions between irrigation and N amounts across cultivars were not significant, cultivar did significantly interact with irrigation and N levels. The year within the 3-year study significantly impacted yield responses to applied N due to higher initial residual soil N at the start of 2016. Across irrigation levels and years, corn peak yields generally occurred at the highest N level in moderate and high irrigation treatments, while in sorghum most yields peaked at the intermediate irrigation water and N application levels.

Use of Remote Sensing to Determine Mid-Season Nitrogen Needs in Rice Systems

Bruce Linquist and Telha Rehman
Department of Plant Sciences, UC Davis
Presenting author's email address: balinquist@ucdavis.edu

The current nitrogen (N) recommendation for California rice (*Oryza sativa*) is that growers apply the amount of N required for an average yielding year before planting. At panicle initiation (PI) it is recommended that growers assess the crop to determine if additional top-dress N fertilizer is required. Accurate assessment is important because not applying N may lead to a reduction in yield; however, over applying can lead to lodging, delayed maturity, increased incidence of disease and reduced yields/quality. While tools are available to assess crop N status, they are not widely adopted as they are time consuming and limited to a relatively small sampling area. The development of new sensor-based technologies has provided a promising alternative. The objective of this study was to develop a sensor-based tool to guide mid-season N management in rice systems. Twelve N response trials were established (2016 to 2019) at various sites throughout the Sacramento Valley. Experiments were arranged in a split-plot randomized complete block design. Main plot treatments were varying rates of preplant N fertilizer (0 to 275 kg N ha^{-1}) and subplot treatments were top-dress N rates of 0 or 34 kg N ha^{-1} at PI. At PI, NDVI and NDRE were measured with a GreenSeeker and/or drone. Plots were harvested at maturity for grain yield. A Response-Index (RI) was developed for each plot. The RI is the ratio of the NDVI and NDRE value in the enriched N treatment (the highest N rate at each site) divided by the NDVI or NDRE value from the plot. The yield response to a top-dress N application in each plot was compared to the RI for that plot. When the RI was 1.1 or greater a top-dress N application led to higher yields. If the RI was less than 1.1, then there was no yield response. These results provide promise that a sensor-based response index can guide mid-season N fertilization in California rice.

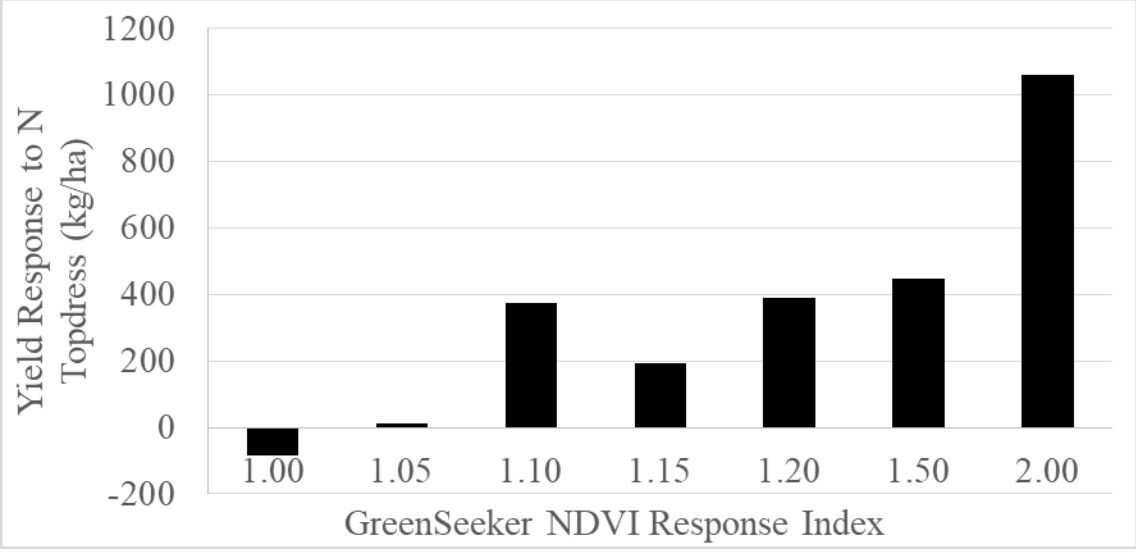

Figure 1. Grain yield response to top-dress N applications relative to a response-index taken at panicle initiation. Results are for the GreenSeeker NDVI.

Measuring and Managing Nitrogen to Optimize Efficiency in California Small Grains

Mark Lundy and Taylor Nelsen
Department of Plant Sciences, UC Davis
Presenting author's email address: melundy@ucdavis.edu

A large majority of California wheat and barley is fall-sown and grown in interaction with winter precipitation. Patterns of precipitation are highly variable across the state as well as within and between seasons. This variability, combined with the extremely diverse set of agroecosystems where small grains are produced in California, results in heterogeneous yield potential and creates a challenge for efficient nitrogen (N) fertilizer management. Achieving high fertilizer use efficiency is particularly important for these fall-sown crops because their interaction with variable winter precipitation patterns can create conditions for N losses from the system through leaching and other loss pathways. Research on the effects of N fertilizer management in California wheat and malting barley was conducted between 2013 and 2018. This included 16 site-years of experimentation where a range of N fertilizer rate and application timing treatments were applied in replicated field trials, and grain yield and protein outcomes as a function of N fertilizer management were measured. A consistent result from these experiments was that the timing of N fertilizer application strongly influenced N fertilizer recovery by the crop. Shifting equivalent amounts of N fertilizer from pre-plant applications to applications made in-season (during the early vegetative growth stages) increased grain yields, grain protein content, and fertilizer recovery by the crop. Furthermore, actionable information about the likelihood and degree of crop response to N fertilization during the vegetative growth stage was available via relatively simple in-field measurements. When the soil nitrate-N concentration in the top 0-12 inches of the soil profile and crop canopy/leaf reflectance (e.g. NDVI, leaf chlorophyll meter) were measured and compared to a N-enriched reference zone at the time of in-season N application, relative crop response could be predicted with 70% accuracy. In addition, measurement-guided rates of in-season application resulted in fertilizer recovery efficiency of greater than 70%. These results indicate that measurement-guided, in-season applications of N fertilizer can improve the predictability of crop response to N fertilizer and increase the efficiency of N fertilizer management in California small grain crops.

Prospects for Sustainable Alfalfa Production Under Sub-Surface Drip Irrigation in California

Umair Gull[1], Khaled Bali[2], Aliasghar Montazar[3], Robert Hutmacher[1, 4], Isaya Kisekka[5], Daniel H. Putnam[1]

[1] Department of Plant Sciences, University of California, Davis, CA, USA
[2] Kearney Agricultural Research & Extension Center, University of California- Division of Agriculture and Natural Resources, Parlier, CA, USA
[3] Irrigation & Water Management Advisor UCCE Imperial County, CA, USA;
[4] West Side Research & Extension Center, University of California- Division of Agriculture and Natural Resources, Five Points, CA, USA;
[5] Department of Land, Air, and Water Resources & Department of Biological and Agricultural Engineering, University of California, Davis, CA, USA

Presenting author's email address: ugull@ucdavis.edu

Alfalfa is a key forage grown in the Central Valley of California, and is utilized primarily for dairy rations. As a high quality forage, it is also a high water user. Climate variability in the valley during the last decade has pushed growers to adopt more efficient ways of delivering water for sustainable forage production. Sub-surface drip irrigation (SDI) along with deficit irrigation strategies may help produce sustainably and maintain the forage quality. SDI has several advantages over the surface irrigation (SI) as former delivers the water more efficiently in a timely fashion. It is also helpful to reduce the built-in deficit periods between the consecutive harvests and making moisture continuously available to the crop in the root zone. With SDI, water can be delivered to the crop when it is required following closely crop evapotranspiration, in addition to delivering water directly to the root system. As alfalfa is a perennial forage with multiple harvests, it is important to deliver the water more efficiently. Series of experiments have been conducted to understand the implications of SDI in alfalfa and find the ways to improve water productivity (production per unit water) along with forage yield and quality. There is evidence of improved yield and quality as well as water productivity. The studies focused on comparing the SDI with SI for alfalfa have concluded SDI could be a viable option. While there are advantages of improved yields in alfalfa, it is challenging to maintain the efficiency of the SDI system. Alfalfa clearly provides an ideal habitat for rodents (primarily gophers and meadow voles) all year long which can severely damage drip tapes. The initial cost of the system is quite high but could be recovered if the system is managed well and yields are increased over time. Growers that have successfully managed SDI in alfalfa have increased management and monitoring for rodent damage and observed higher yields with often reduced water demand. SDI has an excellent potential to improve alfalfa water productivity and yield due to its ability to closely following ET_c requirements, but cost and maintenance of systems still remain a challenge for this crop. Future work to address resiliency of SDI systems to resist rodent damage would improve prospects of this technology for alfalfa as well as other crops.

Use of Dairy Effluent Waste Water in Subsurface Drip Irrigation

Domonic Rossini
Netafim, USA
domonic.rossini@netafim.com

Learn about an SDI system that uses dairy effluent waste water to irrigate forage crops with no synthetic fertilizer, nitrogen leaching, and increased yields. With the use of SDI, we see a reduction in water use close to 30%, as well as 70% - 90% less nitrous oxide emissions (N2O). We'll also cover the testing completed on three different sites in California and is now on the NRCS list for cost sharing in 2020. We will help producers understand the process and benefits of using dairy waste water as a sustainable solution on their farm.

Subsurface Drip Irrigation for Organic Spinach Production

Aliasghar Montazar[1], Michael Cahn[2], and Alexander Putman[3]

[1]UC Cooperative Extension, Imperial & Riverside Counties
[2] UC Cooperative Extension, Monterey County
[3] UC Riverside

Presenting author's email address: amontazar@ucanr.edu

Spinach is a fast-maturing, cool-season vegetable crop. Downy mildew on spinach is a widespread and very destructive disease in California. It is the most important disease problem facing the spinach industry, and crop losses can be significant in all areas where spinach is produced, especially in organic spinach because synthetic fungicide use is prohibited. Most spinach fields are irrigated by sprinkler irrigation, while overhead irrigation could contribute to the speed and severity of downy mildew epidemics within a field when other conditions are favorable. New irrigation techniques in spinach production may have a considerable economic impact to the leafy greens industry through the control of downy mildew. Adapting subsurface drip irrigation (SDI) for high density spinach plantings may be a possible solution to reduce losses from downy mildew and food safety risks caused by overhead application of irrigation water.

This ongoing study aims to explore the viability of drip irrigation for organic spinach production and the management of spinach downy mildew disease. The experiment is conducted at the University of California Desert Research and Extension Center and a commercial field in Imperial County. In the first two trials, various combination of dripline spacings and installation depths was assessed versus sprinkler irrigation. In the third trial, the project plans to refine lateral spacing, evaluate irrigation and nitrogen regimes, and assess germination of spinach by drip. The preliminary results indicated that the number of driplines in bed has a significant impact on the biomass yield. The developed canopy crop curves displayed that the leaf density of drip irrigation treatments was slightly behind that of sprinkler irrigation in time. The results also demonstrated an overall effect of irrigation treatment on downy mildew, in which downy mildew incidence was lower in plots irrigated by drip when compared to sprinkler. The findings of this project showed that SDI has the potential to be used to produce spinach, conserve water, enhance the efficiency of water and nitrogen use, and manage downy mildew, but further work is required to optimize system design and management, and to maintain economic viability of utilizing subsurface drip at spinach.

Evaluating Biochar Use in Agriculture

Sanjai J. Parikh and Danielle Gelardi
Department of Land, Air and Water Resources, UC Davis
Presenting author's email address: sjparikh@ucdavis.edu

The search for simple solutions to complicated problems is a constant throughout the human experience. Today's pressing problems regarding food production, climate change mitigation, and environmental pollution do not likely have easy solutions, yet *biochar* has often been promoted as a panacea for many of our global ailments. Biochar is not a singular product but rather a category of soil amendments, produced via the thermal conversion of biomass, which has been proposed for myriads of agricultural and environmental uses. While there are potential benefits from using biochar, it is not a one size fits all product that delivers benefits all the time. Research is demonstrating that prescribed use of biochar through consideration of biomass feedstock, production parameters, soil type, climate, and anticipated outcome are needed to increase the overall efficacy of biochars. Data from a wide range of biochars will be presented, to demonstrate a range of outcomes for soil fertility, plant growth, soil-water relations, and soil aggregation for different biochars and application parameters. Although biochar is not a magical solution, the prudent use of biochar holds promise as a valuable tool for agricultural practitioners.

Whole Orchard Recycling Increases Soil Organic Matter, Soil Fertility, and Second Generation Tree Growth and Yield

Brent Holtz[1], G. Browne[2], D. Doll[3], M. Culumber[4], E. Jahanzad[6], C. Zuber[3] and A. Gaudin[6]

UC Cooperative Extension, San Joaquin[1] Merced[3], and Fresno[4] Counties
[2]USDA-ARS, UC Davis
[6]Department of Plant Sciences, UC Davis

Presenting author's email address: baholtz@ucdavis.edu

The grinding and incorporating into soil of whole almond trees, during orchard removal, could provide a sustainable practice that enhances soil quality. However, growers fear that incorporating a large volume of wood chips could take valuable nutrients away from second generation trees, by increasing the carbon to nitrogen ratio and tying up other nutrients. We hypothesize that wood debris incorporated into soils could increase organic matter, enhance carbon sequestration, and improve soil quality and tree yield. The objective of this project was to compare on-site grinding up and soil incorporation of whole trees with burning and ash incorporation, as a means of orchard removal. In 2008, each treatment was applied to seven replicate plots of an old stone fruit orchard in a randomized block design. An "Iron Wolf," a 45,454 kg rock-crusher, was used to grind up and incorporate standing tree rows of the old orchard to a soil depth of up to 30 cm. The grinding incorporated an estimated 67,000 kg of woody biomass per hectare. For the burn treatment, trees were pushed into a pile, burned, and the ash was spread evenly throughout the plots. All replicate plots were re-planted at the same tree site with "bare-root" almond trees in 2009. Significantly greater tree circumference was observed in the grind treatment when compared to the burn. Cumulative yields were significantly greater in the grind treatment when compared to the burn. Significantly more soil nutrients (calcium, manganese, iron, magnesium, boron, nitrate, potassium, copper), higher electrical conductivity, organic matter, total and organic carbon were measured in the grind treatment when compared to the burn. Soil pH was significantly lower in the grind treatment. Leaf petiole analysis also revealed higher nutrients (nitrogen, potassium, phosphorus, manganese, and iron) and less sodium and magnesium levels in trees growing in the grind treatment. Bud failure severity was lower in the 'Carmel' variety trees in the grind treatment when compared to the burn. Leaf stem water potentials were lower in the grind treatment when compared to the burn. This study demonstrated that whole orchard recycling is a sustainable alternative to burning in the field or in a co-generation facility. We estimate that over 15,000 hectares have been recycled in California since 2015.

Gypsum and Sulfur Amendments: Dealing with Infiltration Problems and Salinity/Sodicity Issues

Robert Hutmacher
UC West Side REC and Department of Plant Sciences, UC Davis
rbhutmacher@ucdavis.edu

Multiple factors can influence exposure of crops to salt-affected ground, including: (a) limited salt leaching in surface soils associated with rainfall due to low amounts and irregular timing; (b) limited supplies of good quality irrigation water; (c) soil conditions restricting ability to drain soils; (d) disposal problems for collected drainage water; (e) presence of high water tables difficult to manage. All these factors together represent challenges for salinity management. In order to better manage salt-affected soils, it is important to periodically test irrigation water sources and also upper soil profile soil samples, particularly if you continue using degraded irrigation water sources. Irrigation water testing for salinity-related issues should include sodium, calcium, magnesium, EC, pH, specific ions such as chlorides, bicarbonates, carbonates, boron where relevant, and if water sources change over time, retest to update information. Some soil salinity-related tests useful for management decisions are shown in table 1 below.

Table 1. Soil salinity tests useful for management decisions in salt-affected soils.

Test	Information Provided	How use for Management?
Electrical conductivity (EC)	Measures soil solution electrical conductance	Relative indicator of the quantity of salts, dissolved ions in the soil. Higher EC levels (>3-4 dS/m) can bring reduced seedling germination, reduced growth.
pH	Relative indicator of soil acidity, alkalinity	Can indicate sodic soil (if pH>8.5), impacts solubility of some nutrients, minerals. As pH exceeds 8.2-8.5, monitor Na, Ca to identify problematic ESP and SAR.
Cation concentrations (Na, Ca, Mg, K) and CEC (cation exchange capacity)	Cations present in soil, relative concentration impacts what is adsorbed and some soil properties	Allows determination of dominant cations (Na, Ca, Mg). CEC is total cations that can be exchanged (Ca, Mg, K, Na, H, Al). When both are known, ESP values can be determined & used to assess gypsum needs.
Sodium Absorption Ratio (SAR)	Relative indicator of sodium ion concentrations versus Ca,Mg (in soil or water)	Measure of relative sodium hazard (SAR>13) in irrigation water and associated with Na in sodic or saline-sodic soils. Higher Na levels and high SAR is usually associated with reduced infiltration capacity.
Exchangeable Sodium % (ESP)	Sodium as a percentage of cation exchange sites in soil	ESP used in determining gypsum application amounts for sodic soils.
Calcium Carbonate Equivalent	Amount of undissolved calcium carbonate in soil	If calcium carbonate amounts are relatively high, can help with decisions to use acid (sulfuric or others) or elemental S instead of gypsum.

Gypsum may be the most common amendment used for reclamation purposes in saline-sodic and sodic soils with low levels of free carbonates. In soils with higher levels of free carbonates, addition of acids such as sulfuric acid or N-phuric acid, or materials such as elemental S or iron sulfates will react with carbonates to form gypsum (plus water, carbon dioxide). Remediation using these amendments is typically a slow process. Particularly if sodicity problems have progressed to significant depth in soil rather than just surface soils, repeat applications can be needed to greatly reduce soil Na levels, improve soil structure to a degree adequate to improve water movement through the soil, and facilitate effective leaching.

Creating a Pilot Nitrate Management Zone: Helping Growers While Providing Safe Drinking Water

Debra Dunn
Kings River Water Quality Coalition
ddunn@krcd.org

In recent years, nitrate impairments in groundwater have occurred with greater prevalence and magnitude, which affects the health and economic vitality of many Central Valley communities that rely on groundwater as their primary source of drinking water. On October 16, 2019, the State Water Resources Control Board approved Amendments to the Central Valley Water Board Basin Plans pending review by the Office of Administrative Law. The Nitrate Control Program is designed to achieve the following management goals: 1) ensure a safe drinking water supply, 2) achieve balanced nitrate loadings; and 3) restore groundwater quality where reasonable, feasible, and practicable.

Implementation of the Nitrate Control Program is based on the priority designations of Central Valley groundwater basins. Notices to Comply (NTC) to Priority 1 groundwater basins will be issued to permitted discharges beginning in 2020. Permitted dischargers that receive a NTC must choose between two compliance pathways:

- Pathway A – Individual Permitting Approach in which permit requirements are established in the Nitrate Control Plan
- Pathway B - Management Zone Approach in which dischargers opt to work collectively

A template for Management Zone development does not exist. Grant funding from the State Water Resources Control Board's Cleanup and Abatement Account Program funded two Management Zone Pilot Projects: Alta Irrigation District (AID)/Kings River East GSA Management Zone, located in a portion of the Kings Groundwater Subbasin and Turlock Management Zone, located in the Turlock Groundwater Subbasin. A Steering Committee comprised of various public, private, and non-governmental groups guides the development of a Preliminary Management Zone Proposal with an Early Action Plan for the Pilot Projects.

The objective of the Pilot Projects is to create templates for future Management Zone developers as well as provide lessons learned through the development process. Achievements in the AID Management Zone area include identification of a Management Zone boundary, initial participants list and outreach, assessment of current nitrate management practices, identification of public and domestic wells with nitrate exceedance, draft Preliminary Management Zone Proposal and Early Action Plan.

Central Coast Water Board Ag Order 4.0 Development

Sarah Bragg-Flaven
R3 Central Coast Regional Water Quality Control Board
Sarah.Bragg-Flavene@waterboards.ca.gov

The Irrigated Lands Program at the Central Coast Water Board regulates discharges from irrigated agricultural lands to protect surface water and groundwater quality. All owners and operators of irrigated land used for commercial crop production are required to enroll and comply with requirements. The current agricultural order, known as Ag Order 3.0, was adopted on March 8, 2017 and expires on January 31, 2021. A replacement order, known as Ag Order 4.0, is currently under development.

Ag Order 4.0 seeks to provide solutions to five water quality problems that are associated with agricultural activities. These are:

1. Nitrate discharges to groundwater
2. Nutrient discharges to surface waters
3. Pesticide discharges to surface waters and groundwater
4. Wetland and riparian habitat impacts from agricultural activities and discharges
5. Sediment discharges to surface waters

These five water quality problems establish the framework Central Coast Water Board staff is using to communicate proposed Ag Order 4.0 requirements. The proposed Ag Order 4.0 requirements include numeric limits and time schedules designed to achieve water quality objectives, protect beneficial uses, and restore beneficial uses where they have been impaired. The proposed requirements incorporate monitoring and reporting to clearly and reasonably quantify progress towards achieving water quality objectives. The proposed requirements also include elements that increase the effectiveness of the future order, through phasing and prioritization.

Central Coast Water Board staff plan to release the first draft of Ag Order 4.0 for public comment in early 2020. In mid-2020 staff plans to present a final draft of Ag Order 4.0 for Central Coast Water Board consideration, ahead of the January 2021 expiration of Ag Order 3.0.

Central Valley Dairies – From Groundwater Monitoring to Recommendations for Solutions and Upgrades

J.P. Cativiela
Dairy Cares Coalition and Central Valley Dairy Representative Monitoring Program
jcativiela@cogentcc.com

In response to regulations adopted by the Regional Water Quality Control Board (RWQCB), Central Valley dairies devised a network of 443 dedicated monitoring wells from Tehama to Kern County in 2012. The well network was strategically distributed over 42 dairies under consideration of pertinent site conditions and dairy operational characteristics to generate a data set that is representative of the totality of the Central Valley dairy community. The network is used to investigate conditions in first encountered groundwater associated with three management units: animal housing, liquid manure lagoons, and manured crop fields.
The purpose of the regulatory requirement for groundwater monitoring was to identify management practices that are protective of groundwater quality (i.e., resulting in nitrate-N concentrations smaller than or equal to 10 mg/L near the water table).

In April 2019, the Central Valley Dairy Representative Monitoring Program (CVDRMP) met a critical regulatory requirement with the submittal of the Summary Representative Monitoring Report (SRMR) to the RWQCB. CVDRMP was unable to conclude that existing practices, taken as a whole, are protective of groundwater quality. Therefore, CVDRMP proposed solutions and upgrades that collectively are likely to significantly strengthen the ability of dairies to reduce impacts to groundwater, while also increasing the ability of the RWQCB and CVDRMP to assess overall trends in improvement going forward.

Nitrogen use efficiencies associated with dairies' crop fields precipitated as the most important focus point for improvement because 94% of subsurface nitrogen emissions on the scale of Central Valley dairies were attributed to crop fields, while only 4 and 2% were attributed to lagoons and corrals, respectively. Furthermore, it was found that the regulation's pursuit of high-resolution nitrogen application information resulted in severely compromised accuracy on both the field and the whole-farm scale. CVDRMP devised robust diagnostics that reconcile this shortcoming.

A fundamental necessity to achieving whole-farm balance of nitrogen produced and used on dairies is the ability to either transport excess manure from the dairy in an economically sustainable way, or to achieve environmentally safe denitrification on the dairy. Currently, that ability is not established – establishing it is the dairy community's greatest challenge.

DPR Surface Water Protection Program: An Overview of Agricultural Monitoring throughout California

Anson Main, Xin Deng, and Scott Wagner
California Department of Pesticide Regulation, Surface Water Protection Program
Presenting author's email address: Anson.Main@cdpr.ca.gov

As California produces over 400 different commodities, the range and amount of pesticides used to protect crops throughout the year can be highly varied. Many of these chemicals may be transported to surface water systems via spray drift, during irrigation runoff, or through seasonal rain events. Off-site movement may contribute to degradation of surface water in agricultural areas. One of the key missions of the California Department of Pesticide Regulation's Surface Water Protection Program (SWPP) is to protect California's surface waters from pesticide pollution in both the urban and agricultural environment. Currently, SWPP agricultural monitoring is focused on waterways such as rivers, streams, and agricultural drainage channels located in major growing areas such as the Central Coast, Central Valley, and Imperial Valley. Sample sites in these regions provide long-term monitoring data on the fate and transport of pesticides in surface waters with much of the program's monitoring occurring from March through November of each year. All collected surface water samples are analyzed for the presence of insecticides, fungicides, and herbicides as concentrations of these pesticides provide a better understanding of the potential for toxicity toward aquatic organisms. In this presentation, an overview of the key components of the SWPP will be discussed such as prevention, monitoring efforts, mitigation, and ongoing assessment. The current agricultural monitoring program will be highlighted by explaining the pesticide prioritization process, discussing regional monitoring data, and explaining how these data are used by SWPP.

Integrated Approaches to Mitigating Pesticides in Agricultural Runoff

Bryn Phillips[1] and Michael Cahn[2]

[1] UC Davis, Department of Environmental Toxicology, Marine Pollution Studies Laboratory
[2] UC Cooperative Extension, Monterey County

Presenting author's email address: bmphillips@ucdavis.edu

Growers rely on insecticide applications for the control of an array of insect pests in leafy greens and other crops. Concerns about the off-site movement of these chemicals in irrigation runoff and impacts to water quality may lead to stricter governmental regulations or the eventual loss of registration of these pesticides for leafy green production. Effective on-farm management practices are needed to eliminate aquatic toxicity of insecticides in irrigation run-off. Integrated vegetated treatment systems (VTS) can mitigate chemical loading and related toxicity of insecticides such as the organophosphate chlorpyrifos, the neonicotinoid imidacloprid, and the pyrethroid permethrin. Results from two VTS studies demonstrate loadings of the above insecticides can be reduced by greater than 90% in simulated runoff. Corresponding toxicity to the daphnid *Ceriodaphnia dubia*, the amphipod *Hyalella azteca*, and the midge *Chironomus dilutus* was often reduced to below toxic levels. The VTS incorporated a sediment trap area to remove coarse particles, a grass-lined (red fescue) ditch with compost swales to remove suspended sediment and insecticides, and a final treatment using granulated activated carbon or biochar to remove residual chemicals not eliminated by the previous steps. In trials with chlorpyrifos, the VTS reduced loading by 94-98%, and reduced the number of toxic samples by half. In trials with imidacloprid and permethrin, concentrations were reduced by 91% and 96%, respectively, and the incidence of toxic samples was reduced by approximately half. Toxicity data from an evaluation of the VTS with runoff from a conventional lettuce field showed a significant reduction of toxicity in two of three irrigation events. Practices utilized in this integrated system are but several from the Natural Resources Conservation Service Environmental Quality Incentives Program list that also includes sedimentation ponds and larger-scaled treatment wetlands. Under optimal conditions, these simple and relatively inexpensive on-farm practices can significantly reduce pesticide loading through sedimentation, sorption, infiltration and degradation.

Neonicotinoid Product Stewardship Program Targeting Central Coast Vegetables

Parry Klassen
Coalition for Urban Rural Environmental Stewardship (CURES)
klassenparry@gmail.com

Surface water monitoring program detections of neonicotinoid (neonic) insecticides in California Central Coast irrigated agricultural areas are drawing the attention of the California Department of Pesticide Regulation and the Central Coast Regional Water Quality Control Board. Should detections continue, new administrative actions could be imposed to limit neonic use in Central Coast crops. At present, water quality standards are not yet established for neonics. In 2018, a multi-phase project was initiated that was funded by neonic registrants (Bayer Crop Science, Gowan Co., Syngenta Crop Protection LLC, and Valent USA LLC) and managed by the Coalition for Urban Rural Environmental Stewardship (CURES). This project identified potential pathways for neonics to reach waterways then developed a product stewardship program to promote Best Management Practices (BMP's) for users. The program includes educational training materials in print and video in both English and Spanish. In addition to presentations at meetings, the program includes a "mobile classroom" where training videos are presented at the farm or field. The initial focus of the program was vegetable crops including strawberries. The BMPs covered in this presentation are focused on pesticide applicators and growers, and include practices to prevent neonic (and any pesticide) from moving from treated fields into surface waters. These practices include spray drift management, nozzle selection/shut off valves, driving speed to minimize drift, and selecting proper sites for mixing and loading application equipment. Irrigation BMPs focus on minimizing runoff from sprinklers after pesticide applications and circulating runoff throughout sediment ponds and vegetated ditches. After each presentation, participants completed a survey where they rank the video content effectiveness and offer suggestions for other areas to cover. Two subsequent videos were developed based on those responses: *Pesticide Regulatory Process* and *Irrigation Management BMPs*. The neonic BMP brochures are available on CURES' website: www.curesworks.org/publication/ag.asp

California Cowpea Blackeye-Grain, Vegetable and Cover-Crop Improvement Program

Bao-Lam Huynh[1], Nicholas E. Clark[2], Sarah E. Light[3], Rachael Long[3], Ruth M. Dahlquist-Willard[4], Michael Yang[4], Valerie Bullard[5], Margaret Smither-Kopperl[5], William C. Matthews[1], Antoon T. Ploeg[1], Timothy J. Close[1], and Philip A. Roberts[1]

[1] University of California, Riverside, CA, USA
[2] University of California Cooperative Extension, Tulare Co., CA, USA
[3] University of California Cooperative Extension, Sutter-Yuba Co., CA, USA
[4] University of California Cooperative Extension, Fresno Co., CA, USA
[5] USDA-NRCS Plant Materials Center, Lockeford Co., CA, USA

Presenting author's email address: baolam.huynh@ucr.edu

Cowpea (*Vigna unguiculata* L. Walp) is a hardy, versatile legume crop grown in sub-Saharan Africa and other warm-to-hot regions worldwide. In the Central Valley of California, cowpeas are grown as blackeyes (black-eyed peas) and long bean (asparagus bean, yardlong bean) for dry-grain, vegetable and cover-crop production. Root-knot nematodes, aphids, lygus bug, and fusarium wilt disease are prevalent in this region, in part due to the large-scale production of cotton and alfalfa, causing significant reductions in yield and seed quality of current cultivars. The California dry bean industry together with the USAID Feed the Future Innovation Labs supports our program to develop improved blackeye varieties for California and the USA. Sources of genetic resistance to the aforementioned biotic stresses were found in African cowpea germplasm and are being bred into susceptible cultivars using both conventional and molecular breeding strategies. Advanced blackeye breeding lines with stacked resistance loci were developed and are being evaluated in on-station and commercial field trials for cultivar release potential. Pending future CDFA support, local long-bean cultivars with stacked resistance genes will be developed. Novel resistant bush-type long bean is also being developed to enable scaling up production and improving nematode management in commercial farming.

Genetic and Epigenetic Selection in Almond Breeding

T.M. Gradziel
Department of Plant Sciences, UC Davis
tmgradziel@ucdavis.edu

Clonal propagation avoids the complexities of trait inheritance in sexual seed progeny, allowing for the direct selection of both genetic and non-genetic (epigenetic) interactions as long as the desired traits remain true-to-type following vegetative propagation. At UCD, almond variety and rootstock improvement utilizes clonal propagation of elite selections derived from intraspecific and interspecific hybridizations. This hybridization/cloning strategy effectively generates and captures highly complex though often poorly understood genetic, epigenetic and genomic interactions, making it among the most potent breeding techniques. The multifaceted synergistic interactions contributing to high productivity and regional adaptability thus present significant challenges to continued genetic improvement but also highlight opportunities to more fully characterize and harness these higher-order breeding manipulations. Utilizing Noninfectious-Bud-Failure as a relatively well-studied example of epigenetic inheritance in almond, methods for epigenetic selection both within and among genotypes have been successfully developed and employed, but remain tedious and time consuming. Molecular marker analysis utilizing methylation-sensitive amplified fragment length polymorphism has documented useful variability in epigenetic methylation patterns within individual clones, including within individual trees. These breeding strategies have allowed the development and release of improved almond varieties and rootstocks meeting California production needs, including the transformation of almond from a self-sterile to a self-fruitful tree crop through the introgression of germplasm from peach and its wild relatives.

Accessing Crop Wild Relatives: Interspecific Incompatibility Mechanisms and Introgression Line Breeding in Tomato

Roger T. Chetelat and Xiaoqiong Qin
C.M. Rick Tomato Genetics Resource Center, Department of Plant Sciences, UC Davis
trchetelat@ucdavis.edu

Crop wild relatives (CWR) contain genetic traits – for instance, resistance to diseases or insect pests, tolerance to abiotic stresses, or higher yield – that are needed to develop improved cultivars and adapt to climate change. The use of CWR is facilitated by libraries of introgression lines (ILs) – prebred lines with defined genetic material bred from exotic germplasm sources in uniform genetic backgrounds of modern cultivars. ILs are permanent collections of stable (homozygous) genotypes suitable for replicated testing and analysis of monogenic or complex traits. The wild relatives of cultivated tomato (*Solanum lycopersicum*) include 16 recognized species, one of which, *Solanum sitiens*, is a xerophyte that grows only in the Atacama Desert of Chile, where it tolerates extreme aridity, soil salinity, and sub-zero temperatures. Until recently, strong breeding barriers prevented its hybridization and introgression with cultivated tomato. We used a combination of embryo rescue, bridging lines, and allopolyploid hybrids to create a library of ILs representing the *S. sitiens* genome in tomato. Marker assisted selection was used to backcross selected introgressions into tomato, recover a uniform genetic background, isolate recombinant sublines, and select homozygotes. The breakpoints of each segment were mapped using a set of over 7,000 single nucleotide polymorphism (SNPs) markers. Roughly 93% of the *S. sitiens* genome was captured in 56 ILs (65% in homozygous and 28% in heterozygous lines), each containing a single *S. sitiens* chromosome segment, in the genetic background of cv. NC 84173, a fresh market inbred line. The ILs displayed wide morphological variation, including several novel traits, suggesting they are a rich source of allelic diversity. We used the ILs to map genetic loci underlying major breeding barriers such as interspecific incompatibility, hybrid necrosis, and male-sterility. This germplasm resource expands the range of genetic variation available for tomato breeding and will likely encourage further analysis of *S. sitiens* and its unique ecological adaptations.

Monitoring and Quarantine of HLB and BMP's for Control of ACP in CA

Greg W. Douhan
UC Cooperative Extension, Tulare, CA
gdouhan@ucanr.edu

Citrus is susceptible to a wide range of diseases caused by fungi, oomycetes, bacteria, nematodes, viruses and viroids, but the most serious of these on a worldwide scale is now generally considered to be Huanglongbing (HLB), also known as citrus greening. This disease is caused by a phloem limited bacteria (*Candidatus* Liberibacter asiaticus). In California, HLB is spread by the insect *Diaphorina citri* (Asian citrus psyllid: ACP), that is essentially endemic in Southern California but has spread North. However, the insect populations have not seemed to become established in large numbers North of the greater Los Angeles/Ventura areas. HLB is one of the most complex diseases of citrus, with interactions among the pathogen, vector, hosts and the environment in its broadest definition (weather, soils, plant nutrition, presence of other pathogens and pests, etc.). Thus, a main focus of control for this disease is to eradicate the insect vector since no HLB positive trees have been found in commercial citrus blocks and have only been limited to residential properties in the greater Los Angeles area (over 1,600 HLP positive trees to date). In this talk, I will focus on the general biology of the insect and pathogen, control measures that have been developed to limit the spread of the insect, and the overall situation that California citrus growers face with this potentially devastating disease.

Current Status and Mitigation of Insecticide Resistance of Alfalfa Weevil

Ian Grettenberger
Department of Entomology and Nematology, UC Davis
imgrettenberger@ucdavis.edu

Alfalfa weevil is the predominant economic pest of forage alfalfa across the continental US. When left unmanaged, it can cause substantial damage to this crop with thin economic margins. Synthetic pyrethroid insecticide (e.g., lambda-cyhalothrin) is often the first choice for control because of their low cost and efficacy. However, pyrethroid-resistant alfalfa weevils, now documented in the Western US, are causing yield loss and increased management costs. Pest managers face a lack of many effective tools for alfalfa weevil management, further complicating issues caused by insecticide resistance. Successful long-term management of this pest requires an understanding of how insecticide resistance develops and how we can prevent it. I will prevent an overview of insecticide resistance and the current status of insecticide resistance for alfalfa weevil. In addition, I will present best practices for resistance management and open questions with alfalfa weevil insecticide resistance. Finally, I will present a new project aimed at documenting and addressing the current issue of insecticide resistance in the Western US.

Pest Management Challenges in Diversified Specialty Crop Rotations

Ruth Dahlquist-Willard
UC Cooperative Extension, Fresno and Tulare Counties
rdahlquistwillard@ucanr.edu

The presentation will cover current challenges in insect pest management in small-scale, diversified vegetable farms in the San Joaquin Valley. Topics include common pests present in annual crop rotations of specialty vegetables, crops with few registered pesticide products, and challenges in monitoring pest populations. Information will also be presented on on-farm habitat and beneficial insects present and the landscape context of small-scale, diversified farms as it relates to insect pest management.

Principles of Insect Pest Management Utilizing IPM in an Organic System

Gina Colfer
Wilbur Ellis Company
gcolfer@wilburellis.com

Integrated Pest Management (IPM) has been a mainstream buzzword for many years in the pest control industry. It has taken on many nuances through the years as chemistries have evolved and improved from broad spectrum kill everything to more selective types of chemistries that target a more specific type of pest. With these advancements, pest control advisors (PCA's) should utilize and manipulate beneficial insect populations that are natural in our environment.

The UCCE definition of IPM is "an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment."

Enhancement on the farm with insectary habitat is critical for the overall health and longevity of these Biological Control Agents (BCA's), commonly known as beneficial insects. Certain BCA's require pollen and nectar as a main food source as an adult, whereas the immature is the killing machine. To ensure the BCA adult is as strong and healthy as possible, giving birth to offspring that are, in the larvae form, voracious foragers of pest insects, it is our duty to supply the food source for maximum effect of these predators and parasites.

This topic will dive deeper into the complexities of these BCA's, how they work for us in reducing pest populations and how to manage them to keep resident populations on the farm and working for generations.

Nitrogen Management in Organic Systems

Margaret Lloyd
UC Cooperative Extension, Capital Corridor
mglloyd@ucanr.edu

Nitrogen (N) management requires accurate information about the amount and time of crop N needs as well as the quantities and time of N availability from different sources. Organic N management is challenging because most N applied is not directly plant-available, but is made available over time through microbial processes. In field trials and laboratory studies, we have evaluated a number of commonly used organic amendments, including composts, manures, and granular and liquid organic fertilizers, to understand when plant available N is actually available. The N availability from the materials included in our study differed widely. The ratio of carbon (C) to N in an amendment was a good predictor of how quickly its N was released. In general, the higher the amount of N in the material (% N) and the lower the C to N ratio, the more quickly N will be released. In warm and moist soil, low C:N ratio materials such as guano, feather meal and fish emulsion released much of their N in the first week, and almost all their N within three weeks. This quality makes them good side dress materials. Poultry manure composts and granular fertilizers contributed some available N as soon as they were applied, but released their N more slowly. High C:N materials such as plant-based composts released almost no N over a three month period. They are good for building long-term soil fertility and soil physical structure, but provide little N for the current crop. In general, materials with a C:N ratio above 15 temporarily made soil N less available for plant use, and should not be applied too close to planting. For the materials we tested, manure-based composts and fertilizers usually had about 10-30% of their total N available at initial application. The results from our study can help create crop-based N budgets for organic systems to estimate whether a crop's N supply is appropriate for its needs, and over the long term, show whether N supply is in excess or deficit of what is needed for optimal crop production

Soil Health in Organic Systems: A Field-Based Example

Ehsan Toosi
True Organic Products, Inc.
ertoosi@gmail.com

The topic of soil health has gained popularity in the past decade. The concept of soil health is based on the view that soil biological activities (roots, microbes and fauna) are fundamental in improving/maintaining soil chemical and physical properties. Based on this view, it is expected that the overall status of soil health is higher in organic than conventional cropping systems, primarily because of higher soil biological activity under organic systems. Soils under organic systems frequently receive large amounts of organic fertilizers. Carbon is the backbone of organic fertilizers and the primary nutrient for soil microbes. In contrast, input of carbon is generally lacking in conventional systems. Enhanced microbial activity due to supply of carbon results in decomposition and subsequently release of nutrients from organic inputs. In contrast to synthetic fertilizers, organic inputs often supply a "partially" balanced source of macro and micronutrients. However, depending on the type of fertilizer and soil conditions and management practices, application of organic inputs for extended periods of time may lead to accumulation of certain nutrients and harmful ions. On the other hand, many organic systems experience even more intensive soil cultivation than conventional systems. Therefore, opposite factors interact to determine soil health status in organic systems, i.e. the combination of amount/type of organic inputs, no application of synthetic pesticides, and intense soil disturbance. In this presentation, I will briefly discuss the concept of soil health with focus on organic systems. I will also share the results of an example of soil health report in a pair of conventional and organic farms under similar cropping and management. The findings show that long term application of organic inputs has considerably improved soil health status based on a range of biochemical measures, proposed as indicators of soil health (e.g. microbial biomass, mineralizable carbon and nitrogen, soil enzymes, etc.), and this was in line with an increase in soil organic matter in the organic system.

ABSTRACTS: POSTER SESSION

Undergraduate Student Posters

1. Andrade and Perez
2. Baez Vega and Harder
3. Barchini
4. Brosin
5. Cox
6. Dugger
7. Estrada
8. Fernandez
9. Garcia and Lara
10. Pimentel
11. Prieto-Garcia
12. Reyes Solorio and Frnzyan
13. Saldivar
14. Wallin

MS Student Posters

15. Anderson
16. Boots-Haupt
17. Brar
18. Camargo and Cirhigiri
19. Evans
20. Garcia
21. Garcia-Brucher
22. Le
23. Marzall-Pereira
24. McAndrew
25. Perez
26. Reger
27. Singh H.
28. Singh K.
29. Singh S.
30. Steinhauer
31. To
32. Turner
33. Vizcarra
34. Williams
35. Wong
36. Wu

PhD Student Posters

37. Brewer
38. Lazicki
39. Marshall
40. Murphy
41. Renwick
42. Sapkota
43. Villa

Posters by Professionals

44. Angeles
45. Biscaro
46. Brasier
47. Bullard
48. Camarena
49. Halleck
50. Hodson
51. Leon
52. Murdock
53. Ouaknin

1. Undergraduate Student

THE EFFECT OF NITROGEN ON POD PRODUCTION AND BIOLOGICAL NITROGEN FIXATION IN WINTER FAVA BEAN

Hunter Andrade, Will Perez, Kyle Brasier and Hossein Zakeri

California State University, Chico

Contact: Hunter Andrade, CSU Chico, 400 W 1st St, Chico, CA 95929
209-207-8485; handrade3@mail.csuchico.edu

Winter fava bean (*Vicia faba* L.) is known for its ability to fix large quantities of nitrogen (N) when the nutrient is limited in the soil through process known as biological N fixation. The crop is also an excellent protein source for human consumption and is reemerging in niche cuisines. For this experiment, fava beans were grown in a field with low organic matter to test the effects of N fertilizer application rates to observe effects on growth rate, bean pod yield, N fixation, and root nodule production. N fertilizer was a liquid urea applied in treatments levels of 0, 56, 112, and 168 kg N ha^{-1} split over the two node and branching stages. The experiment was conducted to determine whether fertilizer application is beneficial to fresh pod yields for fava bean farmers and to what extent the added N fertilizer will reduce biological N fixation and root nodulation. Data collected in this experiment are: above-ground biomass at four growth stages, fresh pod yield, root nodule number, nodule mass, and percent of above-ground N derived from biological N fixation. Results will be presented at the conference as the experiment is on-going.

2. Undergraduate Student

DISTRIBUTION OF DRILLED PLANT SPECIES WITH DIFFERENT SEEDS SIZE AND DENSITY IN MIXED COVER CROPS

Consuelo Baez Vega, Bella Harder, Ana Medic, Kyle G Brasier and Hossein Zakeri

California State University, Chico

Contact: Kyle Brasier, CSU Chico, Holt Hall Room 381, 400 West 1st Street, Chico, CA 95929
517-375-0625; kgbrasier@csuchico.edu

California orchard growers are increasingly adopting cover crops as a part of orchard floor management. Studies have demonstrated that cover crop have numerous benefits to the soil and environment such as increasing soil infiltration rate that reduces runoff and erosion. These benefits reduce nutrient loss to groundwater and provide habitat for beneficial insects and pollinator species. Cover crops are typically a mix of plant species from there plant families: Poaceae (to increase soil infiltration with their fibrous roots), Fabaceae (to add to soil N with their N fixation capability) and Brassicaceae (to fumigate soil and also increase infiltration). Cover crops seeds, which are significantly different in size and weight, are mixed and sown with a regular grain drill. Such density variation can affect plant species distribution within the filed because denser seeds tend to stay at the bottom of planter. A field experiment has been conducted in a 5-year old walnut orchard to investigate the N benefit of different cover crop mixes on soil and walnut N. Treatments included fava bean (*Vicia faba*), a mix of 10 different crop species, and bare land in three replications. In this poster, we will present the within field distribution of different plant species in the mixed treatment. Random sampling will be performed within each rep and the frequency of each species will be quantified. The results will help growers to decide if one pass sowing of seed mix is as effective as multiple passes of sowing seeds in different size.

3. Undergraduate Student

DEVELOPMENT OF DIGITAL IMAGE ANALYSIS TOOL FOR LEGUME NODULE CHARACTERIZATION

Majd Barchini, Hassan S. Salehi, Hossein Zakeri and Kyle Brasier

California State University, Chico

Contact: Majd Barchini, CSU Fresno, 400 West First Street, Chico, CA 95929
530-588-8788; mbarchini@mail.csuchico.edu

Legume crops such as pea and bean develop symbiosis with a group of bacteria, called Rhizobia, and obtain their nitrogen requirement from the atmosphere. The process of biological nitrogen fixation (BNF) takes place in small nodules that are formed on the legume root system. Due to their capability for biological nitrogen fixation, legumes do not need nitrogen fertilizers, and can add to soil nitrogen for succeeding crop. Thus, legume crops are well known for their contribution to soil nitrogen through the BNF. However, the nitrogen benefits of legume significantly affected by cultural practices and environment. Sophisticated methods such as staple isotope technique is used to estimate the nitrogen benefits of legumes. In addition, it is very common to quantify plant nitrogen fixation through counting the number of nodules on the legume root system. Nodule number, nodule mass, and nodule shape are seen to be correlated with legume's BNF. Due to the slow process of counting nodules by hand, this valuable trait is not often included in legume research. In this research work, a total of 1468 images were collected from 367 legume root systems at CSU Chico and CSU Fresno farms. During data acquisition, the samples were imaged using a smartphone camera. Afterwards, digital image processing techniques such as filtering and image segmentation were applied on the legume root systems images to determine the number of nodules and provide their characteristics. For the image segmentation, a sample image was input to an edge detection algorithm to subdivide the image into objects and detect the nodules. This study highlighted the performance of our method for nodules counting and characterization in legume crops with 5% error.

4. Undergraduate Student

FUNGICIDE SENSITIVITY AND FIELD MANAGEMENT OF *PHOMA FUNGICOLA* CAUSING FRUIT BLIGHT OF PISTACHIO IN ARIZONA, US.

Brosin J.F.C., Lichtemberg P.S.F., Marzall-Pereira M. and Michailides T.J.

University of California; Davis; Universidade Federal do Parana (Brazil)

Contact: Joao Felipe Coimbra Brosin, UC Davis, 9240 S Riverbend Ave, 93648, Parlier 559-646-6500; joao.brosin@gmail.com

Fruit blight caused by *Phoma fungicola* is a new pistachio disease in Arizona, but not reported in California. When infected, fruits became dark brown to black covered with small pycnidia that can produce new infection cycles. So far, this disease lacks basic epidemiological information, including fungicide management and resistance. The objective of this study was to test the field efficacy of two spray programs in controlling this disease and determine *Phoma* sensitivity *in vitro* to several fungicides registered on pistachio. For this purpose, two spray programs based on SDHI/QoI and DMI/AP chemical groups were applied 4 times in the season (April, May, July, and August) to evaluate the effect on latent infection of fruits collected two weeks after each application. Besides that, fungicide amended media prepared at 1 and 10 µg/ml was used to compare the relative growth to control (without fungicide) where eleven fungicides were tested. Despite observing no differences between fungicide sprays, fungicides resulted in less latent infection than unsprayed control. The mycelial growth assay revealed that under 1 µg/ml, five out of eleven fungicides were able to achieve inhibitions rates from 60 to 95% in relation to control. At 10 µg/ml, this range narrows down to 80 to 95% inhibition. QoI fungicides revealed a relative germination rate of 92 to 100% at 1 µg/ml and similar rates at 10 µg/ml. The use of fungicides is recommended to provide adequate Phoma blight control, mainly before the rainy season in Arizona. The fungicides with higher intrinsic value were those formulated with QoI, DMI, AP and SDHI chemical groups, the same used in our field trial.

5. Undergraduate Student

CHOICE OF REFERENCE CROP IN BIOLOGICAL NITROGEN FIXATION QUANTIFICATION VIA Δ15N NATURAL ABUNDANCE METHOD: MONOCOT OR DICOT

Amanda Cox, Kyle Brasier and Hossein Zakeri

California State University, Chico

Contact: Amanda Cox, CSU Chico, 400 W 1st St, Chico, CA 95929
209-206-3274; acox29@mail.csuchico.edu

The $\delta^{15}N$ natural abundance method is commonly used to estimate biological nitrogen fixation (BNF) in legumes. This method compares the $\delta^{15}N$ of the legume to the $\delta^{15}N$ of a non-fixing reference plant to estimate BNF, but the root type (i.e. monocot or dicot) of the reference is often not taken into consideration. Within this field study, the adjustment values of monocot and dicot species are compared to estimate BNF in fava bean (*Vicia faba*). Since nutrient uptake may occur differently, a monocot species, wheat (*Triticum aestivum*), and dicot species, wild radish (*Raphanus raphanistrum*) and little mallow (*Malva parviflora*), were compared as references to calculate the BNF of fava bean accessions. Samples were collected from two sites (Chico, CA and Fresno, CA) upon termination of experiment on May 21st & 23rd, respectively. Twelve samples of monocot and dicot rooted plants were collected in a uniform grid pattern in addition to soil from 0-15 and 15-30 cm depths. Samples were analyzed for within field variation and a spatial analysis was conducted to determine adjustment values. Soil depths exhibited similar $\delta^{15}N$ signatures in both Fresno, CA and Chico, CA. The dicot species had higher $\delta^{15}N$ signatures in both locations. Furthermore, soil and reference crop variations were independent of each other at both locations. In conclusion, there is a possibility of error in determining BNF values when choosing to use either a monocot or a dicot as a reference crop per replication as a larger amount of field variation is observed.

6. Undergraduate Student

VARIATION OF $\delta^{15}N$ AND $\delta^{13}C$ IN DIFFERENT PARTS OF FAVA BEAN AT DIFFERENT DEVELOPMENTAL STAGES

Chloe Dugger, Amanda Cox, Kyle Basier and Hossein Zakeri

California State University, Chico

Contact: Chloe Dugger, CSU Chico, 400 W 1st St, Chico, CA 95929
760-638-1107; cdugger@mail.csuchico.edu

Fava bean (*Vicia faba* L.) is a cool season annual legume that is often used within cover crop mixtures. Stable isotopes are powerful tools in physiological, ecological, and environmental studies to help quantify important plant processes and functions. In plant science, ^{15}N is extensively used to accurately quantify legumes' biological nitrogen fixation while ^{13}C is used to study plant water relations. Whole plant sampling for isotope measurement is time consuming and expensive, highlighting the need to establish more concise sampling methods. In this experiment conducted at the California State University, Chico University Farm, concentrations of ^{15}N and ^{13}C were measured in different fava bean tissue types over the growing season to identify a less destructive sampling procedure using only one part of the plant to provide a representative sample of the ^{15}N and ^{13}C signature of the whole plant. Three fava bean cultivars, 'Windsor' (PI 301013), NEB710 (PI 655333), and 96075 (PI 678631) were selected for the experiment with three replications. One plant was harvested, cut in half, and separated into different portions including the stems, leaves, and pods. Samples were collected during the vegetative and physiological maturity growth stages and were ground and weighed for isotopic evaluation. Results showed the variation of both ^{15}N and ^{13}C signatures in the plant tissues were not significant within the vegetative stage but were significant during the physiological maturity stage. Significant variations of ^{15}N and ^{13}C during the maturity stage makes it impossible to sample individual plant parts to estimate the entire plant isotopic signature. However, individual tissue sampling during the vegetative stage is possible since the variation was not significant.

7. Undergraduate Student

QUANTIFYING NITROGEN REMOVAL FROM FAVA BEAN HARVEST

Saul Estrada, Kyle Braiser and Hossein Zakeri

California State University, Chico

Contact: Saul Estrada, CSU Chico, 400 W 1st St, Chico, CA 95929
559-380-7922; sestrada@mail.csuchico.edu

Fava bean (*Vicia faba* L.) are known for providing beneficial cover crop functions and have positive benefits for human health as a food source. The premise of this study is to quantify the amount of nitrogen removed when fresh pods are harvested and the remaining material is used as a green manure. Nitrogen concentrations were determined for pod, bean, and above-ground biomass from harvested beans and pods during each of the three fresh-market harvests and from remaining green manure samples. These harvested cover crops were compared to the amount of N within a non-harvested control group to assess N lost due to harvest. The average N concentration for the beans of the non-harvested control group was 48.20 g N/g of dry matter (DM), which was higher than the individual average bean N concentrations for the three separate harvest dates. However, the average bean N concentrations of the test group combined amounted to 125.03 g N/g DM. A similar trend to the aforementioned point was observed for the average N concentrations of the pods where the non-harvested control group had an average N concentration of 27.70 g N/g DM while pod N concentrations of the test group combined were 51.30 g N/g DM. More nitrogen is recycled back into the soil from the non-harvested control group biomass; 15.23 g N/g DM, than the biomass from fava beans undergoing three separate harvest; 13.40 g N/g DM. Agronomic purposes of this research are to help create more precise nitrogen budgets by accounting how much nitrogen the fava bean provides and how much is removed from harvest.

8. Undergraduate Student

THE EFFECTIVENESS OF WOOD MANAGEMENT METHODS FOR FAVA BEAN PRODUCTION

Marco Fernandez, Raul Saldivar and Ana Medic

California State University, Chico

Contact: Marco Fernandez, CSU Chico, 400 W 1st St, Chico, CA 95929
831-254-9511; mfernanez@mail.csuchico.edu

Fava bean (*Vicia faba*) is an annual legume of the Fabaceae family. Fava bean is widely cultivated for its high nutrient density and its ability of nitrogen fixation. However, fava bean is a poor weed competitor. A field trial was conducted at California State University - Chico's Paul L. Byrne Agricultural Teaching and Research Center to determine the effectiveness of different weed control practices on fava bean production. A randomized complete block design was established consisting of four treatments and four replications - totaling sixteen 1 x 6 m plots. Treatments consisted of a preemergence herbicide application, mechanical weeding, weed flaming, and a control group. The collected data includes fava bean plant height, fava bean biomass, weed biomass by species, bean yield, and root nodulation. A one-way ANOVA statistical analysis showed that p-values were lower than 0.05, suggesting the plant height of 1 or more treatments compared to control are significantly different (p-value = 1 11e-16). Pod production and plant biomass were highest in the mechanical treatment, suggesting the mechanical treatment method was the most effective. However, both flame and mechanical treatments significantly lowered the weed pressure. Therefore, the flame application remains as a promising weed management method that can be further analyzed. Nevertheless, replication of the experiment is recommended and addressing application rate and intensity of the flame application for optimal fava bean growth is vital. Also, incorporating and combining all treatments at different frequencies and timings in adjacent to an Integrated Pest Management approach would add value to future research and a grower's cropping system, ultimately reducing the grower’s herbicide application frequency, soil disturbance, and maintaining profitable fava bean yields in Northern California.

9. Undergraduate Student

GENOTYPIC CHARACTERIZATION OF *FUSARIUM OXYSPORUM* F. SP. *VASINFECTUM* ISOLATES FROM CURRENT FIELD POPULATIONS OF COTTON IN CALIFORNIA

Jorge Garcia[1], Celeste Lara[1], Josue Diaz[2], Robert B. Hutmacher[3], Mauricio Ulloa[4] and Margaret L. Ellis[1]

[1]California State University, Fresno; [2]The Ohio State University, Columbus, OH; [3]University of California West Side Research and Extension Center, Five Points; [4]USDA-ARS, Lubbock, TX

Contact: Jorge Garcia, CSU Fresno, 2415 E. San Ramon, Fresno, CA 93740-8033

Fusarium oxysporum f. sp. *vasinfectum* (FOV) race 4 is an important wilt pathogen of cotton in California. Due to the nature of its virulence, FOV race 4 is considered the most problematic race in California capable of causing economic levels of injury in the absence of root-knot nematode. It was first identified in the San Joaquin Valley of California in 2001 and later confirmed in Texas in 2017 and New Mexico in 2019. The goal of this research was to confirm the presence of different FOV race 4 genotypes in current California field populations. Isolates were collected from 13 locations across the San Joaquin Valley during the 2017 and 2019 growing seasons. A total of 179 isolates were identified as *F. oxysporum* and two isolates were identified as *F. solani* using DNA sequencing of the translation elongation factor (EF-1a) gene. FOV race 4 specific primers identified 171 isolates as FOV race 4. Eight isolates were identified as FOV race 3. The FOV race 4 isolates were further genotyped based on the absence (N type) or presence (T type) of the insertion of the transposable element *Tfo1* in the phosphate permease (PHO) gene unique to some FOV race 4 isolates. Our results identified 112 isolates as the T genotype and 59 isolates as the N genotype. The results from this study confirm the presences of the T and N genotype of FOV race 4 in current California field populations across the San Joaquin Valley. The N genotype had previously only been identified from one isolate recovered in Merced County. Our results also recovered this genotype from Kings, Kern, and Tulare counties.

10. Undergraduate Student

OPTIMIZING POTASSIUM FERTILIZER APPLICATIONS FOR PRODUCTIVITY AND RETURNS

Brian Pimentel, Nicole Tautges and Brenna Aegerter

University of California, Davis

Contact: Brian Pimentel, UC Davis, 1 Shields Ave, Davis, CA 95616
510-493-8137; bbpimentel@ucdavis.edu

Much uncertainty remains around optimal potassium (K) fertilizer application to processing tomato crops, in terms of yield and profitability maximization. California's Central Valley soils' inherently high K levels are being depleted by increasing yields and K removals via harvested fruit, leading to greater interest in identifying optimal K fertilizer practices. There were questions as to whether fall, early-season fertigation, or early- plus late-season fertigation methods resulted in yield increases and profitability, compared with no K fertilizer application. We compared these three fertilization methods in two locations: 1) UC Davis's Russell Ranch, in winter fallowed and cover cropped systems (100lb K/acre), 2) on-farm in San Joaquin County (200 lb K/acre). Results showed that the split fertigation treatment resulted in the highest soil exchangeable K levels in June. In assessing tomato K uptake, no differences were observed at Russell Ranch, but at the San Joaquin on-farm site, both fertigation times increased tomato K uptake compared to the no-K control. At the Russell Ranch site, we found that applying K fertilizer in fields ranging from 140-280 ppm K benefited fruit yields by 3 to 5 tons/acre on average, when compared to non-fertilized tomatoes. Economically, all K treatments were profitable, but the split treatment (KCl) resulted in the greatest returns relative to the control by an additional $240-310 per acre in both systems, with the conventional system being the most profitable. Additionally, all K fertilizer treatments improved fruit brix and color compared to the no-K control. These results further support the split fertigation treatment as being the most optimal K fertilizer management program for maximizing yields and quality.

11. Undergraduate Student

GENOTYPIC VARIATION FOR ABOVE-GROUND BIOMASS, NITROGEN CONCENTRATION, NODULE NUMBER, AND NODULE MASS IN FAVA BEAN

Jocelyn Prieto-Garcia, Kyle Brasier and Hossein Zakeri

California State University, Chico

Contact: Jocelyn Prieto-Garcia, CSU Chico, 400 W 1st St, Chico, CA 95929
650-554-8812; jprietogarcia@mail.csuchico.edu

Fava bean (*Vicia fava* L.) is an important crop for replenishing soil nitrogen through biological nitrogen (N) fixation and is a common component of cover crop mixtures in California. Growers are interested in utilizing fava bean cultivars with high N fixation in their mixtures. It is important for growers to find the most economically yielding genotype for their cultivar. One factor in cultivar selection is seed size due to costs associated with the number of seeds per bag and therefore the number of bags needed to plant an acre. Furthermore, seed purity can challenge yield potential making the seed more expensive adding to total costs. From a genotypic perspective, seed size can be important due to seed reserve contribution to plant growth and compatibility with available planters. A study was conducted to determine the effect of seed size on the variation in nodulation, shoot biomass, and above-ground nitrogen. Three individuals (PI 469115, PI 655332, and PI 655329) were selected on the basis of seed size (small, medium, and large) and grown in a randomized complete block design with three replications at the Chico State University Farm. Significant genotypic variation for nodule count was observed between 110 and 170 days after planting (DAP) and for biomass 155 DAP. These results can indicate a variance between genotypes by the amount of nitrogen that is fixed throughout each individual. By identifying the most successful individuals, optimal nitrogen fixing varieties can be achieved. Above-ground N concentration data will be presented at the conference.

12. Undergraduate Student

EVALUATING THE EFFECTS OF VARIOUS IRRIGATION AND NITROGEN APPLICATION METHODS ON THE YIELD AND QUALITY OF PROCESSING TOMATOES

Liliana Reyes Solorio, Tiffany Frnzyan, Aldo Garcia, Noe Toribio, Artemio Solorio, Chaitanya Muraka, Janet Robles, Balaji Sethuramasamyraja, Florence Cassel S. and Dave Goorahoo

California State University, Fresno

Contact: Liliana Reyes Solorio and Tiffany Frnzyan, CSU Fresno, 2415 E. San Ramon Ave. M/S AS 72, California State University, Fresno, CA 93740
559-278-2861; liliana_reyes5@mail.fresnostate.edu, tfrnzyan@mail.fresnostate.edu

In the United States, processing tomatoes are consumed as paste, puree, sauces, or in diced form. The nutritional value, ease of handling, and economic value make tomato products appealing to consumers. Common quality traits sought after include Color, Soluble Solids Concentration, pH, and Brix. With the current water and nitrogen (N) restrictions and since tomatoes have a high water demand, optimizing water and N inputs have become paramount to production sustainability. Therefore, the objective of our study was to evaluate the response of processing tomatoes (*Lycopersicon esculentum* Mill) to different irrigation and N application methods in relation to yield and quality. The experiment was conducted in the San Joaquin Valley of California following a split plot design with irrigation as the main factor (100% ET, 70% ET) and N fertilizer application as the sub-factor, replicated three times. Two fertilizer application methods were tested: a traditional practice consisting of seven split N applications during the growing season, and applications based on a Soil Nitrate Quick Test. Results from the first year growing season in 2019 indicated that the irrigation and N application methods did not have an effect (at p=0.05) on the total yield of processing tomatoes (14.0 +/- 0.9 t ac^{-1}). However, tomatoes grown under the 70% irrigation treatment had significantly higher brix content (p=0.000) and blossom end rot (p=0.002) compared to those grown under full irrigation. The fertilizer application method did not influence the brix and instance of blossom end rot.

13. Undergraduate Student

GENOTYPIC VARIATION FOR PEA NODULATION AND GROWTH USING NORMALIZED DIFFERENCE VEGETATIVE INDEX

Raul Saldivar, Kyle Brasier and Hossein Zakeri

California State University, Chico

Contact: Kyle Brasier, CSU Chico, Holt Hall Room 381, 400 West 1st Street, Chico, CA 95929
kgbrasier@csuchico.edu

Pea (*Pisum sativum* L.) is an annual legume of the Fabaceae family. Pea is a nutritious crop that is widely cultivated for grain protein and its ability to fix atmospheric nitrogen – making it an outstanding cover crop. A variety trial was conducted at California State University, Chico's Paul L. Byrne Agricultural Teaching and Research Center to evaluate a panel of 26 genotypes for biological nitrogen fixation and agronomic performance. A complete randomized design was used to evaluate 26 entries over three replications. The GreenSeeker Handheld™ was used to determine Normalized Difference Vegetative Index (NDVI) of each entry at five time points throughout the growing season. This index was used as a proxy for early session vigor and above-ground biomass as a means of assessing weed competitiveness potential. Genotypic variation for in-season NDVI, above-ground biomass, and nodulation will be presented at the conference.

14. Undergraduate Student

POTENTIAL OF WINTER SAFFLOWER PRODUCTION IN NORTHERN CALIFORNIA

Steve Wallin, Raul Saldivar, Aaron Alvarez, Kyle Brasier and Hossein Zakeri

California State University, Chico

Contact: Kyle Brasier, CSU Chico, Holt Hall Room 381, 400 West 1st Street, Chico, CA 95929
517-375-0625; kgbrasier@csuchico.edu

Safflower (*Carthamus tinctorus*) is cultivated as an oil seed crop in California. Safflower is a rotational crop that is typically planted in early spring and harvested in the summer. However, the crop is routinely planted as a winter crop in the world's other Mediterranean climates. If winter production is implemented in California, it could decrease the amount of winter fallow acreage thereby improving soil health and producing income to the growers. A study was conducted at the California State University, Chico University Farm to study the effects of planting dates on yield and yield components of spring and winter sown safflower. A randomized complete block design was imposed with two planting dates and five replications. The first planting was in in November and the second planting was in April. Number of flower heads per plant, number of seed per head, 1,000 seed weight, plant height, and grain yield were measured at time of harvest for each planting date. Results will be reported at the conference.

15. Masters Student

AN ANALYSIS OF THE IMPACT OF SALINITY ON ALFALFA YIELD AND FORAGE QUALITY IN THE SAN JOAQUIN VALLEY OF CALIFORNIA

Aaron Anderson[1], Giuliano Galdi[2], Natalia Franco[1], Sharon E. Benes[3], Simarjeet Singh[3], Umair Gull[1], Robert Hutmacher[1] and Daniel H. Putnam[1]

[1]University of California, Davis; [2]University of California Cooperative Extension, Yreka; [3]California State University, Fresno

Contact: Aaron Anderson, UC Davis, 1 Shields Ave, Davis, CA 95616
865-705-6087; awanderson@ucdavis.edu

Irrigated alfalfa is a critical component of western dairy production, providing protein, energy and digestible fiber for milk production. Salinization of soils and aquifers and variable rainfall, due to climate change has caused alfalfa to be pushed to marginal lands no longer fit for higher value crops. We sought to determine if water from high salinity sources can be used for alfalfa irrigation, and whether varieties differed in salinity tolerance for yield and quality. A RCB design with high and low salinity levels as main plots and 35 varieties as sub-plots was conducted at the UC West Side Research and Extension Center and harvested from 2017-2019. Stands were watered via subsurface drip irrigation (SDI) to insure accuracy and stress uniformity with low (ECw = 0.8- 1.4 dS/m) and high (8.0-11.0 dS/m) salinity water in the main plots. The most saline plots resulted in ECe of 8-16 dS/m in the topsoil. Near-infrared spectroscopy quality analysis was performed on selected harvests. Two-year yield data results show significant yield differences due to salinity and variety, but their interaction was non-significant. Salinity reduced average yields by 4% and 22% in 2017 and 2018, respectively. Trends for higher ADF & NDF and lower CP content were observed in the non-saline vs. saline plots, which corresponds to commonly-observed results from drought-stressed alfalfa. Ash tended to be lower in the high saline plots. While yields were reduced under these high salinity treatments, SDI-irrigated high salinity treatments resulted in average yields of 24.6 Mg ha^{-1} in the first full year of production which are considered highly viable economically for this region. Depending upon management and drainage factors, alfalfa grown under high salinity conditions appears to be viable.

16. Masters Student

EVALUATING BIOLOGICAL NITROGEN FIXATION OF DIFFERENT FABABEAN (*VICIA FABA* L.) CULTIVARS

Laura Boots-Haupt[1], Ranjit Riar[1], Kyle Brasier[2] and Hossein Zakeri[2]

[1]California State University, Fresno; [2]California State University, Chico

Contact: Laura Boots-Haupt, CSU Fresno, 2415 E. San Ramon,
Fresno, CA 93740-8033 M/S AS72
530-228-7773; lboots11@gmail.com

Fababean, an annual winter legume, has the potential to enhance soil fertility due to its ability to biologically fix atmospheric nitrogen in the root nodules. It can be used as a winter cover crop before planting the main summer crop in many areas of the US. This experiment is aimed to evaluate 63 genotypes of fababean, and their ability to fix atmospheric nitrogen.

17. Masters Student

RESPONSE OF FURROW-, DRIP-, AND DEFICIT DRIP-IRRIGATED SORGHUM (*SORGHUM BICOLOR*) TO VARYING NITROGEN RATES, IN COMPARISON WITH CORN (*ZEA MAYS*)

Ramandeep K. Brar, Tiffany Frnzyan, Liliana Reyes-Solorio, Chaitanya Muraka, Katrina Steinhauer, Janet Robles, Anthony Venegas, Aldo Garcia, Timothy Jacobsen, Dave Goorahoo and Florence Cassel S.

California State University, Fresno

Contact: Ramandeep Brar, CSU Fresno, 2415 E. San Ramon Ave., M/S AS 72, Fresno, CA 93740
559-770-3175; brarramandeep@mail.fresnostate.edu

Corn silage is a major forage crop for the California dairy industry in contrast with sorghum, which is grown on limited acreages. Such predominance is mostly attributed to the higher quality (energy, protein digestibility) of corn compared to sorghum. However, following the recurrent droughts and increasing use of groundwater, corn production has been impacted due the sensitivity of the crop to water shortages and salinity. Therefore, there is a need to evaluate alternative forages that are more drought tolerant and have a better adaptability to poor quality soils and waters, such as sorghum. The objective of our study was to evaluate the tolerance of sorghum grown under various nitrogen (N) fertilization rates and irrigation regimes, in comparison with corn. The experiment was conducted at CSU Fresno following a split-split plot design with two crops (sorghum, corn), four N rates (0, 75, 150, and 225 lbs. N ac^{-1}) and three irrigation treatments (100%-ET furrow, 100%-ET surface-drip, and 70%-ET surface-drip). Results from the first growing season in 2019 indicated that sorghum yields were significantly higher for all irrigation and N treatments compared to those of corn ($p = 0.05$). However, there was no statistical difference in yields among irrigation treatments, with averages of 16.4 t ac^{-1} and 24.4 t ac^{-1} for corn and sorghum, respectively. The N treatments had a significant effect on corn yields ($p = 0.057$); however, no significant difference was observed for sorghum. These first findings suggest that sorghum could outperform corn in terms of yield and efficiency. In addition, deficit irrigating both crops at 70% ET and reducing N rates did not decrease yields and maximized water and nitrogen use efficiency.

18. Masters Student

WINDFALL ANALYSIS

Ricardo Camargo, Gustave Cirhigiri, Sat Darshan S. Khalsa and Patrick H. Brown

University of California, Davis

Contact: Ricardo Camargo, UC Davis, 1 Shields Ave, Davis, CA 95616
530-574-8258; ricamargo@ucdavis.edu

During harvest, almonds are shaken to the ground then gathered in middle rows before sweeping them after they have dried to 6 % moisture. This results in multiple passes of heavy machinery that generate 11,200 tons of dust between mid-August to mid-October. The Almond Board of California has set the goal to halve dust emissions by 2025 by introducing off-ground harvest, which presents the benefit of eliminating dust and substantially increase nut quality by reducing pathogen and contaminant exposure. Additional benefits are the reduction of pesticides used and the possibility to use organic amendments for soil health and tree longevity. However, the quantitative estimation and qualitative assessment of windfallen nuts that fall prior harvest, is still unknown. Our project seeks to answer that question by studying the windfall phenomenon in California. The state was divided into South, Central, and North regions. Each region included roughly 20 orchards with different cultivars, rootstocks, and age. Three replicates (trees) of each cultivar were selected from each orchard in a transect. Barcodes were then placed under each tree as reference and were pictured weekly along row (0°) and across row (90°) from 5% hull split to the eve of harvest day to count density of almonds fallen. Preliminary analysis shows that windfall ranges from zero to 1%, with most sites showing <0.4% (0-15 lbs.) It was also found that fruit falling before 4+ weeks of normal harvest are very poor quality, but quality and size of kernels is not compromised at 2-4 weeks early shake. This project will be repeated in 2020 adding 1) high aflatoxin sites and 2) high Navel Orange Worn/Hull-Rot sites.

19. Masters Student

GUT-CONTENT ANALYSIS TO DETERMINE PREVIOUS HOST PLANTS OF LEAFFOOTED BUG (LEPTOGLOSSUS ZONATUS) INFESTING CALIFORNIA ORCHARDS

Danielle Evans[1,2,3], Houston Wilson[2,3] and Jake Wenger[1]

[1]California State University, Fresno; [2]University of California, Riverside; [3]Kearney Agricultural Research Center, Parlier

Contact: Danielle Evans, CSU Fresno, 2415 E. San Ramon, Fresno, CA 93740-8033 M/S AS72
dani.evans8403@gmail.com

Leaffooted bugs (LFB, *Leptoglossus spp.*) are phytophagous insects known to feed on a wide array of weeds and crops across California. In the San Joaquin Valley LFB are recognized as a common pest of more than 20 crops, and is especially problematic in several orchard crops such as almonds, pistachios, and pomegranate. LFB enter the orchard during early in fruit development, and feed on the fruits directly. Feeding at this stage results in blemishing and shriveling of the harvested product; a major issue for fresh market produce. The greatest challenge in management is predicting LFB's initial infestation. LFB first enter the orchards in the late spring, migrating from unknown overwintering host(s). Identifying LFB's overwintering host(s) would allow pest control professionals and growers to monitor overwintering populations, and provide essential data for predicting infestation dates. Here we describe the design and implementation of a DNA gut content analysis for LFB. Gut content analysis involves sequencing barcode genes from the plant DNA found in the guts of captured LFB. By doing so, we can retroactively identify the insect's previous hosts. This includes proof-of-concept experiments that establish protocols for LFB dissection, gut content isolation, DNA extraction, and amplification of the barcode trn-F intergenic spacer region. Initial results suggest that gut content analysis is a viable tool for the identification of overwintering host plants. Preliminary data has shown that the established protocol successfully isolated LFB diet and can be verified via Sanger Sequencing. Further trials are being conducted on wild specimens to isolate unknown hosts which are verified with Next Generation Sequencing.

20. Masters Student

FERTIGATION STRATEGY FOR OPTIMIZING WATER AND NITROGEN USE EFFICIENCY IN PROCESSING TOMATOES GROWN ON A SANDY LOAM

Garcia A.T., Toribio N., Solorio A., Robles J., Sethuramasamyraja B., Cassel S.F. and Goorahoo D.

California State University, Fresno

Contact: Aldo Garcia, CSU Fresno, 2415 E. San Ramon, Fresno, CA 93740-8033 M/S AS72 661-303-9148; a_garcia1012@mail.fresnostate.edu

As much as half of the Nitrogen (N) intended to grow food can end up polluting groundwater through nitrate leaching from inefficient use of N fertilizers. Limiting N losses from agriculture via nitrate leaching will require optimizing nitrogen use efficiency (NUE) through judicious N application practices at the right time and right amount for maximum uptake by the crop. In addition, water conservation is a top priority in California requiring that farmers adopt management practices that increase irrigation and water use efficiency (WUE). One approach to improve WUE and NUE is to implement Fertigation practices that include the use of climatic data to determine evapotranspiration (ET), and soil nitrate tests to guide N fertilizer applications, respectively. Hence, the objective of the current study was to assess the effects of different irrigation scheduling and N fertilization methods on the WUE and NUE of processing tomatoes grown on a Sandy Loam soil. A split block design, with three replicates of two irrigation scheduling (I) amounts as the main factor, and two fertilizer application methods (F) as the subplot factor was established on a sandy loam soil. Irrigation Schedulings (I) were based on 100% and 70% of total ET CIMIS data. Fertilizer Application Methods (F) were (a) Growers Practice- seven split applications, and (b) Soil Nitrate Quick Test (SNQT)-based on test strip readings. For the 2019 crop, F and I had no significant effects on the total yield of tomatoes, which averaged 14.00 ± 0.90 tons/acre. However, NUE for plants subjected to the SNQT method was 22% greater than the Growers Practice; and, WUE with 70% ET were 29% higher than that for 100% ET.

21. Masters Student

THE EFFECT OF PRE-PLANT FERTILIZER MANAGEMENT ON SOIL NITROGEN DYNAMICS, SOIL HEALTH, DISEASE INCIDENCE, AND YIELD IN FOUR STRAWBERRY CULTIVARS

Kamille Garcia-Brucher[1], Charlotte Decock[1], Gerald Holmes[1], Kelly Ivors[1,2], Robyn Brooks[1] and Janelle Rey[1]

[1]California Polytechnic State University, San Luis Obispo; [2]Driscolls Inc., Watsonville, CA 95076

Contact: Kamille Garcia-Brucher, California Polytechnic State University. One Grand Ave. San Luis Obispo, CA 93405
310-717-1863; kgarci87@calpoly.edu

An experiment at the Cal Poly Strawberry Center began in Oct 2018 to observe soil and plant nitrogen (N) dynamics in the strawberry production system by comparing three pre-plant fertilizer strategies (100 lbs. N/acre of synthetic control release fertilizer, 100 lbs. N/acre of compost, and a control) among four cultivars (Monterey, San Andreas, Albion, and a proprietary variety). This experiment was conducted in a field inoculated with *Macrophomina phaseolina* (*M. phaseolina*) in 2017. Analysis of soil pore water samples show there was no significant effect of pre-plant fertilizer strategy ($p= 0.49$) or cultivar ($p= 0.66$) on NO_3^- exposure in or below the root zone. Pre-plant fertilizer did not affect soil health indicators such as permanganate oxidizable carbon ($p= 0.88$) or mineralizable carbon ($p= 0.16$). An Area Under Disease Progress Curve (AUDPC) was calculated to explore the impact pre-plant fertilizer and cultivar have on disease by *M. phaseolina* throughout the 2019 growing season. There was no effect of pre-plant fertilizer on AUDPC ($p= 0.16$) but there was a significant effect of cultivar on AUDPC ($p< 0.00$). Post- hoc comparison indicated that mean AUDPC of the Proprietary cultivar (107 ±29 %-days) was significantly less than Monterey (257 ±29 %-days) and Albion (367 ±29 %-days) cultivars. Harvest data show there was no significant difference in total yield between pre-plant fertilizers ($p= 0.20$). There was a significant difference in total yield among cultivars ($p= 0.00$). Post- hoc comparison indicated that mean yield of Monterey (3242 ±151 trays/Ac) was significantly greater than San Andreas (2487 ±151 trays/Ac) and Albion (2029 ±151 trays/Ac) cultivars. Plant samples are being analyzed for plant biomass and N uptake. Year two data is being collected.

22. Masters Student

IMPROVING SUSTAINABLE FERTILIZER PRACTICES FOR POMEGRANATES BY LEAF NUTRIENT CONCENTRATION EVALUATION AND FERTILIZER TRIALS

Minh Le, Charlotte Decock and Lauren C. Garner

California Polytechnic State University, San Luis Obispo

Contact: Minh Le, California Polytechnic University, San Luis Obispo, 1 Grand Avenue, San Luis Obispo, CA 93407
916-205-8373; mle46@calpoly.edu

Fruit tree leaves are analyzed to determine nutrient status and/or fertilizer program effectiveness but there is limited information about pomegranate mineral nutrient requirements. To examine relationships between fertilizer rates, leaf nutrient concentrations, fruit yield and quality, fertilizer was applied at three rates (150, 300, and 450 g N/tree) in a single July application or split applications (75, 150, and 225 g N/tree) in July and August at three commercial California 'Wonderful' pomegranate orchards in 2018. A randomized complete block design was used with 24 trees per treatment and 4 blocks per site (432 data trees). Sixty leaves were collected per tree in July, August, and September (early, mid-season and late fruit development, respectively) and analyzed to determine nutrient concentration. In September, trees were harvested and fruit weight and diameter were measured. Leaf collection time resulted in significant differences in leaf nitrogen concentrations between fertilizer rates but treatments did not result in significant yield differences. Leaf nitrogen concentrations averaged 1.6% in July and August and 1.5% in September. Leaf nitrogen concentrations in September were positively associated with fruit yield and leaf iron and phosphorus concentrations in July were negatively associated with fruit yield. Leaf boron and phosphorus concentrations in September were positively associated with fruit diameter. Leaf nutrient concentrations of manganese in July, potassium in August and iron in July and September were negatively associated with fruit diameter. This season, the study was replicated at two additional orchards and results of the study were used to design ongoing studies that include assessments of soil N dynamics and leaching, estimation of N uptake and removal rates and fertilizer rate treatments based on estimated N removal at harvest.

23. Masters Student

BENZOVINDIFLUPYR AS A SUCCINATE DEHYDROGENASE ALTERNATIVE TO CONTROL *COLLETOTRICHUM FIORINIAE* CAUSING THE PISTACHIO ANTHRACNOSE IN CALIFORNIA

Marzall-Pereira M., Lichtemberg P.S.F., Brosin J.F. and Michailides T.J.

University of California – Davis / Universidade Federal do Parana (Brazil)

Contact: Miriam Marzall Pereira, UC Davis, 9240 S Riverbend Ave. 93648, Parlier
559-646-6500; marzallp@ucdavis.edu

The pistachio anthracnose caused by *Colletotrichum fioriniae* was identified in 2016 in Glenn County, California. If not controlled, the anthracnose is able to destroy an entire crop when a susceptible cultivar is infected, causing severe fruit blight and necrotic lesions on leaves and rachises. Among the four succinate dehydrogenase inhibitors (SDHIs) registered for pistachio, only one has the potential to inhibit *Colletotrichum fioriniae in vitro* mycelia growth. The latest SDHI release, benzovindiflupyr (Solatenol™) was registered for cereal crops, presenting the potential to control *Colletotrichum* spp. The objectives of this study were to demonstrate the activity of benzovindiflupyr in the inhibition of *Colletotrichum* growth *in vitro* and *ex-vivo,* and to determine the role of single polymorphisms as a putative resistance mechanism for this chemical group. In total, 78 isolates were used to determine sensitivity to benzovindiflupyr and penthiopyrad using the mycelia growth assay on amended media, and one isolate was used to inoculate detached leaves of pistachio. To determine the putative resistance mechanism, the sequences of *sdh* genes encoding the three subunits B C and D of three isolates were compared with UV irradiated isolates. The preventive *ex-vivo* assay, benzovindiflupyr resulted in higher inhibition activity then penthiopyrad. *Colletotrichum* isolates were more sensitive to benzovindiflupyr. Sequences of *sdhB, sdhC,* and *sdhD* genes revealed no nucleotide differences in regions already associated with SDHI resistance. Moreover, the sequences of the *sdh* genes of UV irradiated isolates did not differ from wild types (baseline isolates). This study shows that benzovindiflupyr may be recommended for controlling anthracnose in pistachio, once registered. The SDHI resistance may be associated with a different mechanism than target-site modification, such as membrane pump-efflux or gene overexpression.

24. Masters Student

NUTRITIONAL BENEFITS, CONCERNS, AND DIETARY USES OF FAVA BEANS (*VICIA FABA*)

Madeline McAndrew, Maria Giovanni, Hope Morgan and Lacey Pettigrew

California State University, Chico

Contact: Madeline McAndrew, CSU Chico, 400 West First Street, Chico, CA 95929-0002
650-922-4158; mmcandrew@mail.csuchico.edu

Fava beans, also known as faba or broad beans, are a commonly consumed legume in the Middle East, west Asia, north Africa and other regions, but not in the U.S. As part of a project to promote cultivation of fava beans as "double purpose" cover and a cash crop, research about the nutritional benefits, concerns, and dietary uses of fava beans in the U.S. is underway, including understanding their market potential. Fava beans can be used in recipes such as stews and soups, prepared as a snack such "fava nuts", and processed to use as an ingredient, such as flour, in other foods. Fava beans are a rich source of protein and complex carbohydrates, and have also been linked to lower rates of cancer, cardiovascular disease, and possible support for people with Parkinson's disease. However, they are directly linked to favism, a potentially fatal disease that results from a deficiency of glucose-6-phosphate dehydrogenase due to the presence of vicine and convicine. Most prominent in Mediterranean and Afro-Caribbean peoples and males, some varieties of *Vicia faba* contain lower amounts of these proteins than other varieties. In the U.S., fava beans are primarily used in ethnic cooking but with the increasing interest in plant-based diets, understanding how to incorporate fava beans into the American diet is beneficial to both the producers and consumers. To present complete information about fava beans, this poster gives suggestions for preparation and consumption, and also information about favism targeted to the U.S. consumer.

25. Masters Student

PERFORMANCE OF SEMI- AND NON-DORMANT "HIGHER QUALITY" ALFALFA VARIETIES AS INFLUENCED BY HARVEST SCHEDULE IN A MEDITERRANEAN ENVIRONMENT

Brenda Perez, Chris DeBen and Daniel H. Putnam

University of California, Davis

Contact: Brenda Perez, UC Davis, 1 Shields Ave, Davis, CA 95616
559-909-5055; bperez@ucdavis.edu

Producing high yields of dairy-quality alfalfa (*Medicago sativa*) hay is largely hindered by the increased levels of lignin and low fiber digestibility by ruminant animals as the crop matures. Reduced-lignin varieties have the potential to increase yields unhindered by the penalty in quality that typically occurs with late maturity. Studies were conducted in Davis, CA and Parlier, CA in 2017-2019 in irrigated trials using a Split Plot Design with harvest schedules as main plots and varieties as sub-plots utilizing semi- dormant (Fall Dormancy 6) and non-dormant (FD 8-9) lines. Later cutting intervals (37 to 40 d) resulted in significantly higher yields than a 'normal' schedule (28-29 d), indicating the yield reward for delayed cuttings. Reduced lignin varieties cut at a later time in a Mediterranean environment show the potential of increasing yields while maintaining high digestibility (NDFD), without the dramatic increase in fiber and lower digestibility that typically accompanies late harvests.

26. Masters Student

RELATIVE IMPACT OF STRAIN, IRRADIATION, AND HANDLING ON FLIGHT PERFORMANCE OF NAVEL ORANGEWORM (LEPIDOPTERA: PYRALIDAE)

Joshua Reger, Jacob Wenger, Charles Burks and Houston Wilson

California State University, Fresno

Contact: Joshua Reger, CSU Fresno, 5241 N Maple Ave, Fresno, CA 93740
317-378-9628; jereger@mail.fresnostate.edu

Navel orangeworm (NOW) *Amyelois transitella* (Walker) (Lepidoptera: Pyralidae) is a key pest of almonds, pistachios and walnuts in California. While several integrated pest management strategies have been developed for this insect, studies have recently been initiated to explore the use of sterile insect technique (SIT) as another control tool. Previous studies have shown NOW to be a strong flyer in a laboratory environment, but flight performance of irradiated NOW was unknown. NOW flight performance was measured with computerized flight mills. Locally reared moths were flown with moths shipped from the Phoenix, AZ USDA APHIS facility. Shipped moths included both irradiated and non-irradiated treatments. Moths were flown for a single night (10.5 hours) while distance, duration, and velocity were recorded. Locally reared moths performed similarly, flying a mean 9.7-11.0 km in a night. Groups of shipped moths on average flew shorter distances of 4.6-6.1 km with irradiation showing no compounding effect on performance. Shipped moths had three times as many “non-fliers” (moths that did not engage in 2 minutes of continuous flight). Findings from this study provide new information on the effects of strain, irradiation, and handling on NOW flight capacity, which is critical to the development of an effective SIT program for this pest.

27. Masters Student

DIFFERENT PHOTOPERIOD REGIMES WITH LED LIGHTING INFLUENCE GROWTH OF CONTAINER GROWN BUDDED AND NON-BUDDED CITRUS NURSERY TREES

Hardeep Singh, Sharon Benes, John Bushoven and Gurreet Brar

California State University, Fresno

Contact: Hardeep Singh, CSU Fresno, 2415 E. San Ramon, Fresno, CA 93740-8033 M/S AS72
559-579-6065; hardeepsingh003@mail.fresnostate.edu

Nursery citrus trees in California must be grown in insect exclusion facilities to be protected against *Huanglongbing* (HLB), a deadly disease spread by the Asian citrus psyllid. Faster year-round propagation is critical for citrus nurseries to offset the investment in new exclusion facilities, but nurseries currently face serious problems of poor bud push and slow scion growth in fall-budded container grown trees. Therefore, the purpose of this study was to explore the effect of supplemental LED lighting technique on improving container citrus tree growth and propagation efficiency. 72 trees of the common 'Carrizo' citrange rootstock with and without 'Clementine Mandarin' scion were placed in growth chambers under four photoperiod treatments: T1, 10 h LED with low supplemental light extension of day length (EoD-10); T2, 10 h LED with low supplemental night interruption (NI-10); T3, 10 h supplemental far red light; and T4, 10 h LED. Light spectrum of LEDs were adjusted to 90 Red and 10 Blue ratio. The trees were maintained in the growth chambers at 21/13 °C day/night temperatures and 80% RH for 12 weeks. The results showed that there were significantly higher leaf count and average shoot growth in NI-10 and EoD-10 than in 10 h LED in both budded and non-budded trees. Far red supplemental light treatment was able to increase significant shoot length in budded trees as compared to 10 h LED. The efficacy of low supplemental light intensities (10 μmol s^{-1}) below the light compensation point and the partitioning of dry weight between roots, stems, and leaves of trees in the different photoperiodic treatments indicated phytochrome-mediated control of growth in citrus trees.

28. Masters Student

PHYSIOLOGICAL RESPONSES OF GRAPEVINE TO SALT STRESS AND REMEDIATION BY $CASO_4$ AMENDMENTS IN CENTRAL VALLEY OF CALIFORNIA

Khushwinder Singh, Qun Sun and Luca Brillante

California State University Fresno

Contact: Khushwinder Singh, CSU Fresno, 2360 E Barstow Ave., Fresno CA 93740
559-720-7008; khushwindersingh@mail.fresnostate.edu

This project focuses on impact of salt stress on physical-chemical properties of soils and effects on grapevine physiology. The project will evaluate best practices for reclamation of saline soils by $CaSO_4$ in the San Joaquin Valley of California, SJV, and beneficial effects on wine grape production. Accumulation of salt harms the physical properties of soils causing swelling of clays, destruction of soil structure, reduction in infiltration and water holding capacity. This leads to reduced availability of water and oxygen to roots which affects grapevine physiology and performances. In wine grapes moderate water stress can improve grape composition but the salt stress has no positive effects on yield and quality. The problem of saline soils in SJV, is exacerbated by the use of saline water for irrigation leading to a major loss in crop production which cannot be compensated and represent an economical cost to the grower.
Alleviation of salt related problems is a crucial factor in the valley especially in areas where the irrigation water is saline. This can be done by decreasing the amount of Na^+ ions, causing the destruction of soil structure, and replacement by Ca^{2+} ions. For this purpose the soil can be treated with $CaSO_4$. This project will evaluate different forms (anhydrite, $CaSO_4$ and gypsum, $CaSO_4 \cdot 2H_2O$) and dosages of $CaSO_4$, in synergy with organic matter (compost). Effects of reclamation on grapevine water status and fruit composition will be thoroughly evaluated. Currently, we have conducted a preliminary assessment of conditions on grapevine status and soil in the Bakersfield area, and treatments have been applied in winter 2019. First effects will be measured in the 2020 season.

29. Masters Student

RESPONSE OF ALFALFA VARIETIES TO SALINE, SUB-SURFACE DRIP IRRIGATION: UNIFORMITY OF SOIL SALINITY IMPOSED AND DRY MATTER YIELD

Simarjeet Singh[1], Daniel H. Putnam[2], Robert B. Hutmacher[2], Isaya Kisekka[2], Aaron Anderson[2], Sharon E. Benes[1].

[1]California State University, Fresno; [2]University of California, Davis.

Contact: Simarjeet Singh, CSU Fresno; 2415 E. San Ramon Ave., Fresno, CA 93740-8033
559-326-9713; simar_maan@mail.fresnostate.edu

Increasing water scarcity along with frequent drought events in California encourages the use of saline water for irrigation, especially for forages and row crops. Alfalfa (*Medicago sativa*) is the most-valued forage for dairy production in California because of its high yields and protein content. Recent evaluations under greenhouse and field conditions by our group and others suggest that improved varieties of alfalfa are much more salt tolerant than the established salinity tolerance guidelines (2 dS/m ECe) indicate. Thirty-five varieties, including new salt-tolerant materials, AZ salt-sensitive and salt-tolerant controls and CUF-101 as a public control, are being tested in a three-year field trial in a clay loam soil, under saline, sub-surface drip irrigation. The two irrigation water treatments (high saline (HS) = 7-10 dS/m and low saline (LS) = 1.0 – 1.2 dS/m EC_w) are replicated four times and arranged in a split-plot design with variety as the sub-plot factor. Acclima TDR-305H soil moisture probes are used to monitor volumetric water content and pore water conductivity. Soil sampling (0-180 cm in 30 cm increments) is conducted in late spring and fall to determine the salinity imposed. Spatial variability in soil salinity is being assessed among variety plots and as a function of lateral distance from the drip line using an Eijkelkamp four-electrode, direct EC soil probe. ECa readings will be calibrated to ECe by soil sampling in selected areas. Direct EC probe readings will also be compared to EM-38 electromagnetic sensor surveys to assess the degree of similarity between these two instruments for detecting spatial variability in soil properties in small plot variety trials.

30. Masters Student

EFFECTS OF SHADE AND MOISTURE ON PRE-EMERGENT HERBICIDES ON THE CONTROL OF GLYPHOSATE-RESISTANT JUNGLERICE (*ECHINOCHLOA COLONA*)

Katrina Maria C. Steinhauer and Anil Shrestha

California State University, Fresno

Contact: Katrina Steinhauer, CSU Fresno, 2415 E. San Ramon,
Fresno, CA 93740-8033 M/S AS72
559-999-7264; kmsteinhauer@yahoo.com

Junglerice (*Echinochloa colona*) is a problematic weed throughout the world. In recent years, it has become more problematic in California because of glyphosate-resistant (GR) populations. Alternative herbicides, such as glufosinate and sethoxydim, are being used for control of these populations. However, the efficacy of these herbicides is inconsistent in orchards because of shade from the trees and soil moisture levels. Therefore, the effect of shade and soil moisture level on efficacy of glufosinate and sethoxydim were evaluated. Three shade levels (0%, 50%, 70%) and two irrigation levels [50% and 100% of Field Capacity (FC)] were tested in 2016 and 2017. Potted GR junglerice plants were placed in tents made from shade cloths and irrigated according to the FC levels. Plants were sprayed with labeled rates of the herbicides after the first tiller and placed back in the treatment conditions. After 28 days, the plants were harvested and mortality, biomass, and seed production data were recorded. Temperature differences between the two years affected the treatments. In the cooler year (2016), plant mortality was greater in the 70% than in the 50% or 0% shade treatment while irrigation had no effect. Glufosinate provided best control (81%) of the plants in the 0% shade whereas, sethoxydim provided best control (94%) in the 70% shade treatment. In the warmer year (2017), both shade and irrigation level affected herbicide performance. Plant mortality with glufosinate was greatest (100%) in the 50% shade at both 50% and 100% FC. Control with sethoxydim was greatest (75%) at 50% FC but inconsistent in the other treatment combinations. Therefore, environmental conditions could have a major effect on the efficacy of glufosinate and sethoxydim on jungelrice.

31. Masters Student

DEVELOPMENT OF A DNA EXTRACTION METHOD FROM EPIDEMIOLOGICALLY MEANINGFUL AMOUNTS OF SOIL FOR QUANTIFICATION OF NEMATODES USING QUANTITATIVE PCR

Mala To[1], Andreas Westphal[2], Jacob A. Wenger[1] and Margaret L. Ellis[1]

[1]California State University, Fresno, [2]University of California Riverside, Kearney Agricultural Research and Extension Center, Parlier

Contact: Mala To, CSU Fresno, 2415 E. San Ramon, M/S 72, Fresno, CA 93740-8033
559-579-3794; frenostate@mail.fresnostate.edu

Almonds are one of the most profitable crops in California. In 2017, the production had trippled from 703 million pounds in 2000 to 2.27 billion pounds. Despite the significant increases in almond yields, growers continually face challenges from several soil-borne pathogens. *Pratylenchus vulnus,* or the walnut root lesion nematode, is currently a pest of great concern for California almond orchards. The traditional methods currently available for nematode extraction involve extracting nematodes from soil and identifying them morphologically under a microscope. This process is tedious and time-consuming, even for trained professionals, and has variable extraction efficacies for different nematode species. Molecular technologies could provide a quick and accurate alternative to the microscopic identification and quantification methods. This study aimed at developing such methods for *P. vulnus* from soil samples. DNA primers were designed and verified to be species-specific for *P. vulnus*. A qPCR protocol was optimized and a standard curve was developed using DNA amounts of *P. vulnus* obtained from nematode carrot disk cultures. The next step will be optimizing DNA extraction protocols from soil samples, using U.S. commercially available soil DNA extraction kits. The acquired DNA will be used in qPCR, and results will be compared with the previously developed standard curve. In this exercise, relation of DNA amount and infective *P. vulnus* will be determined. In summary, the project is aimed at developing a test that could be easily used across public and private laboratories. Such efforts will provide almond growers meaningful and economically necessary information for their improved soil management decisions.

32. Masters Student

RESIDUE INCORPORATION AND SOIL WATER CONTENT EFFECTS ON NITROGEN MINERALIZATION

Suzette Turner and Daniel Geisseler

University of California, Davis

Contact: Suzette Turner, UC Davis, 1 Shields Ave, Davis, CA 95616
916-513-1151, snturner@ucdavis.edu

Available nitrogen is frequently the limiting nutrient in agricultural systems but can be a pollutant when applied in excess of crop demand. For that reason, nitrogen cycling is of great concern to producers and scientists alike. This study investigates how soil water content and the moisture content of incorporated tomato vine residues affect nitrogen mineralization in a twelve-week incubation. During the first week, residue incorporation resulted in nitrogen immobilization. Residue moisture content had a short-term effect on available nitrogen during the first three weeks of incubation. Soil water content had a strong long-term effect on available nitrogen, with field capacity resulting in the greatest mineralization rate by the end of twelve weeks. Soils maintained at permanent wilting point also mineralized nitrogen, however at a much lower rate. This result suggests that even in the dry topsoil of subsurface drip irrigated fields, incorporated residues are being decomposed. Nitrogen availability from crop residues is being further explored by several continuing studies including in an incubation of eleven Central Valley soils examining nitrogen mineralization at different soil moisture contents and in a field-trial incorporating eight various crop residues and monitoring the top two feet for effects on available nitrogen. The results from these experiments will be used to improve upon a nitrogen budgeting calculator that is available for growers to use in order to estimate soil nitrogen availability in their fields.

33. Masters Student

THE "HIDDEN HALF" - USE OF GROUND PENETRATING RADAR IN ASSESSING TREE ROOT ARCHITECTURE

Vizcarra, A., Yeasmin, D., Bushoven J.T. and Krauter, C.

California State University Fresno

Contact: Allen Vizcarra, CSU Fresno, 2415 E. San Ramon, Fresno, CA 93740-8033
559-278-2861; allenviz8@mail.fresnostate.edu

Tree roots are responsible for anchorage, acquisition of nutrients and water, and thus have an important role in crop yield. The objective of this research was to better understand existing tree root architecture, and that in response to irrigation, fertility etc. More traditional methods such as trench or pit excavation are destructive and costly. Thus there is a need for a more non-traditional and cost-effective approach. Ground Penetrating Radar (GPR) has recently been recognized as a potential technology for non-destructive root detection and modeling. In this study attempts to validate GPR data with direct visual assessment post-excavation in both landscape and orchard tree roots were conducted over a period of several years. Preliminary results suggest that GPR can indeed be a reliable technology to estimate root architecture with relatively small, and field-relevant, margins of error. These results have significant potential towards furthering our efforts to develop, and maintain healthy root systems in perennial woody crops, and will be presented.

34. Masters Student

REINTEGRATING ANIMALS INTO VEGETABLE CROPPING SYSTEMS: SHEEP GRAZING IMPACTS ON C AND N POOLS

Sequoia R. Williams, Nicole Tautges, Israel Herrera, Kate Scow and Amélie C.M. Gaudin

University of California, Davis

Contact: Sequoia Williams, UC Davis, 1 Shields Ave, Davis, CA 95616
510-778-0755; srwilliams@ucdavis.edu

Agricultural intensification has led to the specialization of agricultural systems in California and animal and crop production systems are no longer integrated. Re-integrating animals into cropland in integrated crop-livestock systems (ICLS) could provide an opportunity to increase land-use efficiency, add forage value to winter cover crops and use ecosystem services provided by animals to enhance nutrient use efficiency. Grazing can impact C and N cycling profoundly by altering C inputs and converting plant nutrients into animal waste with a lower C:N ratio that is more readily mineralizable and accessible to the crop and soil microbes. However, if grazing is too intense, the N leaching potential of the system could be increased. Using an organic sheep-tomato ICLS replicated trial at Russell Ranch Sustainable Agriculture Facility, soil C and N pools and N leaching rates are being compared across fallow, tilled cover crop, and grazed cover crop treatments. Soil inorganic nitrogen (SIN) levels and N in the following tomato crop will be used to calculate apparent nitrogen use efficiency. Preliminary results, 1 month post-grazing, showed trends toward higher microbial biomass carbon (MBC) in the tilled and grazed treatments compared to the fallow. In particular, the grazed treatment at 15-30cm depth, had a higher MBC and lower SIN than the other two treatments, suggesting grazing may tie up inorganic N in microbial biomass at deeper depths, potentially preventing leaching.

35. Masters Student

EFFECTS OF COMPOST APPLICATION ON SOIL CARBON AND GREENHOUSE GAS EMISSIONS IN WINE GRAPE PRODUCTION

Tsz Fai Wong[1], Jenna Janz Merrilees[1], Craig Stubler[1], Cristina Lazcano[1,2], Charlotte Decock[1]

[1]California Polytechnic State University, San Luis Obispo; [2]University of California, Davis

Contact: Tsz Fai (Connie) Wong, California Polytechnic State University, San Luis Obispo, 1 Grand Avenue, San Luis Obispo, CA 93407
805-620-8767; twong88@calpoly.edu

Compost is commonly used as an organic amendment in cropping systems such as vineyards, and has been shown to be beneficial to carbon (C) sequestration and soil health improvement. As perennial crops, grapevines have a larger potential for carbon (C) sequestration than most crops. Yet, there is a lack of clear correlation between compost application rate, the magnitude of C sequestration, and its environmental tradeoff in the form of greenhouse gas (GHG) emissions. In this study, we investigated the effects of compost application rate on soil C sequestration and GHG emissions at J. Lohr Vineyards and Wines, Paso Robles, CA. The effects of four compost application rates (0, 2, 4 and 6 tons $acre^{-1}$ $year^{-1}$) on total soil C at depths of 0-6" and 6-12" of two functional locations (tractor row and vine row) was assessed, as well as cumulative and management-induced GHG emissions. Compost treatments were applied to the entire plot area between harvest and first precipitation event in fall. We hypothesized that soil C sequestration would increase with increasing compost application rates. We also expected that no significant difference in GHG emissions would be observed between compost application rates. Soil depth and location on the vineyard floor had the most influence on total and active C, while the effect of compost application rates was not significant. Our results corroborated the hypothesis that compost application rates would not affect GHG emissions. The lack of effect of compost application rates on C sequestration is likely due to the relatively low compost application rates. Long-term observations will be required to track any changes of total soil C.

36. Masters Student

THE EFFECT OF COVER CROPS ON SOIL HEALTH AND FE AVAILABILITY IN ORGANIC PEARS

Juliana Wu, Rachel Elkins and Astrid Volder

University of California, Davis

Contact: Juliana Wu, UC Davis, 1 Shields Ave, Davis, CA 95616
415-680-8268; jliwu@ucdavis.edu

The incorporation of cover crop mixes in organic orchard production can increase the sustainability and carbon sequestration potential of agricultural systems in order to address climate change. We initiated a field study March 2018 in Kelseyville, CA with cereal-legume cover crop mixes in an organic pear orchard and our objectives were to (i) elucidate changes in iron Fe cycling, (ii) determine pear root growth response, and (iii) quantify changes in soil health parameters. In year 1, the cover crop treatments resulted in significant decreases in soil pH and increased Fe availability compared to the mechanically managed control, however after cover crop termination there was no longer a significant effect on pH but the effect on soil Fe persisted. In year 2, the cover crop treatment resulted in significant increases in soil pH, however there were significant increases in Fe availability which may suggest other mechanisms for changes in Fe cycling. The increases in soil Fe did not result in significant increases in pear leaf Fe or decreases in pear leaf chlorosis for both years. These findings suggest that cereal-legume cover crops can be utilized as a sustainable management practice to increase soil Fe availability in orchards susceptible to iron chlorosis but further research is required to better understand the mechanism and Fe-uptake in organic orchard systems.

37. PhD Student

AGROECOLOGICAL AND SOIL HEALTH IMPACTS OF SHEEP-INTEGRATION INTO CALIFORNIA COASTAL VINEYARD SYSTEMS

Kelsey M. Brewer and Amélie C.M. Gaudin

University of California, Davis

Contact: Kelsey M. Brewer, UC Davis, 1 Shields Ave, Davis, CA 95616
530-601-8870; kmbrewer@ucdavis.edu

Integrated sheep-vineyard systems (ISVS) utilize sheep to graze resident vegetation and/or cover crops and facilitate the provision of ecosystem services for vineyard production. However, knowledge of carbon sequestration and soil health impacts from livestock integration into perennial cropping systems remain unclear. We are currently conducting a three-year ISVS monitoring program, assessing agroecological and soil health shifts from sheep integration into a previously unintegrated vineyard cropping system. Our project examines grazer-induced shifts in understory vegetation composition, biomass accumulation, and plant root development. We are further exploring downstream effects on soil microbial composition and functions related to energy (carbon) and nutrient cycling and storage. Specifically, we are interested in whether sheep integration modifies plant-associated soil microbial communities, soil nutrient status, and soil aggregation and structure, and whether observed alterations in soil ecology translate to additional soil carbon storage. Preliminary data from a survey study conducted at three long-term (10+ years) ISVS sites found that soil carbon stocks were significantly higher at multiple ISVS plots for each depth zone (0-15 cm, 15-30 cm, and 30-45 cm). Microbial biomass was also significantly higher at shallow depths (0-15 cm) and showed enrichment in multiple distinct functional groups related to plant productivity and soil carbon and nutrient cycling. Grazed plots had higher bioavailable-P, despite lower phosphorous cycling enzyme activity. NH_4^+ and NO_3^- were both higher in grazed plots, as was nitrogen cycling enzyme activity. These results support that ISVS has substantial potential to increase soil C storage and improve important ecosystem synergies, such as microbial functioning and biogeochemical cycling. Our current study aims to confirm these findings, further exploring underlying mechanisms responsible for observed shifts in agroecosystem dynamics.

38. PhD Student

VARIABILITY OF DYNAMIC SOIL HEALTH INDICATORS

Patricia Lazicki and Daniel Geisseler

University of California, Davis

Contact: Patricia Lazicki, UC Davis, 1 Shields Ave, Davis, CA 95616
626-298-9066; palazicki@ucdavis.edu

To choose or incentivize practices that build healthy soils, growers and policymakers need indicators that can reliably show whether improvements in soil health have occurred. A useful indicator for monitoring soil health over time must be sensitive enough to respond quickly to management changes. However, it should not be overly influenced by variations in sampling time or location, previous crop, or normal year-to-year differences in weather or operations timing. In this experiment, we assess the sensitivity and variability of a suite of dynamic soil health indicators at the Russell Ranch long-term agricultural research facility over two years. These plots have been either conventionally or organically farmed in a corn-tomato rotation for 25 years and were expected to have developed strong, stable differences between management systems. We took samples in both corn and tomato crops prior to planting and at flowering. Indicators relating to soil biology and carbon accumulation differed between sampling years, but showed highly significant management-based differences which were consistent across year. Physical and chemical measures tended to be more influenced than the biological indicators by non-management related factors such as previous crop or soil type. All indicator values tended to be affected by in-season sampling date but the differences were normally small compared to management effects. Our results demonstrate that in these systems analyses relating to soil biology and organic C are the most robust indicators of soil health improvement.

39. PhD Student

SOIL HEALTH TARGETS AND ECOSYSTEM SERVICE POTENTIAL IN CALIFORNIA ALMOND ORCHARDS

Krista Marshall[1], Katherine Jarvis-Shean[2], Amanda Hodson[1], Timothy Bowles[3], Jorge Rodrigues[1] and Amélie C.M. Gaudin[1]

[1]University of California, Davis; [2]University of California Cooperative Extension; [3]University of California, Berkley

Contact: Krista Marshall, UC Davis, 1 Shields Ave, Davis, CA 95616
952-200-6219; knmarshall@ucdavis.edu

Soil health building practices are gaining popularity across California cropping systems as a means to improve the sustainability of crop productions whilst maintaining productivity. The services provided by a healthy, living soil can also help address management challenges such as salinity, water use inefficiencies, and soil-borne pests and diseases. However, much of the potential benefits of building soil health for orchard systems as well as the environment remain elusive and largely untapped. We used a survey-style approach to quantify 7 soil services in 13 orchards spanning a gradient of soil management practices – from bare soils to winter cover crops and pasture understories grazed by livestock. Principal component analyses (PCA) suggest that systems using organic amendments alone were not differentiating from orchards with bare soils. Winter cover crops or continuous cover crops lead to a positive shift in soil physical properties such as wet aggregate stability and available water holding capacity. The distinct clustering of continuous cover crops versus winter cover crops indicated the importance of continuous living roots for improving soil health indicators. Livestock grazing of continuous pasture understories positively shifted soil health indicators related to C and N cycling, soil micronutrients, and microbial communities. Cluster analyses and multivariate statistical modeling will be used to further explore the potential benefits and tradeoffs of soil health building practices for the provision of soil services in California orchard systems.

40. PhD Student

NITROGEN CYCLING DYNAMICS IN THE SHALLOW VADOSE ZONE UNDER VARYING AGRICULTURAL MANAGED AQUIFER RECHARGE PRACTICES

Nicholas Murphy, Hannah Waterhouse, Seanna McLaughlin and Helen E. Dahlke

University of California, Davis

Contact: Nicholas Murphy, UC Davis, 1 Shields Ave, Davis, CA 95616
207-230-4626; npmurphy@ucdavis.edu

Agricultural managed aquifer recharge (AgMAR) has emerged as a promising groundwater replenishment opportunity in California; AgMAR is a form of managed aquifer recharge where farmland is flooded during the winter using excess surface water in order to recharge the underlying groundwater. However, questions remain as to how AgMAR could be implemented on fertilized agricultural fields such that nitrate leaching from the root zone is minimized. Specifically, we are interested in estimating how timing and duration of recharge events affect percolation rates, nitrate leaching and mineralization/ denitrification processes in different soil systems within the Central Valley. To investigate this question we conducted laboratory and field experiments on two contrasting soil types (sandy soil, fine sandy loam) measuring nitrogen species (NO_3^-, NH_4^+, N_2O, DON), total organic carbon, dissolved oxygen, moisture content and EC during recharge events. Using a mass balance approach in soil column experiments, nitrogen mineralization dynamics were quantified, and their relative impact examined as a function of time elapsed between flooding applications for recharge. When flooding applications take place at long intervals (every 1-2 weeks), organic nitrogen mineralization potential increases and we see significant quantities of nitrate leached from both soil types (137% and 145% of initial residual nitrate). Models using mineralization incubations (0.5-4.0 mg N kg^{-1} wk^{-1} for fine sand and 1.0-3.4 mg N kg^{-1} wk^{-1} for sandy loam) and water-content-dependent scaling factors support the laboratory mass balance results, accurately constraining mineralization fluxes. Decreasing the time interval between flooding applications to 72 hrs leads to less potential mineralization, and increases potential denitrification. Together these results will allow developing best management practices for the joint use of agricultural lands for groundwater recharge and crop production.

41. PhD Student

TOWARD QUANTIFYING IF MANAGEMENT-INDUCED SHIFTS IN SOIL PHYSICOCHEMICAL PROPERTIES ENHANCE RESILIENCE TO DEFICIT IRRIGATION IN PROCESSING TOMATO

Leah L.R. Renwick[1], Rebekah Velasco[1], Margaret Lloyd[2], Anna Azimi[1], Scott Park[3] and Amélie C.M. Gaudin[1]

[1]University of California, Davis; [2]University of California Cooperative Extension, Woodland; [3]Park Farming, Meridian

Contact: Leah Renwick, UC Davis, 1 Shields Ave, Davis, CA 95616
209-768-7361; llrenwick@ucdavis.edu

The recent California drought decreased irrigation allocations to tomato growers, driving demand for integrated irrigation strategies that lower water inputs without reductions in fruit yield and quality. Prior research found that moderate deficit irrigation minimally impacts yield and quality, through cultivar traits. Could building soil health further enhance tomato resilience to deficit irrigation?

We assessed the effect of early irrigation cutoff (45 versus 30 days preharvest) on tomato yield and quality, agronomic water use efficiency, plant water status, and root length density during 1 season at 2 furrow-irrigated on-farm sites differing in long-term management (organic or conventional). The organic site (clay loam) had lower soil bulk density and higher soil organic matter, saturated hydraulic conductivity, and gravimetric water content at harvest than the conventional site (loam), regardless of irrigation treatment. We did not detect effects of irrigation treatment or site on root length density or plant water stress, or of irrigation treatment on fruit quality at either site. Yield differences between irrigation treatments and sites were practically relevant but not statistically significant, with smaller yield reduction due to deficit irrigation at the organic site (3.8 t ha^{-1}) than at the conventional site (9.4 t ha^{-1}).

We show preliminary evidence that management-sensitive soil physicochemical properties (e.g. saturated hydraulic conductivity) are associated with higher soil water content and smaller tomato yield reduction from deficit irrigation. Our study is an early step toward quantifying how and to what extent shifts in specific soil properties can enhance tomato resilience to deficit irrigation. Future multi-site research with wider ranges of irrigation inputs will advance understanding of how soil health can help a prominent California annual cropping system cope with drought.

42. PhD Student

UAV-BASED REMOTE SENSING TO ASSESS THE EFFECT OF IRRIGATION MANAGEMENT ON LANDSCAPE PLANT HEALTH

Anish Sapkota and Amir Haghverdi

University of California, Riverside

Contact: Anish Sapkota, UC Riverside, 900 University Ave., Riverside, CA 92521
asapk001@ucr.edu

The development of water conservation strategies for urban landscape species is crucial as they are the largest residential water users in the southwest United States. The objective of this study is to assess the efficacy of unmanned aerial vehicle (UAV) based remote sensing to detect the effect of irrigation management on plant health and growth of different landscape species. The research field was established in early 2019 with twelve different landscape species and four irrigation frequencies (7, 5, 4, and 3 days per week irrigation cycles) replicated three times in a randomized complete block design. Irrigation was scheduled autonomously by two evapotranspiration-based smart controllers to fulfill 100% of reference evapotranspiration for all the treatments and species. Normalized difference vegetation index (NDVI) was used as an index to quantify the growth and health of different landscape species. The NDVI was measured using handheld and UAV-mounted sensors. The preliminary results showed that the effect of irrigation frequency on NDVI was not significant ($p>0.05$). Vegetation index was significantly different ($p<0.05$) between species. *Lonicera japonica* was found to grow fast and had the highest average NDVI values (0.74 to 0.81), whereas *Frankenia thymifolia* did not grow well in its establishment year and had the least NDVI values (0.16 to 0.31). The data obtained from the UAVs and handheld sensors indicated a strong correlation (r^2 = 81 to 97%, $p<0.001$). Preliminary results showed that UAVs have the potential to measure plant health over time and space by replacing labor-intensive and time-consuming handheld sensors. Further studies with multiple deficit irrigation treatments and measurement of plant physiologic parameters like stomatal conductance, leaf area index, and leaf water potential is in progress.

43. PhD Student

LONG-TERM APPLICATION OF BIOSOLIDS INCREASES SOIL CARBON IN AGRICULTURAL SOILS

Yocelyn Villa[1] and Rebecca Ryals[2]

University of California, Merced

Contact: Yocelyn Villa, UC Merced, 5200 N Lake Rd., Merced, CA 95343
951-464-6790, yvilla3@ucmerced.edu

Biosolids are the nutrient-rich organic residues from wastewater treatment, are a large organic waste stream to landfills. Currently, only about half of the biosolids produced is land applied and approximately 94,000 Mg of biosolids are landfilled in California per year (calrecycle.gov). One potential beneficial reuse of biosolids as a soil amendment that supplies a large source of carbon (C) and nutrients to managed lands. Regional studies testing the effects of biosolids application on soil carbon sequestration are lacking and thus limit the ability to inform the management and reuse of biosolids. The objective of this study was to quantify changes in C and N storage in rangeland soils across California that have received long-term (>20 years) application of biosolids. We approached this objective by comparing the size and characteristics of C pools at three rangelands, Sacramento, Solano, and Merced, each ranch has different soil types and management practices. This fractionation method will determine what C is readily available for microbes to mineralize and what C is protected from decomposition. Results so far show that total C concentrations is higher in soils that have been treated with Biosolids for twenty years compared to the unamended controls. It is estimated that an increase of 7 Mg C/ha in the Sacramento ranch and an increase of 10 Mg C/ha in the Solano ranch have been added through long-term biosolids application. No change was observed in the Merced ranch. The implications of this research is that the reuse of biosolids for land application can contribute to climate change mitigation by reducing greenhouse gases that are attributed to the use of synthetic fertilizers and landfill disposal.

44. Professionals

NITROGEN FERTILITY AND REMOVAL IN SAN JOAQUIN VALLEY CORN AND WHEAT SILAGE ROTATIONS

Jorge Angeles, Nicholas Clark, Bob Hutmacher and Till Angermann

California Cooperative Extension Tulare & Kings County, West Side Research and Extension Center

Contact: Jorge Angeles, UCCE Tulare & Kings County
559-940-8549; jaangeles@ucdavis.edu

Ground water quality is negatively impacted by inefficient agricultural applications of Nitrogen (N) fertilizer and manure in the San Joaquin Valley. The Revised Dairy General Order of 2013 mandates for N to be monitored in crop fields receiving manure or process waste water, to not exceed 1.4 times the N removed in harvested plant parts. The Central Valley Dairy Representative Monitoring Program (CVDRMP) was started to monitor and report the impacts of irrigation water and N inputs on groundwater quality. The main focus of the program is on the breadth of environmental and management practice variables representative of SJV dairies. A study was conducted in 2017-19 at a heifer ranch located in the Tulare, CA to examine the seasonal N accumulation and soil mineral N content of a silage corn and wheat rotation. The three treatments were Manure Only, Manure & synthetic fertilizer and a zero supplemental N control treatment. In the summer of 2017, silage corn was planted and it was rotated with wheat in the winter. N tisuse and soil accumulation were monitored by taking plant tissue, soil and irrigation water samples at different crop growth stages for both crops. Environmental N loss was not measured in this multiyear study. This study is a continuation of a multi year study with the addition of tissue and soil N accumulation for both corn and wheat silage crop grown in 2017-2019.

45. Professionals

ASSESSMENT OF THE ACCURACY AND PRECISION OF SOIL CHEMICAL ANALYSIS PERFORMED BY EIGHT COMMERCIAL LABORATORIES

Andre Biscaro, Robert Miller, Dirk Holstege, Steve Orloff, Tim Hartz and Eryn Wingate

University of California Cooperative Extension, Ventura County

Contact: Andre Biscaro, UCCE Ventura, 669 County Square Drive, Suite 100, Ventura, CA 93003
805-645-1465; asbiscaro@ucanr.edu

An accurate soil chemical analysis is the cornerstone of an effective nutrient management program. Without a reliable soil test result, significant mistakes in fertilization programs can occur, which can dramatically affect profitability and can potentially have negative environmental consequences. Despite the large number of analytical commercial laboratories that exist in California, there is no public data reporting on lab accuracy and there isn't a true certification program in the United States. Although a lab may participate in a proficiency program called the North American Proficiency Testing (NAPT), or the Agricultural Laboratory Proficiency Program (ALP), these programs are not mandatory and they do not guarantee quality control. Therefore, laboratories are chosen based on "word of mouth", personal preference and or price. Because of the absence of data, growers, farm managers, consultants, environmentalists and even researchers are left without a reliable means by which to select a testing laboratory. A project was initiated in Ventura, CA to assess the accuracy and precision of eight commonly used commercial ag-laboratories. Four standard reference soils were submitted on three dates over six months for soil pH, ECe, NO_3-N, P, K micronutrients and CEC analysis. Results indicated significant variability between commercial laboratories for NO_3-N and ECe for three of the four soils evaluated. Temporal variability was noted for NO_3-N, ECe and P. Inter-lab results for soil K and micronutrients were consistent for most labs. Results will be discussed and guidance provided to the agriculture industry in California for selecting a commercial testing laboratory. Overall, three labs were consistently accurate and precise, while two labs were consistently inaccurate and imprecise.

46. Professionals

EXPLOITING GENOTYPE, MANAGEMENT, ENVIRONMENT, AND THEIR INTERACTIONS TO ENHANCE FAVA BEAN PRODUCTION

Kyle Brasier and Hossein Zakeri

California State University Chico

Contact: Kyle Brasier, Holt Hall Room 381, 400 West 1st Street, Chico, CA 95929
517-375-0625; kgbrasier@csuchico.edu

The production of winter fava bean (*Vicia faba* L.) pods harvested at horticultural maturity for fresh pods offers an incredible opportunity to improve grower profitability, nourish regional communities, and building soil health in the Central Valley of California. Ongoing research at California State University – Chico aims to enhance the potential of fresh fava bean production by exploring genotypic variation for biological nitrogen fixation and horticultural traits, crop management schemes, and cultivar performance over several diverse site-seasons. Our program is currently involved in 13 fava bean experiments that provide educational opportunities for 15 undergraduate and graduate students and rely on collaborative efforts with four regional growers, five USDA partners, and faculty at five universities. This poster outlines the ongoing experimental objectives while student led fava bean experiments at California State University are presented in detail at this conference.

47. Professionals

MATURATION DATES OF WARM SEASON COVER CROP SPECIES

Valerie Bullard and Margaret Smither-Kopperl

USDA-Natural Resources Conservation Service, Lockeford Plant Materials Center

Contact: Valerie Bullard, USDA-NRCS, 21001 N. Elliott Rd., P.O. Box 68,
Lockeford, CA 95237
209-867-3101; valerie.bullard@usda.gov

Warm season cover crops (WSCC) are widely grown in the U.S., but rarely used in California because they require some irrigation for establishment in the hot, dry summers of the Mediterranean climate. WSCC can provide benefits of improved soil quality, enhanced nutrients, increased water holding capacity, and competitive suppression of weeds. Planted in late summer or early fall, WSCC protect the soil from erosion prior to the first fall rainstorms. Depending on selected species, WSCC may also contribute or retain nitrogen, while suppressing fall weeds and breaking pest cycles. Barriers to implementation of cool season cover crops into annual cropping systems include termination and residue concerns prior to planting the cash crop. WSCC avoid this problem since they winterkill with cold temperatures, leaving residue to prevent erosion in the fall. This residue will break down over the winter and enable early planting in the spring. When selecting a suitable cover crop, understanding the time to maturation (here defined as 50% bloom), is critical as the plant(s) selected must mature fast enough to provide suitable biomass, while not producing seed that could lead to future weed problems. The purpose of this trial was to evaluate WSCC adaptation to California's Central Valley and determine the time of maturation with minimal irrigation. This summary includes two years of evaluations at the Lockeford Plant Materials Center. Most of the species and cultivars evaluated in this trial performed well in the Central Valley. WSCC drought tolerance, ability to winterkill in the fall, and range in maturity dates suggest potential for WSCC incorporation into many California cropping systems.

48. Professionals

CARBON DIOXIDE AND NITROUS OXIDE EMISSIONS FOLLOWING WHOLE ORCHARD RECYCLING

Diana Camarena, Julio Perez, Robert Shenk, Aileen Hendratna, Mae Culumber, Amisha Poret-Peterson, Brent Holtz and Suduan Gao

USDA-ARS, San Joaquin Valley Agricultural Sciences Center

Contact: Suduan Gao, USDA, 9611 S. Riverbend Ave., Clovis, CA 93619
559-596-2870; suduan.gao@usda.gov

Whole orchard recycling (WOR) has shown several benefits such as increased soil organic carbon and nutrients, improved soil physical properties, and improved soil health by enhancing microbial activity. However, the impact on greenhouse gas emissions is not well understood. The aim of this research was to collect field data on carbon dioxide (CO_2) and nitrous oxide (N_2O) emissions from one time high rate of woodchip incorporation into the surface soil of an orchard. Emissions of CO_2 and N_2O were measured in woodchip incorporated and control (no woodchip) plots since April 2018 through 2019. Carbon dioxide emission fluxes were more than two times higher in woodchip plots than the control in first year and the differences in the second year were much reduced. Estimated C loss from CO_2 emissions was about one third of incorporated during the first two years. Nitrous oxide emissions spiked following each fertilizer application with much higher peaks from woodchip plots than the control. The N_2O emissions were consistently higher in woodchip plots than the control. The N_2O emission rates were several times higher during the first year than those from the second year in woodchip plots suggesting strong correlation with woodchip decomposition. Data suggest that woodchip decomposition decreases significantly with time and this impacts N_2O emissions. This research continues to investigate the relationship between woodchip incorporation and long-term effects on soil C and N dynamics in the efforts to develop effective management strategies.

49. Professionals

PERFORMANCE OF CYCLANILIPROLE AGAINST LYGUS IN SAFFLOWER

Ben Halleck, Jorge Angeles and Nick Clark

University of California Cooperative Extension

Contact: Ben Halleck, UCCE Kings County, 680 Campus Drive, Suite A, Hanford, CA 93230
559-852-2730; bthalleck@ucdavis.edu

Safflower is an important rotational crop used in the southern San Joaquin Valley (SJV) of California. Safflower provides soil conditioning benefits that support production of higher yielding crops such as tomatoes and cotton. Safflower attracts many insect pest species which subsequently migrate to nearby crops and can be effectively used as a trap crop to manage pests. Pest control options are limited in safflower due its classification as a "minor use crop" (<300,000 ac) in the US with relatively few insecticides currently registered to safflower. A research program initiated by Southern SJV Safflower Working Group seeks effective solutions to highly migratory pests such as lygus bugs, stinkbugs, and beet leafhopper by using IPM decision making and area-wide approaches. The objective of this study was to evaluate the effects of the active ingredient, cyclaniliprole (Harvanta 50SL Insecticide), as a foliar spray for control of lygus on oleic type safflower as well as the degree of its phytotoxicity. This trial was conducted in a commercial field in the Tulare Lake region of the SJV of California between May and July of 2018 and 2019. The experimental design for the insecticide efficacy experiment was a one-way RBCD replicated five times. Four levels of the single factor, insecticide, were evaluated. Lygus populations were assessed by counting the number of lygus per 50 bug net sweeps. Each lygus sample was evaluated for the number of small nymphs, large nymphs, adults, and beneficial insects. Results showed that Harvanta is protective of beneficial insect populations compared to the Grower Standard treatment. Although Harvanta had efficacy against lygus nymphs, Harvanta did not show a significant difference on adult lygus populations compared to the untreated control.

50. Professionals

EFFECTS OF RAW AND COMPOSTED OLIVE POMACE ON PRODUCTIVITY AND SOIL HEALTH IN CALIFORNIA OLIVE GROVES

Hodson A.K., Milkereit J. and Archer L.

University of California, Davis

Contact: Amanda Hodson, UC Davis, 1 Shields Ave, Davis, CA 95616
530-752-3814, akhodson@ucdavis.edu

Olive pomace is the olive meat, seed and skin byproducts of olive oil production. Compost made from olive pomace could restore soil organic matter, increase soil health and reduce irrigation needs. Due to grower input, we are also examining the effects of raw, unprocessed olive pomace, since the current practice of using such agricultural byproducts for animal feed provides little value. This ongoing project assesses which amendments increase soil organic matter, drought resilience and soil health using a combination of field, greenhouse and laboratory experiments. In a 24 week laboratory incubation, none of the amendments mineralized significant nitrogen, but raw pomace did stimulate beneficial soil biology, such as bacterial and fungal feeding nematodes, which are involved in biologically-based nutrient cycling. In year one of field trials, some effects were seen on leaf micronutrients, although treatments did not affect yield. In trial 1, both compost blends and the raw pomace increased leaf phosphorus slightly to 0.2% compared to the grower standard of 0.18%. In trial 2, pomace caused leaf potassium to increase slightly to 1.3% compared to the grower standard, which was (1.1%), or either compost blend (1.1%). In greenhouse experiments, pomace also helped leaves retain water for longer when water was withheld.

51. Professionals

SOIL MICROBIAL COMMUNITY RESPONSES TO DEFICIT IRRIGATION SHIFT WITH ORGANIC AMENDMENTS

Nicole Leon, Daniel Curtis, Milt McGiffen, Muhammad Azeem and Lauren Hale

United States Department of Agriculture

Contact: Nicole Leon, USDA, 9611 S Riverbend Ave, Parlier, CA 93648
559-322-1392; nicole.leon@usda.gov

Turfgrass is valued because of its ability to serve as durable ground cover and its inexpensive cost; however, it often requires increased irrigation, which is a disadvantage in dry and arid environments. In this study, we amended turf soils with biochar, compost, and biosolids to promote turfgrass robustness under deficit irrigation. More specifically, we evaluated the microbial communities within the amended turf soils in order to reveal any compositional or functional shifts that may influence soil water retention. Amended and control field plots were seeded with turfgrass and treated with full (80%) or reduced (50%) irrigation based on turf evapotranspiration demands. Samples were collected 4 years after organic amendments were applied, when the turf plots had received 3 years of seasonal irrigation. Microbial communities were profiled using phospholipid fatty acid (PLFA) analysis and microbial activities associated with enhanced soil water holding capacity were evaluated by quantifying the soil extracellular polysaccharide (EPS) content and water stable aggregates. The results indicate variable impacts of the amendments, with the biosolid and compost treatments exhibiting the strongest influence on bacterial/archaeal community profiles and total soil biomass. The biosolid and compost treatments also showed an increased quantity of EPS and water stable aggregates. These findings insinuate the potential for organic amendments to shift microbial communities and their functions providing multifaceted impacts on soil water retention. The next step in this study is to conduct 16s rRNA gene sequencing to provide further insight into how microbial community composition shifted with the different amendments and irrigation treatments.

52. Professionals

COSTS AND RETURNS STUDIES FOR AGRICULTURAL CROPS

Jeremy Murdock, Donald Stewart and Daniel A. Sumner

University of California, Davis - Ag Issues Center

Contact: Donald Steward, UC Davis, 271 Quad Avenue, 209 Hunt Hall, Davis, CA. 95616
destewart@ucdavis.edu

Cost studies have been calculated and distributed by UC Cooperative Extension for years. The earliest cost studies archives go back to 1931 for walnuts grown in Stanislaus County. The studies report new information such as organic and conservation tillage production practices, new technology such as drip irrigation and GPS/GIS systems. Farmers, Ag support companies and Agricultural advisors provide the ARE staff person with production details, such as what operations are performed and what month they occur, materials used for cultural practices, such as seeds, pesticides, and fertilizers, and what, if any, custom services are hired, such as spraying and harvesting.

The narrative section of the study is compiled from the information gathered at the initial data collection meeting and is written in collaboration with the participating farm advisors. The finished study is posted on the department website for release to the public.

Clients for the studies have traditionally been, and still are, farmers and lending institutions. Bankers and other lenders consider the studies to be an accurate estimation of production costs and returns, provided by a neutral third party, and gauge a loan request using them. Over 45,000 cost studies are downloaded annually from the ARE website.

53. Professionals

IRRIGATION AND NITROGEN MANAGEMENT, TO IMPROVE ALMOND PRODUCTION WHILE MINIMIZING NITRATE LEACHING TO GROUNDWATER

Ouaknin Hanna, Patrick K. Nichols, Christine M. Stockert, Patrick H. Brown, David R. Smart and Thomas Harter

University of California, Davis

Contact: Ouaknin Hanna, UC Davis, 1 Shields Ave, Davis, CA 95616
530-746-1794; houaknin@ucdavis.edu

Offsite transport of reactive nitrogen (N) (e.g. NH_4^+, NO_3^-, NH_3, NOx and N_2O) from agriculture is facing increased regulatory scrutiny due to air and drinking water quality impacts. One of those is the Irrigated Lands Regulatory Program (ILRP), developed to assess, control, and regulate nitrate leaching from irrigated crops. To comply, growers must implement N management plans, improve N use efficiency, and reduce N leaching to groundwater. HFLC is an innovative management practice which applies N at each irrigation event of 10 lbs/acre (about 15 events compared to 60 lbs/acre in 3-6 events) yielding higher WUE and NUE, while potentially reducing nitrate leaching to groundwater in a variety of crops. However, commercial orchard scale implementation with direct measurements of resulting groundwater quality immediately underneath the orchard is lacking.
The project provides the first comprehensive assessment of groundwater nitrate impact from a best practice (HFLC) using three monitoring approaches to assess nitrate impact to groundwater: (1) Groundwater monitoring is the regulatory gold standard to assess pollution sources, but is expensive. (2) Vadose zone monitoring provides immediate feedback on potential groundwater nitrate discharge but can be labor-intensive. (3) The nitrogen balance is a tool familiar to growers under the ILRP but its relationship to actual groundwater nitrate discharge is poorly understood. This project demonstrates the link between these approaches.
groundwater nitrate concentrations where highly heterogeneous spatially but did not show temporal change over the first two growing seasons, on the other hand, the mass balance approach and the vadose zone monitoring show similar estimates of the fluxes out of the root zone, varying in the different sites in the orchard due to the high soil heterogeneity.

CONSTITUTION AND BY-LAWS OF THE CALIFORNIA CHAPTER OF THE AMERICAN SOCIETY OF AGRONOMY

ARTICLE I
NAME AND OBJECTIVES

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

Section 2. The California Chapter was founded in April 1971 with the objectives to be generally those of the American Society of Agronomy, Inc., an educational and scientific corporation qualified for exemption under Section 501 (c) (3) of the Internal Revenue Code of 1954, as amended or comparable section of subsequent legislation.

The California Chapter shall strive to promote human welfare through advancing the acquisition and dissemination of scientific knowledge concerning the nature, use, improvement, and interrelationships of plants, soils, and environment. To this end, the California Chapter, like its parent society, shall (1) promote effective research, (2) disseminate scientific information, (3) foster high standards of education, (4) strive to maintain high standards of ethics, (5) promote advancements in the profession, and (6) cooperate with other organizations having similar objectives.

The California Chapter supports the efforts and objectives of the Western Society of Soil Science and the Western Society of Crop Science and will operate in a manner consistent with their purpose.

ARTICLE II
MEMBERSHIP AND DUES

Section 1. The membership of the California Chapter of the American Society of Agronomy shall consist of individuals actively interested in the objectives of the Chapter as outlined in Article I.

Section 2. Any person as set forth in Section 1 may be a member of the California Chapter and be entitled to all the privileges of members. When holding an elective office in the California Chapter, members should also be a member of either the American Society of Agronomy, the Soil Science Society of America, or the Crop Science Society of America.

Section 3. Annual membership dues shall be set by the Executive Committee and shall be assessed and collected as provided for in the by-laws.

Section 4. Fees or dues associated with the operation of the California Chapter will be held to a minimum.

Section 5. Members in arrears for Chapter dues will be dropped from the rolls in accordance with the by-laws.

ARTICLE III
GOVERNING BOARD AND OFFICERS

Section 1. The governing board of the Chapter shall be constituted by an Executive Committee and a Council of Representatives.

Section 2. The Executive Committee shall consist of the Past President, President, First Vice President, Second Vice President, and Executive Secretary/Treasurer. The term of office with the exception of the Executive Secretary-Treasurer shall be for one year. The Executive Secretary-Treasurer may serve more than one year.

Section 3. The representation on the Executive Committee shall be split as evenly as possible between Industry, Higher Education, and Government groups, and evenly between the broad groupings of Soils and Crops. The objective would be that, if the President comes from the higher education grouping and is considered as Soils professional, the First Vice President should be a Crop professional from Industry. The normal order of progression would be President to Past President, First Vice President to President, Second Vice President to First Vice President, with the election of the Second Vice President coming from the Council Representatives. In the event that an Executive Secretary/Treasurer is invited to the Second Vice President role, the election of a new Executive Secretary/Treasurer will come from the Council of Representatives.

Section 4. The Council of Representatives shall consist of nine elected representatives, which broadly represent individuals from the following areas:

1. Agronomy and Range Science
2. Hydrologic Science & Biological & Agricultural Engineering
3. Soil Science
4. Agricultural, Horticulture & Forest Production
5. Nutrient Management
6. Plant Protection & Integrated Pest Management
7. Plant Breeding, Seed Production and Technology
8. Environmental Quality & Eco-Systems Restoration
9. Public Policy and Regulatory Agencies

Section 5. Each Council Representative will be elected to serve a three-year term. The terms will be staggered so that three Representatives will be elected each year. When a vacancy occurs on the Council because of death, resignation or other cause, appointment to fill the vacancy will be made by the Executive Committee and the appointee will serve until the next election.

Section 6. All Council Representatives and Members of the Executive Committee should be Members of the American Society of Agronomy, the Soil Science Society of America, or the Crop Science Society of America.

Section 7. The Council Representatives will be elected by the membership assembled at the time of the Annual Business Meeting. The Nominating Committee will be the Executive Committee. Additional nominations may be made from the floor at the Annual Business Meeting. Elections shall be by majority ballot of those in attendance and voting.

Section 8. The duties of the Past President, President, Vice-President, Second Vice-President and Executive Secretary-Treasurer shall be those which usually pertain to such offices of similar organizations. See Appendix A for a list of duties associated with each position.

Section 9. The President, with the approval of the Executive Committee, shall annually appoint such committees, their members and chairman, as they or the Executive Committee deems necessary to assist in carrying out the objectives of the Chapter.

ARTICLE IV
ANNUAL MEETING

The California Chapter of the American Society of Agronomy will hold an Annual Meeting at such time and place as shall be advantageous to the members. The Program Committee shall include both invitational and non-invitational presentations on subjects of wide interest to educators, scientists, farmers and those who serve agriculture. Emphasis will be on the application of scientific developments. Sectional meetings, special symposia, joint or cosponsored meetings with other groups may be arranged by the Executive Committee and may be held separately from or in conjunction with the Annual Meeting.

ARTICLE V
GENERAL PROVISIONS

Section 1. Contracts and Execution: Except as in these bylaws otherwise provided or restricted, the Governing Board may authorize any member or members, agent or agents to enter into any contract or execute and deliver any instrument in the name of and on behalf of the CALASA, and such authority may be general or confined to specific instances; and unless so authorized, no member or agent shall have any power or authority to bind CALASA by any contract or engagement or to pledge its credit or to render it liable financially for any purpose in any amount unless in the ordinary course of business.

Section 2. Deposits: All funds of The California Chapter shall be deposited from time to time to the credit of the California Chapter with such banks, bankers, trust companies or other depositories as the Governing Board may select or as may be selected by any member or members, agent or agents of the California Chapter to whom such power may be delegated from time to time by the Governing Board.

Section 3. General and Special Accounts: The Governing Board from time to time may authorize the opening and keeping of general and special bank accounts with such banks, trust

companies or other depositaries as the Governing Board may select and may make such rules and regulations with respect thereto, not inconsistent with the provisions of these bylaws, as they may deem expedient.

Section 4. The Executive Secretary-Treasurer shall be authorized to pay all routine expenses. Expense items other than of an operational nature shall require the approval of the Executive Committee.

ARTICLE VI
FISCAL YEAR

The fiscal year of the California Chapter shall begin on October 1 and end September 30.

ARTICLE VII
RESERVE FUND MANAGEMENT

A reserve fund of $30,000.00, or the estimated annual total costs to execute the California Plant and Soil Conference, will be maintained in the budget. The Reserve will be used to cover unanticipated decreases in revenue or increases in cost. Examples include extremely low conference turnout, unanticipated venue or other cost increases, legal expenses, equipment purchases or other expenditures necessary to ensure funding to execute the annual conference. The Board retains the right to access this Reserve on an as needed basis for day-to-day operations, with the expectation that the $30,000.00 will be replenished as the California Chapter budget allows.

ARTICLE VIII
INDEMNIFICATION

Each person who is or was a member or officer of the California Chapter, including the heirs, executors, administrators, or estate of such person, acting in good faith shall be indemnified by the California Chapter to the full extent permitted or authorized by the laws of the State of California, as now in effect and as hereafter amended, against any liability, judgment, fine, amount paid in settlement, costs and expense including attorney's fees, incurred as a result of any claim arising in connection with such person's conduct in his or her capacity, or in connection with his or her status, as a member or officer of California Chapter. The indemnification provided by this bylaw provision shall not be exclusive of any other rights to which he/she may be entitled under any other bylaws or agreement, vote or disinterested directors, or otherwise, and shall not limit in any way any right that the California Chapter may have to make different or further indemnification with respect to the same or different person or classes of persons.

ARTICLE IX
AMENDMENTS TO CONSTITUTION AND BY-LAWS

The conditions set forth in the Constitution and By-laws terms described herein may be amended by a simple majority vote of the members present at the Annual Meeting, providing such amendments have first been presented, in writing, to the Executive Committee for consideration not less than sixty (60) days prior to the Annual Meeting.

ARTICLE X
PUBLICATIONS

The publications of the California Chapter may consist of proceedings made up of abstracts of submitted and individual papers, reports of committees, minutes of the Annual Business Meeting and such other items, as shall have general interest to the members. The Executive Committee is authorized to charge for publications in such a manner as to reclaim actual costs.

Proposed revision presented to Annual Meeting Membership for vote February 5, 2020

Appendix A
Duties of Executive Board Members

President

1. Prepare board meeting agendas and run meetings
2. Plan General Session
3. Seek Scholarship funding from Western Plant Health Association
4. Preside over 2nd day conference luncheon
5. Ensure certificate of authority is revised (signers added to checking account)
6. Provide guidance to 1st VP

First Vice President

1. Responsible for planning and organizing 6 technical sessions
2. Prepare conference agenda – ensure that all speakers are confirmed in timely manner
3. Ensure that there is a session chair responsible for set up (e.g. getting presentations loaded, introducing speakers, any unique set up needed communicated to facilities point person, etc.) and that all key tasks are done on time
4. Produce conference Proceedings
5. Oversee (delegate) application of CCA and PCA CEU hours
6. Provide guidance to 2nd VP

Second Vice President

1. Responsible for arranging hotel facilities
2. Responsible for publicity (postcard mailing, online, AgAlert, PCA mag, etc.)
3. Site arrangements (rooms, lunch, presentation set-up, trouble shoot any issues during the conference)
4. Help registration
5. Provide guidance to Secretary-Treasurer

Secretary-Treasurer

1. Record minutes of board meetings
2. Responsible for financial matters (pay bills, collect income)
3. Responsible for overseeing registration
4. Prepare registration or manage with online support
5. Run registration at conference
6. Responsible for maintaining mailing list

2020 Plant and Soil Conference Evaluation Form

American Society of Agronomy
California Chapter

http://calasa.ucdavis.edu

Please complete this form and return it to the registration desk in the boxes provided.
Your responses will help us improve future Chapter activities.
Thank you!

Overall Conference Evaluation

	Agree				Disagree
Conference fulfilled my expectations	1	2	3	4	5
Conference provided useful information	1	2	3	4	5
Conference provided good contacts	1	2	3	4	5
Conference Poster session was valuable	1	2	3	4	5
Proceedings booklet sufficed for my needs	1	2	3	4	5
I would like longer session breaks to network	1	2	3	4	5

Which session(s) did you find to be particularly valuable for your work and why?

What session topics do you recommend for future conferences?

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

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

For the past several years the Conference has been held in Fresno due to strong attendance at this location. Are there other locations that you believe would draw a larger attendance? Please tell us where and why?

The Conference Proceedings is currently available in print and on the CA-ASA website during the Conference. How would you prefer to access the Proceedings:

___ Continue with printed copy as part of registration fee

___ Online only at no charge

___ Option of printed (reduced cost if don't choose to receive printed copy when register)

___ Other, please describe:

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