

UA-CEAC Summer 2020 Newsletter



COLLEGE OF AGRICULTURE
AND LIFE SCIENCES
CONTROLLED ENVIRONMENT
AGRICULTURE CENTER

We're Celebrating 20 Years!



The University of Arizona's Controlled Environment Agriculture Center has been, and continues, to celebrate an incredible 20 years of teaching and innovations in the CEA industry.

Thank you to our students, staff, faculty, volunteers, industry collaborators and CEA enthusiasts for all their support as we continue to educate and grow our programs.

UA-CEAC Alumni Reunion

If you are an alumni or have worked at UA-CEAC, we want to hear from you! Click [here](#) and please provide your name, year graduated, and contact info. There is a reunion gathering also being planned for a later date. More information to follow.

CEAC Gives Back During COVID-19

The CEAC has been working very hard the past few months to help our community during the COVID-19 pandemic.

We have been able to donate a variety of our produce to many local organizations that help distribute to those in need. Some of which have included:

- Navajo Nation
- UA Campus Food Pantry
- Iskashitaa Refuge Network
- International Refugee Center
- Husainiya Center of Tucson
- Bhutanese Refugee Group
- Nepalese Community
- Pivot Produce



Left and Right: Students and staff harvest produce to donate to different local organizations

We are proud to be considered an essential service during these difficult times and are trying to do our part by donating to local organizations weekly. Thank you to our staff, students, and faculty for all your hard work to help us give back!

Spring 2020 CEAC Covering Environment Seminars

We want to thank all of our guest speakers for joining us last semester for our Covering Environment Seminar Series. If you missed them, they are available on our YouTube page! Click the links below to check them out.

- [“Building Our Piece of Paradise: Practical Sustainable Living in Tubac, AZ” by Jim and Jean Wagner](#)

- [“Plant Empowerment, A Data-Driven Strategy to Control the Interaction between the Plant and its Environment” by Dr. Peter Van Weel](#)

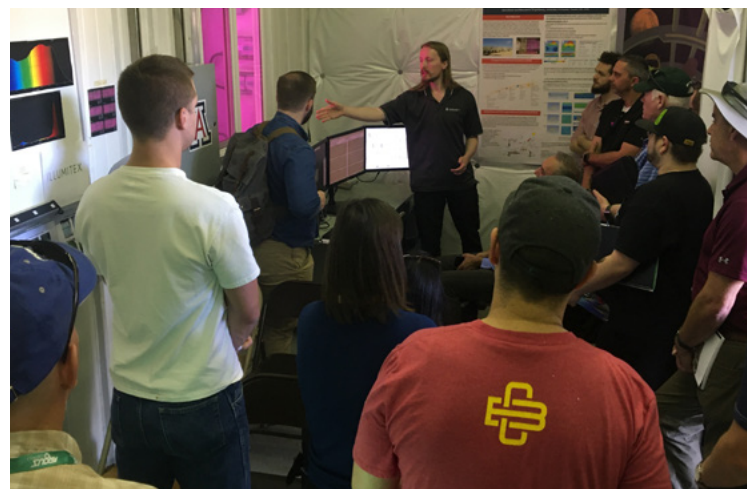
- [“Industrial Hemp: Overview and Research Opportunities” by Andrea Yasmin Carter](#)

- [“Hemp Cell Cultures as a Sustainable Alternative to Open-Field Hemp Cultivation” by Dr. Joel Cuello](#)



Dr. Peter Van Weel gives his presentation in the CEAC Classroom back in February 2020.

A Successful 19th Annual CEAC Short Course



Graduate student, KC Shasteen, gives a tour of the UA-CEAC's vertical farm to a group of participants during the 19th CEAC Short Course.

We had a phenomenal CEAC Short Course this year! Total of 23 technical presentations were given by 18 experts from academia and industry with topics that included fundamentals of hydroponics, integrated pest management, optimal systems design and management, fertigation requirements, trends and technology in CEA, and more.

This was also followed by hands-on workshops at our CEAC facilities as well as a tour of Merchant Gardens here in Tucson, AZ.

Thank you to all of our participants who came to join us! We look forward to seeing you at our next Short Course in March 2021!

Thanks to our invited guest speakers:

Dr. Rosa Raudales, Dr. Merle Jensen, Dr. Fei Jia, Dr. Hope Jones, Joe Swartz, Jenny Harris, Karin Tifft, Dr. Tharindu Weerartne, Dr. Joel Cuello, Dr. Goggy Davidowitz, William Artwohl, Dr. Jose Chen Lopez, and Artem Efremov

Thank you also to our sponsors and exhibitors:



Online Offerings Coming Soon

Be on the lookout! We are in the process of converting our programs to an online format. If you have interest in any of the these programs or training courses, please email arizona.ceac@gmail.com.

Intensive Workshops:

Our intensive workshop course are coming soon to an online platform. Topics we will be offering will include: **Leafy Greens, Tomatoes, Aquaponics, Mushrooms, and CEA Systems and Environment Control**

Credit/ Non-Credit Professional Offerings:

Soon we will be offering these online courses: **Introduction and Advanced Hydroponics Production, Aquaponics Design and Engineering, Applied Instrumentation for CEA, Controlled Environment Systems, Integrated Greenhouse Pest Management, Mushrooms in CEA**

Research Highlights

Energy Producing Greenhouse: Organic Photovoltaics Integrated Greenhouse

Rebekah Waller (Graduate Student), Neal Barto (Engineering Support), Tilak Mahato (Research Associate), Murat Kacira (PI).

This project evaluates the use of organic photovoltaics (OPV) wavelength selective film technology in the greenhouse production system on greenhouse microclimate, plant growth, produce yield and quality, and OPV's energy generation. Collaborators include Dr. Meir Teitel of Volcani Research Center-ARO and Dr. Ibrahim Yehia from Triangle Research and Development Center. Sponsor: UA-Israel Binational Agricultural Research and Development Fund (BARD).



Graduate student, Rebekah Waller working in the organic photovoltaics covered research greenhouse at UA-CEAC.



Hydroponically grown lettuce in a UA-CEAC greenhouse

Carbon Nanoparticles on Crop Growth, Yield, Water Use Efficiency

Tilak Mahato (Research Associate), Neal Barto (Engineering Support), Murat Kacira (PI).

This project is evaluating the effects of carbon nanoparticles on growth, yield and water use efficiencies with hydroponically grown lettuce. Collaborator: Rick Shang, Sponsor: Vulpes Corp.

Research Highlights (cont.)

Optimizing Indoor Agriculture for Leafy Green Production (OptimIA)

Murat Kacira (PI, UA). PostDoc and Grad. Student positions available.

A collaborative project between Michigan State University (Erik Runkle, PI; Co-PIs Roberto Lopez, Simone Valle de Souza, Christopher Peterson), Ohio State University (Chieri Kubota), Purdue University (Cary Mitchell) and University of Arizona to study indoor leafy green production, with the goal of improving the quality, quantity, and resource use cost-effectiveness of indoor vertical farming production. Research at UA-CEAC will design and efficiency and test more effective localized air-distribution methods, environmental monitoring and control strategies for indoor vertical farms using computer simulations, modeling and experimental studies. While most of the research will take place at the project universities, on-the-ground trials will be conducted at industry partner facilities, with UArizona working alongside AeroFarm, Ridder and Heliospectra. Special thanks to our collaborators that also include more than 25 CEA industry leaders. Sponsor: USDA Specialty Crop Research Initiative.



UAg Farm-Urban Agriculture Vertical Farm Research Facility at UA-CEAC.

NSF/NRT-IndigeFEWSS: Indigenous Food, Energy, and Water Security and Sovereignty

Rebekah Waller (Graduate Student), Karletta Chief (PI), Co-PIs: Murat Kacira, Kimberly Ogden, Benedict Colombi, Erin Ratcliff, Kelley Simmons-Potter, Valerie Shirley, Robert Arnolds.

This project bridges natural, social and physical sciences with engineering to develop novel and sustainable solutions for off-grid production of safe drinking water, brine management operations, and controlled environment agricultural systems to address challenges of food, water and energy in Native American Community. Sponsor: National Science Foundation.



Off-Grid Greenhouse Research Facility at UA-CEAC

Crop Production in Space: Efficient Water/ Nutrient Delivery, Volume Management, and Providing Diet Diversity for the International Space Station

Murat Kacira (PI), Co-PIs: Phil Sadler, Barry Pryor, Minkyu Kim, Roberto Furfaro, Kitt Farrell-Poe. John Adams.

In support of NASA's goals for human exploration and sustained presence on the Moon and beyond, new spaceflight-based agriculture systems are needed to provide astronauts nutrition through freshly grown crop plants. This project will develop an improved water/nutrient delivery system for crop production to be used in the International Space Station. UArizona partners with Stefania De Pascale, Veronica De Micco, Youssef Roupheal and Chiara Amtrano from the University of Naples Federico II; Alberto Battistelli, Stefano Moscatello and Simona Proietti from the Italian National Research Council; Daniel Schubert from the German AeroSpace Center; Cesare Lobascio and Giorgio Boscheri from Thales Alenia Space-Italy; and Gary Stutte of SyNRGE LLC. Sponsor: NASA.



International Space Station (ISS)

Research Highlights (cont.)

NSF-INFEWS/T2: Saltwater Greenhouse System for Agricultural Drainage Treatment and Food Production

Joe Alcorn (Graduate Student), Dr. Yanbao Ma (PI, UC-Merced), Stacy Tollefson (PI, UA) and Gene Giacomelli (PI, UA)

Joe Alcorn is continuing his Professional Science Masters degree in the Applied Biosciences Graduate Interdisciplinary Program with focus on CEA with a study of multiple crop production of greenhouse tomato, cucumber, lettuce, basil and melon. They are grown at higher than normal air temperatures to meet the needs of the solar greenhouse systems that will remediate open field irrigation drainage water.



Joe Alcorn produces lettuce in deep water culture

NASA STTR Phase II UbiQD-UA, Tailoring the Solar Spectrum for Enhanced Crop Yield for Space Missions

Michael Blum (Graduate Student), Matt Bergren (PI, UbiQD) and Gene Giacomelli (PI,UA)

With the success of Phase I work of graduate student Charles Parrish, the UbiQD company has won a Phase II grant to continue the work. This will include additional lab studies on the nano-particle enriched films, as well as scaled greenhouse production tests with tomato and lettuce. Michael Blum will be welcomed to campus as the new Masters Student in Biosystems Engineering to lead the continuation of this project.

Graperly, Table Grape Production Automation in CEA

Sam Farrow (Graduate Student), Gene Giacomelli (PI) and Yi Zhang (Research Director, Graperly)

Sam Farrow, graduate student in the Applied Biosciences, Professional Science Masters Graduate Degree in the Graduate Interdisciplinary Program with CEA focus, will lead the project to develop an fertigation protocol for grape vines in the greenhouse.



Sam Farrow with grape vine seedlings.



Allie Allgeyer with fertigation controls from Autogrow, Inc.

Plenty Unlimited, Inc, Extreme Indoor Tomato Production

Allie Allgeyer (Graduate Student), Drs Nate Story and Azize Homer, Gene Giacomelli (PI)

Allie Allgeyer has completed her internship at the Plenty research facility in Wyoming, and her research study at the UA-CEAC to earn her Professional Science Masters degree in the Applied Biosciences Graduate Interdisciplinary Program with focus on CEA. Her study of greenhouse micro-mini tomatoes evaluated fruit yield and quality.

Expanding Research and Training Programs for Commercial Mushroom Production in Arizona

Barry Pryor (PI), Justin Chung and Charlotte Bonner (Graduate Students)

This research program focuses on optimization of substrates and environmental parameters that support commercial mushroom production in Arizona with efforts on initiation and development of the Arizona Mushroom Growers Association, a grower-based commodity group directed by Dr. Pryor, focused on building a strong, profitable, and progressive mushroom industry in Arizona. Sponsors: Arizona Department of Agriculture, USDA Specialty Crop Program.



Multi-layered Mushroom research facility at UA-CEAC

Research Highlights (cont.)

Research on Hydroponic and Aquaponics Media Beds

Mathew Recsetar (PI)

This research examines various flow rates through different substrate media and helps determine optimal flow rates and substrates for maximum nutrient dispersion in hydroponic and aquaponic media beds. The potential use of hydroponic media beds for removing emerging contaminants from wastewater effluent is also evaluated and demonstrated that recirculating hydroponic bed bioreactors were able to significantly reduce all contaminants found in tertiary treated effluent. The work has been published in *Journal of Ecological Engineering* on the “Hydrodynamics of a hydroponic bed bioreactor with different substrate media.”



Aquaponics greenhouse research facility at UA-CEAC



Diseased and healthy lettuce

Variation in Virulence Among Yuma Isolates of the Fungus that Cause Fusarium Wilt of Lettuce

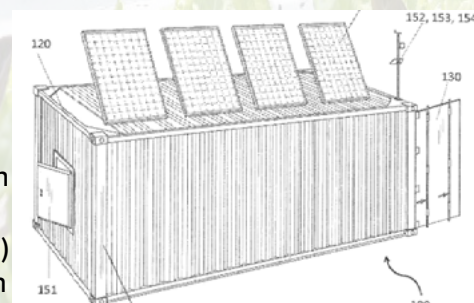
Barry Pryor (PI), Bree Rodriguez

This research develops methods for conducting research on Fusarium wilt of lettuce in controlled environments such as greenhouses as opposed to traditional studies in the field. The advantages of CEA-based research over field-based research is the opportunity to closely control most environmental parameters, including soil composition, and the opportunity to run experiments continuously, up to 6-7 experiments per year, as opposed to one or two opportunities under standard winter vegetable conditions like those in Yuma, AZ. Sponsor: Arizona Department of Agriculture.

Collaborative Efforts with Arizona Vegetable Company

Myles Lewis (Arizona Vegetable Co.)

Myles Lewis of the Arizona Vegetable Co. has been working on several research projects conducted at CEAC, including Controlled Environment grape vine production with Dr. Gene Giacomelli. Myles works as staff with the School of Plant Sciences in Dr. Dennis Ray's lab working on the industrial crops Guayule (*Parthenium argentatum*) and Guar (*Cyamopsis tetragonoloba*), assisting graduate students with plant nutrition research and conducting greenhouse evaluations of Guayule germplasm lines and their tolerance to NaCl. Myles was also awarded US Utility Patent #10,624,275 in April of 2020 on his Container Production System after 10 years of work! This is the third patent to add to his portfolio of CEA related technologies, and he is now moving forward licensing and manufacturing. Myles continues to provide the UA-CEAC's Lettuce Intensive Workshops for the 7th year, and preparing for the new and online offering of this professional training workshop in June 2020.



Visiting Scholar

UA-CEAC had pleasure of hosting Chiara Amitrano from Department of Agricultural Sciences, University of Naples Federico II, Italy. Chiara conducted research in Dr. Murat Kacira's Lab focusing on crop response to various environmental conditions and modeling to predict lettuce crop biomass and photosynthesis. She is also among our collaborators from University of Naples Federico II for our NASA funded project and we look forward to our continued collaborations.



Left: Chiara Amitrano working in the vertical farm at CEAC. Right: Students, faculty and staff celebration with Chiara Amitrano

Congratulations to our Graduating Students!

Graduate Students:



Robert Heintz, Applied Biosciences, Graduate Interdisciplinary-Controlled Environment Agriculture, Professional Science Masters Degree

Robert joined our program all the way from Hawaii in 2018. His defense was titled “Single-Use Polyethylene Encapsulated Substrate Bags: The Potential For Sanitation and Reuse” with committee members Dr. Giacomelli, Dr. Kacira, and Dr. Tollefson

Robert is eager to apply his skills in controlled environment agriculture and business administration but has not settled on an employer yet. He is pursuing opportunities in Arizona, California and Hawaii.



Allie Allgeyer, Applied Biosciences, Graduate Interdisciplinary-Controlled Environment Agriculture, Professional Science Masters Degree

Allie joined our program in Fall of 2018 after attending the University of Florida for her undergrad degree. Her defense was titled “Evaluating Mini Tomato Production in a Closed Loop Hydroponic System” with committee members Dr. Giacomelli, Dr. Kacira, and Dr. Tollefson.

Allie will be interning with Tech Core. She is also working on a starting a non-profit that focuses on bringing food access to those in need in the community in a sustainable way with practices she learned at CEAC.



Charles Parrish, Master of Science-Biosystems Engineering

Originally from North Carolina, Charles joined our program in Fall of 2018. His thesis was “NASA-STTR Phase I, Tailoring the Solar Spectrum for Enhanced Crop Yield for Space Missions.” His committee members were Dr. Giacomelli, Dr. Kacira, and Dr. Tanya Quist.

Charles has recently accepted a position with UbiQD, Inc. in Los Alamos, New Mexico.

Undergraduate Students:

Lia Crocker, BS in Biosystems Engineering, **Caroline Schulte**, BS in Biosystems Engineering, **Joaquin Antonio Felix Valdez**, BS in Sustainable Plant Systems-CEA Emphasis, **Daniel Stewart Harmon**, BS in Sustainable Plant Systems-CEA Emphasis, **William Thomas Holewinski**, BS in Sustainable Plant Systems-CEA Emphasis, **Pablo Daniel Cueva**, BS in Sustainable Plant Systems-CEA Emphasis

New Graduate Students to CEA Programs



Justin Chung, MS Student -Biosystems Engineering (Advisor B. Pryor)

Justin joined our program last fall of 2019. He is originally from Seoul, South Korea, and has lived in San Francisco and Washington D.C. before moving to Tucson.

At the CEAC, he has been focusing in specialty mushroom cultivation while working with Dr. Pryor. He strongly believes that allying with the fungal kingdom will address issues surrounding sustainability and food insecurity.



Charlotte Bonner, MS Student-School of Plant Sciences (Advisor B. Pryor)

Originally from Plymouth, Minnesota, She also obtained her undergraduate degree from the University of Minnesota before joining our program last fall.

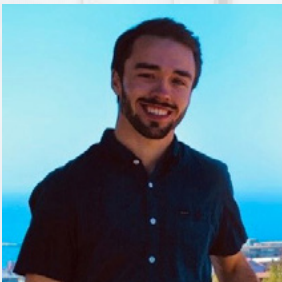
She has been working with Dr. Pryor on mastering the skills and techniques needed to cultivate specialty mushrooms. She sees benefits working with mushrooms because they are a sustainable food source since mushrooms require trace amounts of water and light.



Joseph Alcorn, PSM Student-Applied Biosciences-CEA Track (Advisor G. Giacomelli)

Joe is from Peoria, Illinois and gained his B.S. in Plant from Soil Science at Southern Illinois University in 2005. Since then, he has many years of experience in the hydroponics industry working as a grower, working for manufacturers, wholesale distributors and for retailers.

He has been working on the Saltwater Greenhouse System with Dr. Giacomelli at CEAC, which is evaluating the effects of superoptimal temperatures on crop production. He has built a recirculating top-drip system to eliminate waste runoff water and is growing cherry tomatoes, truss tomatoes, cucumbers, and melons. He also built a deep-flow hydroponic system for lettuce and basil.



Sam Farrow, PSM Student-Applied Biosciences-CEA Track (Advisor G. Giacomelli)

Sam Farrow is from Watsonville, California. He studied biology at Cal Poly San Luis Obispo, taking a particular interest in Botany during his time. After graduating, Sam worked as a field scientist for Hi fidelity genetics in both California and Chile.

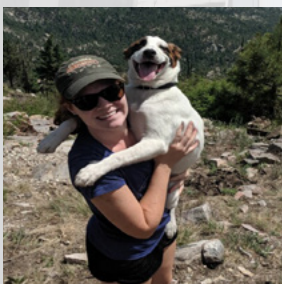
At the CEAC, Sam is working on a project with Dr. Giacomelli to use the Ebb and Flood growing technique for the production of a new greenhouse crop.



Jaymus Lee, PSM Student-Applied Biosciences-CEA Track (Advisor M. Kacira)

Jaymus was born in New Mexico and raised in the East Valley of Arizona. He obtained his undergraduate degree in Cellular & Molecular Biology from Fort Lewis College in Durango, CO.

He is interested in tribal food sovereignty, aquaponics in rural / off-grid systems, and collaboration with tribal healthcare systems. Jaymus is among graduate student trainees within NSF-NRT funded IndigeFEWWs project working with Dr. Kacira



Samantha Heward, PSM Student -Applied Biosciences-CEA Track (Advisor S. Tollefson)

Samantha Heward is from Reno, NV, and moved here for undergrad 5 years ago. She started in the Teaching Greenhouse as an undergrad intern in Fall 2018, and then became a student worker and later as greenhouse manager last May.

She assists Dr. Tollefson in running the greenhouse and helps with training interns and guiding students in the lab. She has done a few small projects under Dr. Tollefson in the past year and plans to work in the new aquaponics greenhouse this coming semester with Dr. Tollefson and Dr. Recsetar where they will be trying to grow fruiting crops with no additional non-organic nutrients.

New Graduate Students Joining in Fall 2020:

Edmundo Hernandez, PSM Student- Applied Biosciences- CEA Track (Advisor Dr. Pryor), **Amy Pierce**, AMP Student- Biosystems Engineering (Advisor Dr. Kacira), **Lianne Evans**, AMP Student-Biosystems Engineering (Advisor Dr. Kacira), **Michael Blum**, MS Graduate Student (Advisor Dr. Giacomelli)

Events (Upcoming and Updates)

NCERA-101 International Meeting

Considering the ongoing Covid-19 impact, the Sep 13-17, 2020 NCERA-101 International Meeting has been postponed and will be rescheduled. We are actively working to secure new dates and will announce them as soon as they are finalized. Ensuring the safety of our participants, speakers, exhibitors and sponsors is our primary focus. Please continue to follow the updates at <https://www.controlledenvironments.org/meetings/>

Annual CEAC Short Course and Intensive Workshops

Stay tuned for updates on our Annual Short Course (<https://ceac.arizona.edu/events/cea-short-course>) and on-site Intensive Workshops (<https://ceac.arizona.edu/events/intensive>).

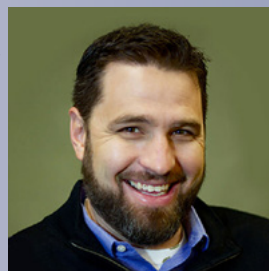
2020 CEAC Mission Award- Chris Higgins, Hort Americas

We were pleased that Chris Higgins received the 2020 CEAC Mission Award to Chris Higgins. Chris has been in the CEA industry for over 20 years and is dedicated to the commercial horticulture industry.

He currently is the President and General Manager of Hort Americas, LLC, a wholesale supply company servicing on all aspects on commercial horticulture. He is also owner of UrbanAgNews.com. Chris has served on CEAC's Advisory Board since 2018.

The award was presented at this years CEAC Short Course and accepted by Karla Garcia on Chris's behalf.

Thank you, Chris, for all of your work in the CEA industry as well as supporting our programs!



Top left: Chris Higgins, Hort Americas. Bottom right: Karla Garcia accepts CEAC Mission Award on Chris's behalf.

Stay Connected with Us!



©2020. UA-CEAC Newsletter is written and produced by Ellen Worth, Gene Giacomelli, and Murat Kacira (editors) with input from the CEAC faculty, staff and students, as part of CEAC outreach. Direct comments or questions to Ellen Worth, Program Coordinator (ellenworth@email.arizona.edu). The Controlled Environment Agriculture Program is a collaboration among UA College of Agriculture and Life Sciences (CALs) Departments, Centers and Institutes. Its programs are supported in part by State funding directed to the Department of Biosystems Engineering, and School of Plant Sciences.

Center Director: Dr. Murat Kacira



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