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STUDENT RESEARCH JOURNAL
JORDAN COLLEGE

Research Newsletter, Vol. 2, Issue 1 Spring 2017

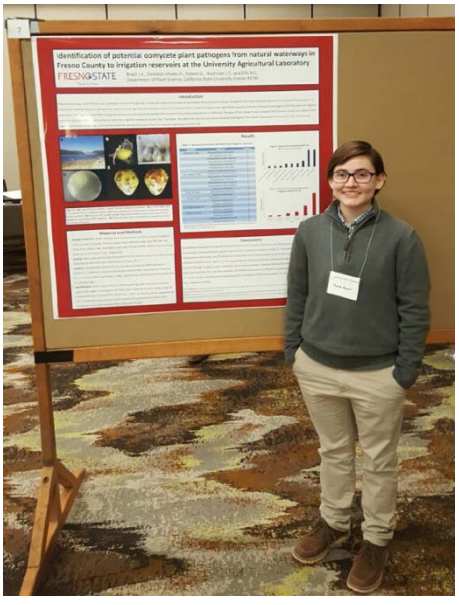
Message From The Editorial Team

We are now in the second year of the Jordan College Student Research Journal. Our goals remains the same, i.e. to showcase undergraduate and graduate student research in the Jordan College at California State University, Fresno, and share news of student activities and success stemming from their research projects. We continue to invite interested faculty and students (graduate or undergraduate) from all departments in the Jordan College to serve on the editorial team as we wish to see a broader representation. Contributions from students in the form of abstracts or full-length articles are most welcome. We welcome comments, suggestions, and contributions in the form of articles, abstracts, or research news.

2016-17 USDA-NIFA-NLGCA GRANTEE NEWS

Student interns in the USDA-NIFA-NLGCA funded project titled 'Promoting undergraduate research in agriculture: opportunities for experiential learning and a pathway to graduate studies' have lots of successful stories to share.

JESSIE BRAZIL—Plant Science



Jessie presenting her poster at the California Plant and Soil Conference, Fresno in February 2017.

Jessie won 2nd place in the poster contest at the California Plant and Soil Conference held in Fresno from January 31 to February 1, 2017.

The title of her poster was 'Identification of potential oomycete plant pathogens from natural waterways in Fresno County to irrigation reservoirs at the UniversityAgricultural Laboratory'. Jessie was mentored by Dr. Margaret Ellis, Plant Science.

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Jessie also received a research assistantship and will be joining a Master's program at Oregon State University, Corvallis, OR this Fall.

Congratulations on both of your achievements Jessie!



Mark researching nematodes.

MARK CASTANON—Plant Science

Mark narrated the Plant Science Club video which won 1st place at the American Society of Agronomy/Crop Science Society of America/Soil Science Society of America undergraduate video competition: Youtube.com—Mark Castanon. This was a national competition. Mark also presented a talk titled 'Nematode host status of *Crotalaria juncea*, a potential orchard cover crop' at the 63rd Annual Conference on Soilborne Plant Pathogens held in Davis, CA. Mark was mentored by Dr. Andreas Westphal, Nematologist, Department of Nematology, Univ. of Calif. Riverside.

Congratulations on both of your achievements Mark!

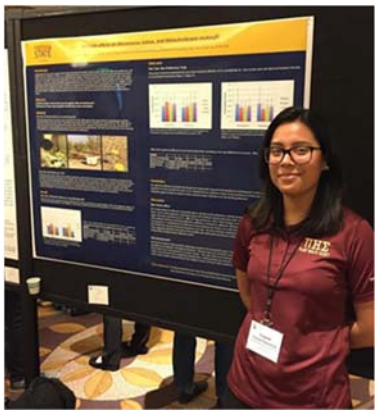


Carolyn (left) engaging with school children at the Food Commons in Fresno.

CAROLYN CHASE—Food Science

Carolyn's poster titled 'Sanitization of Whole Mango Fruit by Hot Water Immersion ' was selected for presentation at the Long Beach Department of Health and Human Services' "Food Systems & Public Health's S3 Symposium". The conference was held on May 11, 2017 at Long Beach, CA. Carolyn was mentored by Dr. John Bushoven, Plant Science.

Great job Carolyn!

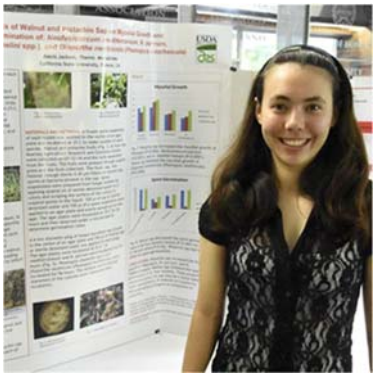


Crystal presenting her poster at the PBESA Annual Meeting in Portland, OR.

CRYSTAL ESPINDOLA - Biology/Plant Science

Crystal presented a poster titled 'Pesticide effects on *Micrococcus luteus* and *Metschnikowia reukaffii*' at the Pacific Branch of the Entomology Society of America (PBESA) Annual Meeting in Portland, OR in April, 2017. Crystal was mentored by Dr. Jacob Wenger, Plant Science.

Best wishes Crystal!



Alexis presenting her poster at the Central Calif. Research Symposium at Fresno State.

ALEXIS JACKSON - Plant Science

Alexis placed 1st in the poster contest at the California Plant and Soil Conference held in Fresno from January 31 to February 1, 2017. The title of her poster was 'Effects of walnut and pistachio sap on mycelial growth and spore germination of *Neofusicoccum mediterraneum*, *N. parvum*, *Phomopsis* (Nomelini spp.), and *Diaporthe neothicola* (*Phomopsis neotheicola*)'. Alexis was mentored by Dr. Themis Michailides, Plant Pathologist, Department of Plant Pathology, University of California, Davis. Alexis received the Jordan Harvey Scholarship/Assistantship to join the Master's program in Plant Science at Fresno State.

Congratulations on both of your achievements Alexis!



Michael receiving his award at the PBESA Annual Meeting in Portland, OR .

MICHAEL SERRATO—Plant Science

Michael won 1st place in the student oral presentation competition with his talk titled 'A comparison of thermal performance between the two pupa parasitoids, *Pachycrepoideus vindemiae* and *Trichopria drosophile*' at the Pacific Branch of the Entomology Society of America (PBESA) Annual Meeting in Portland, OR in April, 2017. Michael was mentored by Dr. Kent Daane, Entomologist, Department of Environmental Science, Policy, and Management, University of California, Berkeley.

Congratulations on your achievement Michael!



May receiving her award at the PBESA Annual Meeting in Portland, OR .

MAY YANG - Plant Science

May won 2nd place in the student poster presentation competition with her poster titled 'A comparison of thermal performance between the two pupa parasitoids, *Pachycrepoideus vindemiae* and *Trichopria drosophile*' at the Pacific Branch of the Entomology Society of America Annual Meeting in Portland, OR in April, 2017. May was mentored by Dr. Kent Daane, Entomologist, Department of Environmental Science, Policy, and Management, University of California, Berkeley.

Congratulations on your achievement May!

2017/2018 USDA-NIFA-NLGCA GRANTEES

Congratulations to the following students who were selected as research interns for 2017/2018.



DIANA CAMERANA—Plant Science

Diana will be working with Dr. Katherine Waselkov, Department of Biology, Fresno State. She will be working on the physiological and molecular aspects of herbicide resistance in hairy fleabane (*Conyza canadensis*).



ALDO GARCIA—Plant Science

Aldo will be working with Dr. Jeffrey Mitchell, Department of Plant Science, University of California, Davis. He will be working on soil and water conserving cropping systems.



JOHN LAKE—Plant Science

John will be working with Dr. Themis Michailides, Plant Pathologist, Department of Plant Pathology, University of California, Davis. He will be working on pistachio diseases.



HUY LE—Industrial Technology

Huy will be working with Dr. Balaji Sethuramasamyraja, Department of Industrial Technology, Fresno State. His area of interest is modification of commercial/civilian drones to be used for precision agriculture as an unmanned aerial platform using different types of sensors.



PEDRO MARTINEZ—Viticulture and Enology

Pedro will be working with Dr. Matthew Fidelibus, Viticulture Specialist, Department of Viticulture and Enology, University of California, Davis. He will be working on varietal trials in winegrapes.



VIVIAN MAIER—Plant Science

Vivian will be working with Dr. John Bushoven, Department of Plant Science, Fresno State. Her area of interest is in hydroponics.



BRIANA QUINTERO—Plant Science

Briana will be working with Dr. Margaret Ellis, Department of Plant Science, Fresno State. Her area of interest is plant pathology.



CHRISTINA SANDOVAL—Plant Science

Christina will be working with Dr. Margaret Ellis, Department of Plant Science, Fresno State. Her area of interest is plant pathology.

We wish this second cohort all the best for a productive experience!!!

STUDENT RESEARCH ACTIVITIES/NEWS



Dr. Serhat Asci (left) with Madeline Loftus (right) at the Central California Research Symposium

Department of Ag Business

Madeline Loftus an undergraduate student in Agricultural Business won the outstanding poster award in the Central California Research Symposium held on campus of April 18-19, 2017.

The title of her poster was 'Stochastic Simulation for the Future of California Blueberry Production'. Her mentor was Dr. Serhat Asci, Assistant Professor of Agricultural Business.

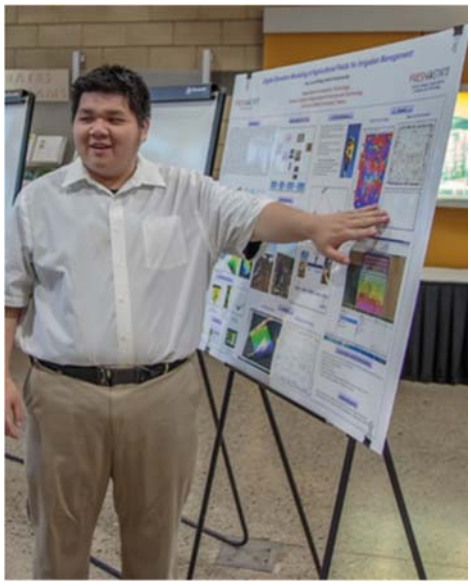
Department of Industrial Technology

Arthish Bhaskar, a graduate student in Industrial Technology received the best poster award for his research in developing a Soil Library for calibrating various sensors to find soil moisture, soil pH, electrical Conductivity, etc. He worked with Dr. Balaji Sethuramasamyraja, Program Director of Precision Ag Technology Minor and Ag. Systems Management major option in his Autonomous Systems Laboratory. Our system, called SmartFarm, integrates disparate environmental sensor technologies into a customized open-source cloud-based data appliance and new analytics that provide growers with a secure, easy to use, low-cost data analysis and decision support system (continued on next page).



Arthish Bhaskar with his poster

Using open-source private cloud platforms, this data appliance can be hosted at a range of scales including personal, private clouds on-farm, large-scale public clouds, or in combination (cloud hybrid). Because of multiple technologies that are available, the goal is to provide Do-It-Yourself kits to farmers/crop consultants with affordable DAS data acquisition systems for deployment in the farm. This can be established by utilizing new data analytic tools, agronomics and precision agriculture/site-specific crop management. For a successful Soil Library consisting of 5 soil types (Sandy loam, sandy clay loam, clay, sandy, clay loam), we need to process them for homogeneity so that the values obtained after various results will be stable and accurate.



Huy Le presenting his poster at the ASABE CA/NV Section Meeting.

Huy Le, an undergraduate student in Industrial Technology received the best Undergraduate poster award at the 2017 ASABE CA/NV Section Meeting held in February. The objective of his research is to develop a Digital Elevation Model (DEM) of the selected field and to infer effective water management and irrigation recommendations. Trimble WM Topo Base station was used in the study as the surveying equipment. It has a base station and rover which is a pole mounted Global Navigation Satellite System (GNSS) receiver. This system works on the principle of Real Time Kinematics (RTK). There are various data collection methods but the gator was used. The pole was mounted on the gator and using the handheld Nomad Computer the surveying was initialized with a customized setting of 10 feet to automatically map data points which are geo-referenced. At the end of the survey, final data files where extracted from the Nomad 900 series handheld computer in an USB stick /drive or can be ported by wireless via connected farm solution.

The data files are then extracted in Farm works or Multiplane's software. The software allows the user to run numerous analyses using the collected data file. The summary results of the analysis would include digital elevation model of the field, cut and fill contour models of the existing field as well as best fit models for rectifying levelling issues and recommending irrigation types and water management decisions. The types of conclusions that was reached for this project is that developing the DEM of farm land is possible, though the most difficult issue is having to create a data point every ten feet traversing the whole acre with the surveying equipment. The project concluded with having created data to be inputted into a database for future use to assist in levelling, and landscaping of the acre to more accurately reflect better irrigation management.

Undergraduate students Samikshya Budhathoki and May Yang presented posters at the California Weed Science Society Meeting in January 2017 at Monterey, CA.

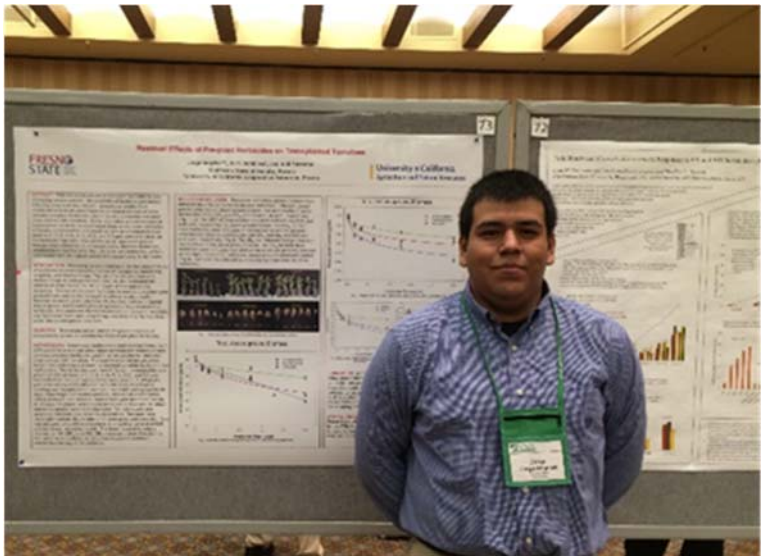
Vivian Maier presented a talk at the same meeting and was awarded 2nd place in the student oral presentation competition.



L-R: Undergraduate students Samikshya Budhathoki, Vivian Maier, and May Yang (at the California Weed Science Society Meeting, Monterey, CA.

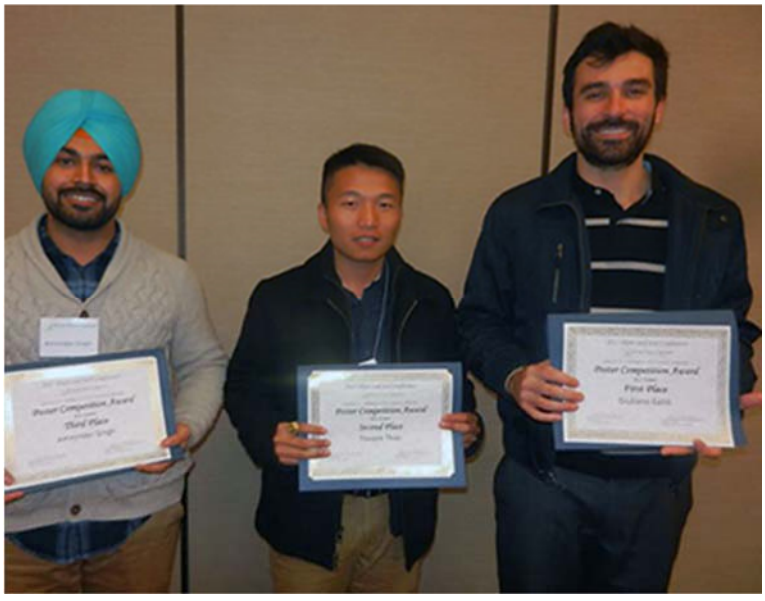
Department of Plant Science

Graduate student Jorge Angeles presented a poster at the Weed Science Society of America Annual Meeting in February 2017 in Tucson, AZ.

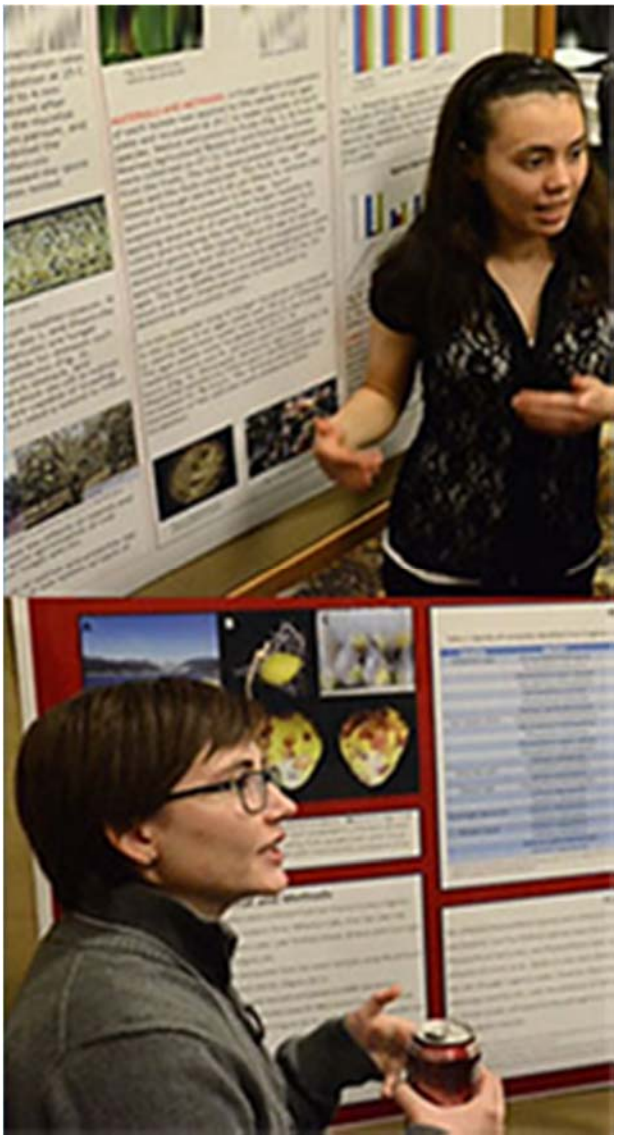


Jorge Angeles with his poster

Graduate students Giuliano Galdi, Touyee Thao, and Amninder Singh also presented posters at the same meeting and placed 1st, 2nd, and 3rd respectively. Congratulations to all of them.



Amninder Singh (lef), Touyee Thao (center), and Giuliano Galdi (right) at the California Plant and Soil Meeting held from 31 January to 1 February, 2017 in Fresno, CA.



Alexis Jackson (top) and Jessie Brazil (bottom) with their posters at the California Plant and Soil Meeting held from 31 January to 1 February, 2017 in Fresno, CA.

Undergraduate students Alexis Jackson and Jessie Brazil presented posters at the California Plant and Soil Science Society Meeting in February 2017 at Fresno, CA. They won 1st and 2nd place, respectively.

STUDENT ABSTRACTS

(*undergraduate student; **graduate student)

Department of Plant Science

Residual Effects of Pre-plant Herbicides on Transplanted Tomatoes

Jorge Angeles*, Kurt Hembree, and Anil Shrestha*

Greenhouse studies were conducted in Fresno, CA in 2015 and 2016 to evaluate plant injury to simulated residues of some common pre-plant herbicides used in tomato production and other crops rotated with tomatoes. Above- and below-ground response of transplanted tomatoes to incremental doses of pre-plant herbicides trifluralin, *s*-metolachlor, and pendimethalin at simulated residual doses of 0, 0.03, 0.06, 0.12, 0.25, and 0.5 ppm were evaluated. Herbicide-free the different herbicide doses. One tomato seedling was transplanted in each pot. Plant height and leaflet numbers, chlorophyll concentration (SPAD) of leaves, and stomatal conductance were monitored weekly. At 45 days, the plants were clipped at the soil surface and the above- and below-ground parts were separated. The leaves were also separated and their total area was determined. The roots were thoroughly washed. Dry weights of all plant parts were recorded. Data were analyzed using ANOVA procedures and non-linear regression models. The doses required to reduce biomass by 10% (GR_{10}) and 50% (GR_{50}) were estimated. All the herbicides reduced plant biomass at the highest dose when compared to the non-treated control. Trifluralin caused greater reductions in above-ground biomass than pendimethalin and *s*-metolachlor with a GR_{10} and GR_{50} of 0.02 and 0.46 ppm, respectively. The GR_{10} of *S*-metolachlor and pendimethalin was 0.03 and 0.08 ppm, respectively for above-ground biomass. The GR_{50} for both these herbicides were >0.5 ppm. *s*-metolachlor caused the greatest reductions in root biomass with GR_{10} and GR_{50} of 0.004 and 0.22 ppm, respectively. The GR_{10} for trifluralin and pendimetalin was 0.008 and 0.04, respectively; whereas, the GR_{50} for both these herbicides were >0.5 ppm. Stomatal conductance was generally reduced at the higher doses of all herbicides compared to the untreated control. Leaf area was reduced by *s*-metolachlor more than the other herbicides. Although trifluralin caused greater reduction in above-ground biomass, *s*-metolachlor had the greatest overall potential to cause above- and below-ground injury. Pendimethalin was relatively safer than the other two herbicides. Therefore, residual concentrations of herbicides in the soil should be assessed before transplanting tomatoes in buried drip-irrigated fields in California.

Presented at the WSSA Annual Meeting, February 6-9, 2017, Tucson, AZ.

Influence of Growing Degree Days on Sugarbeet (*Beta vulgaris*) Evapotranspiration and Crop Coefficient

Touyee Thao*, Florence Cassel S.,* ***Anthony Mele****, Dave Goorahoo, and James Ayars*

Knowledge of crop water requirements and crop coefficients is essential when scheduling irrigations using the evapotranspiration-based (ET) method. Such information is also critical to optimize irrigation water applications and improve crop water use efficiency, particularly in periods of drought. Traditionally, crop ET (ET_c) and crop coefficients (K_c) are reported as a function of time during the growing season. However, previous studies conducted on tomato suggested that ET_c and K_c data expressed in terms of Growing Degree Days (GDD) might provide estimates less dependent on location and climatic conditions. We conducted a two-year lysimetric study to develop ET_c and K_c curves for sugarbeets grown under drip irrigation in a clay loam soil. Sugarbeets were planted in the Fall of 2014 and Fall of 2015 at the UC Westside Research and Extension Center in Five Points, CA. Comparative ET_c and K_c curves were developed and reported both as a function of time and GDD. Relationships between K_c and fractional ground cover were also derived for each growing season. Results indicated that seasonal ET_c was 1034 mm and 540 mm for the first and second growing seasons, respectively. Midseason K_c ranged from 1.2 to 1.35 in 2014-15 and from 1 to 1.1 in 2015-16. Daily GDD accumulation varied from 70 to 311 units between seasons. Maximum groundcover was achieved at 186 DAT (2400 GDD units) and 180 DAT (2292

GDD units) in the first and second years, respectively. A strong correlation ($R^2 > 0.88$) between K_c and fractional ground cover was also observed for each growing season.

Poster presented at the California Plant and Soil Conference, January 31 - February 1, 2017, Fresno, CA.

Root Yield Increase in Deficit Drip Irrigated Sugar Beets, an Alternative Fodder Crop

Anthony Mele**, *Florence Cassel S., Dave Goorahoo, and* ***Touyee Thao*****

The dairy and beef cattle industries of California consistently rank in the top four of the state's most valued commodities. It takes a tremendous amount of water to grow the alfalfa, corn, and various forage crops which fuel these thriving industries. Given the uncertainty of the state's water supply, alternative feed crops are currently being tested with the hopes of developing a more sustainable fodder crop rotation. In this research project, sugar beets, or in this case feed beets, are evaluated for both water use efficiency and nitrogen use efficiency when grown under different irrigation and nitrogen regimes. The experimental design is a split-plot with three replications of irrigation as the main treatment (100% ET surface-drip, 70% ET surface-drip, and 100% ET furrow) and nitrogen rate as the sub-treatments (0, 100, 150, 200 lb/ac). The feed beets were grown in the Central Valley of California in a sandy loam soil located on the campus farm at Fresno State University. Data from the first growing season was analyzed to see which treatments had an effect on root weight. Preliminary results show that irrigation did have an effect on average root weight per acre ($P<.05$). The 100% ET drip had a significant increase in root yield compared to both the 70% ET drip and the 100% ET flood method. Nitrogen rates did not have an effect on root weight, but an interaction between irrigation and nitrogen rate was detected ($P=.053$). The interaction occurred only with the 100%ET drip coupled with the control rate of 0 lb/ac resulting in slightly diminished root weight averages.

Poster presented at the California Plant and Soil Conference, January 31 - February 1, 2017, Fresno, CA.

Development of validation data sets for a transient hydro-salinity model using EM-38 soil surveys, irrigation water monitoring and forage analysis

Amninder Singh*, *Sharon E. Benes, Nigel Quinn, Florence Cassel-Sharma*

Soil salinity is a major factor affecting irrigated agriculture in today's world, especially in arid/ semi-arid regions like the Western San Joaquin Valley of California. In this region, both salinity and drainage are limiting factors for agriculture. Soil salinity is a very dynamic property both spatially and temporally. Thus, mapping at field scale requires a rapid and reliable means of taking geospatial measurements. Electromagnetic Induction (EM) survey data and prediction equations relating the apparent electrical conductivity (ECa) measured by the EM- 38 to soil salinity (ECe) are important tools to assess the spatial variability of soil salinity in a field. This research is being conducted at the SJRIP (San Joaquin River Improvement Project) facility managed by Panoche Water District (Los Banos, California) where subsurface drainage water is re-used on ~6,000 acres of dedicated cropland (primarily forages such as 'Jose' tall wheatgrass (*Thinopyrum ponticum* var. 'Jose' (TWG) and alfalfa (*Medicago sativa*) to reduce salt loading into the San Joaquin River. EM-38 soil salinity surveys were conducted in two alfalfa and two tall wheatgrass fields to monitor soil salinity in response to the salinity (ECw) and volume of applied drainage water. Soil samples taken to a depth of 120 cm (4 ft.) in 30 cm (1 ft.) increments for calibration of ECa data were analyzed for pH, ECe, gravimetric water content and saturation percentage. The average ECe was 12.5 to 19.5 dS/m for tall wheatgrass fields and 9.2 to 14.4 dS/m (alfalfa fields) for spring and fall 2016 samples. GIS maps were developed depicting the spatial variability of salts in the fields. Data will be used for the refinement and validation of a computer model (CSUID-II) developed as a decision support tool to optimize soil leaching fractions for irrigation water of varying salinity levels, with the overall goal of improving the sustainability of the forage production in the SJRIP using saline irrigation.

Field Performance of 21 Alfalfa (*Medicago sativa*) Varieties under Saline Irrigation: dry matter yield, mineral composition and soil mapping

Giuliano Galdi*,

Due the water shortage in California, use of drainage and worse quality water for agriculture is needed in order to keep the high state's production. High quality water use is shifting to the high value crops such as almond and tomatos. Alfalfa is known to have a moderately salt tolerance, and according to Mass and Grattan (1999), the crop starts to loose yield with ECe above 2 dS/m. However, according to our data, this threshold seems too conservative. 21 new alfalfa varieties, bred for salinity tolerance, were tested in an experiment conducted in a field at West Side Research and Extension Center, in Five Points-CA. Two salinity levels, low salinity (ECiw~ 1.15 dS/m) and high salinity treatment (ECiw~10 dS/m) were applied in the irrigation water in order to challenge the varieties. In this 3 years trial, the first two years of data (i.e. 2015 and 2016) showed no significant difference between the varieties regarding shoot dry matter yield. However, varieties had good yield in the high salinity treatment, some of them having over 100% of relative yield (RY=HS/LS). In 2016, average RY was 89% ranging from 70 to over 100%. Very similar to 2015 season, when the average RY was 86% ranging from 75 to over 100% as well. Correlations between shoot dry matter yield and sodium and potassium concentration in the plant tissue were made to check if the ratio of the elements is a good indicator of salt tolerance. Soil salinity maps were created to understand the spatial and temporal accumulation of salts in the soil profile.

Comparison of the thermal performance between two resident pupal parasitoids of *Drosophila suzukii*

Michael Serrato**, Xingeng Wang, Kent Daane, Betsey Miller, and Vaughn Walton

Drosophila suzukii is a primary invasive pest of many soft- and thin-skinned fruits in North America. *Pachycrepoideus vindemiae* and *Trichopria drosophilae* are the two only known resident parasitoids readily attacking this invasive pest in California. This study compared three major thermal performance profiles (development, survival and reproduction) across a wide range of temperatures (12–32°C) between the two parasitoid species and between a Californian and an Oregon population of *P. vindemiae*. Temperature ranges for the development and reproduction were similar for both species and populations. However, survival rate of *T. drosophilae* was lower than *P. vindemiae* and the Californian population of *P. vindemiae* was lower than the Oregon population at the low temperatures. The results showed slight thermal profile differences between the two species and two *P. vindemiae* populations, with *T. drosophilae* being less cold tolerant whereas the Oregon *P. vindemiae* population was more cold tolerant than the California population. The results are discussed with respect to thermal adaptation and the potential implication for biological control of this invasive pest.

Insect and Weed Interactions in Small-Farm Southeast Asian Cropping Systems

May Yang**, Robert Straser, Jesus Ceja, Alejandro Hernandez, Anil Shrestha, and Kent Daane

Since the 1980s, there has been a rapid expansion of Southeast Asian small farms in California, corresponding to an increasing Hmong population in the San Joaquin Valley. These farms often have a rich diversity of specialty crops (e.g., Chinese bittermelon, lemongrass, long beans, mustard greens, Thai pepper, Chinese squash). The crops are grown in complex polycultures, mixing traditional farming practices with some modern techniques. Currently, insect pests are a primary concern because there are few integrated pest management programs (IPM) developed for these farms. As part of a sustainable program, we looked at the impact of weeds vs no weeds on two crops (luffa and cucumber). Plots were established in a complete randomize design, with 7 replicates for both a luffa and a cucumber plot. From July to November 2016, over 10,000 insects were recorded. Most insects collected with a D-Vac or visually recorded were herbivorous insect pests, primarily among these were the potato leafhopper and whiteflies. Across the entire season there was an increase in pest density, driven by an increase in leafhoppers. There was no statistical season-long difference, however, between control

(no weed) and weed treatments, although there were trends in the total numbers of beneficial insects found. There was however a statistical different in plant damage and crop marketability ratings between control and weedy plots, with more severely damaged luffa found in control plots. The information is currently being extended to the Southeast Asian farm community.

Poster presented at the California Plant and Soil Conference, January 31 - February 1, 2017, Fresno, CA.

Identification of potential oomycete plant pathogens from natural waterways in Fresno County to irrigation reservoirs at the University Agricultural Laboratory

Jessie A. Brazil**, *Holly Deniston-Sheets, , John T. Bushoven, and Margaret L. Ellis*

Phytophthora spp. and Pythium spp. belong to a class of fungal-like organisms known as oomycetes. Many species in these two genera cause devastating yield losses to a variety of annual and perennial crops grown in California. Previous research on the University Agricultural Laboratory (UAL) at California State University, Fresno identified a number of known oomycete pathogens from the soil and irrigation reservoirs. The species identified in this survey were also frequently baited from streams from forest ecosystems in California. The goal of this current research was to expand the previous survey and determine a possible source for these oomycetes to enter the irrigation reservoirs at the UAL. Therefore, the objectives were to 1) bait oomycete plant pathogens from natural waterways supplying Fresno County crops, 2) characterize baited oomycetes to species, and 3) compare species composition identified from natural waterways and the UAL. Oomycetes were detected from water samples using a standard pear baiting technique. Symptomatic pear tissue was excised and plated on PARP medium. Resulting isolates were characterized using direct colony PCR and DNA sequencing of the internal transcribed spacer region. With the exception of Pythium dissotocum and Pythium aphanidermatum, there was little evidence of an overlap of species composition between the natural waterways and the UAL. However, three species recently described as pathogenic to pistachio were identified. Phytophthora parsiana, Phytopythium helicoides, and Phytophthora taxon walnut, were detected in several locations that could potentially be transmitted to the UAL through irrigation water.

Poster presented at the California Plant and Soil Conference, January 31 - February 1, 2017, Fresno, CA.

Spider Mites

Lincoln Denlinger*

Almonds are the second most valuable commodity in California Agriculture, worth an estimated $5.9 billion in 2014-2015. As almond acreage has grown and drought conditions have stressed orchards, populations of pests and their damage have increased. One such pest is the two-spotted spider mite (*Tetranychus urticae*), which causes foliar damage and premature leaf drop. This damage reduces the following years yield and vegetative production. *T. urticae* is primarily controlled through miticide applications, including the popular active ingredient etoxazole (trade name Zeal). In recent years etoxazole's effectiveness has been called into question as many fields that have had large mite resurgences after being treated with Zeal. Etoxazole has been applied regularly throughout California suggesting possible resistance to the chemistry. However, resurgence reports have been irregular, suggesting that they may be due to applicator error. In this work we sought to 1) determine if *T. urticae* in California almonds have developed resistance to etoxazole, and 2) quantify the degree of resistance in these populations. Mites were sampled from three populations in Stanislaus County with known cases of resurgence, and were subjected to an ovicidal leaf-dip assay to identify potential resistance. This work is currently ongoing, and ongoing, and preliminary results will be presented as they relate to insecticide resistance management and application techniques.

Poster presented at the Pacific Branch of the Entomology Society of America Annual Meeting, April 2-5, 2017, Portland, OR.

Dormancy Requirements of Hairy Fleabane (*Conyza bonariensis*) Seeds

Vivian Maier* and Anil Shrestha

Hairy fleabane (*Conyza bonariensis* L. Cronq.) is considered a summer annual weed in California. However, it is often seen to be growing year round in the Central Valley. This is primarily because there are two major periods of germination of this species in the Central Valley. It either germinates and emerges in Fall, over-winters as a rosette, and completes its life cycle in early summer or it germinates and emerges in late winter and completes its life cycle in late summer or early fall (Shrestha et al. 2008). This species is known to produce as many as 226,000 seeds per plant (Kempen and Graf 1981). Although the optimal temperature of seed germination for this species ranges between 65º to 75º F, it has been reported to germinate at temperatures as low as 39.5° F (Wu et al. 2007). The seeds are also reported to be able to germinate under moderate water stress of up to -0.4 MPa (Karlsson and Milberg 2007). This species, similar to horseweed, is primarily a surface germinating type, i.e. its germination is reduced when buried more than 1 mm deep. Although much information is available on germination ecology of horseweed (*C. canadensis* L. Cronq.), very limited information is available for hairy fleabane. For example, it has been suspected that its seeds may not have a long dormancy period for germination. Therefore, the objectives of this study were to determine the dormancy and moisture requirement of hairy fleabane seeds for germination.

A study was conducted in Fresno, CA in 2016 in a lab under room temperature of 72º F and ambient light conditions. Seeds of hairy fleabane plants were collected from vineyards in Fresno. Seeds of five random plants were collected and bagged separately. Twenty five seeds from each hairy fleabane plant were placed on Whatman No. 1 filter papers placed in separate 100 by 15 mm Petri dishes. Ten ml deionized water was added to each petri dish with a pipette. The seeds were tested for germination, a) the day they were harvested, b) one week after they were harvested, c) two weeks after they were harvested, and d) three weeks after they were harvested. The petri dishes were periodically examined for germination till the process ceased. A seed was considered to have germinated if they had a 1 mm long radicle and plumule. The experiment was arranged as completely randomized design where the different days after harvest were the treatments and each plant was a replicate.

Another study was conducted to determine the level of tolerance to moisture stress during germination. The study was also conducted in the same lab under similar environmental conditions. Solutions of various water potentials (0, -0.149, -0.51, -1.09, -1.88, -2.89, -4.12, and -5.56 MPa) were prepared using polyethylene glycol (PEG 6000; Fisher Scientific, Houston, TX). Twenty seed from each hairy fleabane plant were placed on Whatman No. 1 filter papers placed in separate 100 by 15 mm Petri dishes. Ten ml of the different ψ solutions were added to each Petri dish with a pipette. The Petri dishes were then sealed with parafilm (Parafilm M™ Wrapping Film, Fisher Scientific, Houston, TX). Germination was monitored as described above. Total germination at 0 MPa was considered 100% and the percent germination in the other treatments were calculated relative to germination at 0 MPa. The experimental set up was a completely randomized design where each plant was a replicate. The experiment was repeated. Data for both experiments were analyzed using analysis of variance procedures and the means were separated by Fisher's least significant difference process at a 0.05 level of significance. A non-linear regression was also fit to the data on moisture stress.

More than 54% of the seeds that were put in the petri dishes the day they were harvested germinated; although, the germination percentage was significantly lower than the other treatments. Total germination in the other treatments ranged between 68 to 72% and there were no significant differences between the treatments in total germination percentage of the seeds. In the moisture-stress study, up to 71% of the seeds germinated at – 0.149 MPa, a few (approximately 10%) seeds germinated at -0.51 MPa but none of the seeds germinated in the other treatments. The non-linear regression estimated that the water potential to reduce germination by 50% was approximately -0.28 MPa.

This study showed that hairy fleabane seeds could germinate the day they fall off from the mother plants. However, they need adequate moisture to germinate and it is not very drought-tolerant in terms of seed germination compared to several other weed species.

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Is glyphosate resistance in junglerice (*Echinochloa colona* L.) temperature-dependent?

Samikshya Budhathoki*, Katrina Steinhauer**, *and Anil Shrestha*

Junglerice (*Echinochloa colona* L.) is considered to be amongst the world's top ten worst weeds. It is a summer annual grass belonging to the Poaceae family. In recent years, glyphosate-resistant (GR) biotypes of junglerice have been documented in various parts of the Central Valley of California. These plants have shown four-fold resistance to glyphosate than the label rate. As such, various studies on the biology, ecology, genetics, and alternative control measures are being conducted by several researchers in California. In another weed species, *Conyza bonariensis* (hairy fleabane) it was reported that some of the GR biotypes were susceptible to glyphosate when the herbicide was applied at cooler times of the year. However, it is not known if the results would be similar in junglerice. Therefore, the objective of this study was to compare the susceptibility of GR and glyphosate-susceptible (GS) biotypes of junglerice grown under different temperature regimes to an application of label rate of glyphosate.

A study was conducted in spring and summer of 2016 in growth chambers at California State University, Fresno. Seeds of confirmed GR and GS biotypes were obtained from University of California, Davis. The seeds were germinated in plastic cells and then transplanted to 4 inch plastic pots and grown in a greenhouse set at 72° F till they reached 4- to 5- leaf stage. Each pot contained one plant. Once the plants reached the aforementioned growth stage, six potted plants each of GR and GS biotypes were placed in different growth chambers programmed for a day/night temperatures of 60° F /50° F, 77° F /68° F, and 95° F /86° F, respectively and acclimatized to the temperatures for 72 hours. After 72 hours, three potted plants of each biotype were removed from the growth chambers and sprayed outdoors with a label rate (22 fl. oz/ac) of glyphosate. The remaining three potted plants of each biotype were not sprayed and used as controls. The plants were immediately placed back in the growth chambers after spraying and grown in the respective temperatures mentioned above for 7 additional days. On the eighth day, all the plants were moved to the greenhouse set at 72° F and allowed to grow for 21 additional days. The plants were then evaluated for mortality on a 0 to 100 scale (where 0 = complete death of the plant with no green tissue and 100 = completely alive with no herbicide damage). The plants were then clipped at the surface of the soil and their dry weights were recorded after drying them in a forced air oven set at 140° F for 72 hours. The experiment was repeated four times. The experimental design was a randomized complete block where the blocks were the experimental runs over time. Data were analyzed at the 0.05 level of significance.

Results showed that none of the glyphosate-treated GS junglerice plants survived at any of the temperature regimes tested while all of the untreated control GS plants survived in all the growth chambers. Among the GR plants, all the sprayed and untreated control plants survived in the 77° F /68° F and 95° F /86° F temperature treatments. However, all the GR plants sprayed with glyphosate died in the 60° F /50° F treatment, whereas the untreated control plants survived in these chambers. The biomass of both GR and GS junglerice untreated control plants were reduced under cooler temperatures. Therefore these results showed that glyphosate resistance in junglerice was dependent on the temperatures they were exposed to before and after they were sprayed with glyphosate. It needs to be determined what the practical implications of this finding may be for field conditions and what role temperature has in regulating the resistance mechanism of junglerice to glyphosate.

Poster presented at the California Weed Science Society Annual Meeting, January 17-19, 2017, Monterey, CA.

Department of Agricultural Business

Stochastic Simulation for the Future of California Blueberry Production

Madeline Loftus** and Serhat Asci

California blueberry production, typically, has been limited to northern California and the coast line because blueberries prefer cooler and wetter climates. Advancements in irrigation as well as the recent water conservation technologies have supported the possibility of blueberries being grown in other parts of California, such as the Central Valley. The purpose of this study is to examine the overall profitability and the future production of blueberries in California. This study also addresses the current state of California blueberry production and focuses on the growth trends and projections for future production. The forecast results suggest that the grower price per hundredweight for California blueberries would decline, however, the overall return to farmers would increase due to the vast increase in acres produced.

STUDENT PUBLICATIONS:

Alkahtani, M., Y. Chen, **J. J. Pedraza****, J. M. González, D. Y. Parkinson, P. R. Hemmer, and H. Liang. 2017. High resolution fluorescence bio-imaging upconversion nanoparticles in insects. Optics Express 25 (2): http://dx.doi.org/10.1364/OE.25.001030.

RESEARCH IN ACTION





Plant Science Undergraduate students Jose Omar Carrillo (left), Robert Ullo (middle) and Graduate student Touyee Thao (right) working on their research projects.





Plant Science graduate students Amninder Singh (left), Arthish Bhaskar (middle) and Julie Pedraza (right) working on their research projects.

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