BIOSYSTEMS ENGINEERING

Controlled Environment Agriculture Center

25th Annual

Greenhouse Engineering Design and Crop Production

Short Course

Online & In-Person

April 15th - 17th, 2026

Welcome to the 2026 Greenhouse Crop Production and Engineering Design Short Course

Dear Participants,

Our dedicated faculty, staff, and students at the UA-CEAC, as well as guest speakers along with our sponsors and exhibitors, welcome you to the 25th Greenhouse Crop Production and Engineering Design Short Course!

University of Arizona's Controlled Environment Agriculture Center (UA-CEAC) is a multidisciplinary program with engineers, scientists, students, faculty, volunteers, and industry collaborators sharing the same vision to develop controlled environment agriculture as an economically, environmentally, and socially sustainable agricultural option. The UA-CEAC is dedicated and continues to prepare the controlled environment agriculture (CEA) workforce of the future with its research, educational, and outreach/extension programs.

We put together an excellent three-day program with lectures presented by leaders in academia and the Controlled Environment Agriculture industry and supported by our industry sponsors and exhibitors. The 25th Short Course program consists of experts in their respective fields on plant nutrition, systems, sensors and controls, insects and pests, lighting, fertigation, automation, environmental controls, plant physiology, engineering, artificial intelligence, business development, urban agriculture, mushrooms, aquaponics, microgreens, strawberries and others. They are all here to help you!

There are different kinds of CEA systems and technologies considered for crop production within controlled environments. Therefore, no single silver bullet system or solution fits all. The selection will depend on various factors, with the plants to be grown and their optimal environmental requirement being the central focus, but also including expected yield and quality, consumer expectations, market demand, climate, finances, growers' capabilities, and others. At the end of the program, you will not leave with the full knowledge of CEA aspects. However, you will have the essential information to guide you towards achieving success.

We are excited and looking forward to your active participation in this program.

Murat Kacira
Professor and Director, Controlled Environment Agriculture Center

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Acknowledgments and Thanks

OUR INVITED SPEAKERS:

Mats Kleemans, Dr. Erico Mattos, Dr. Gioia Massa,
Dr. Kellie Walters, and Karla Garcia.

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OUR ORGANIZATION AND DEVELOPMENT COMMITTEE:

Dr. Murat Kacira, Dr. Gene Giacomelli, Bree Gomez, Dr.
Triston Hooks, Dr. Matthew Recsetar, Aaron Tevik,
and Amanda O'Reilly.

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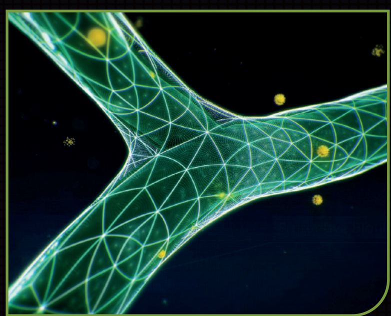

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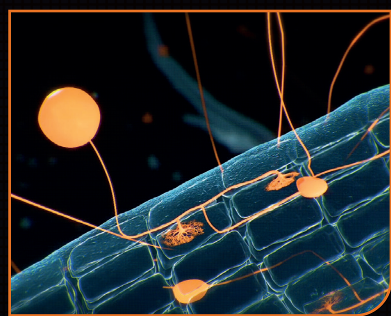

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Day 1: Fundamentals Of CEA and Hydroponics| Wednesday, April 15th

8:00 am - 8:45 am	**Check-in for on-site participants**
8:45 am - 9:00 am	**Welcome and Introductions** Dr. Murat Kacira - CEAC Director, Interim Head and Professor, Biosystems Engineering Department, The University of Arizona
9:00 am - 9:45 am	**Greenhouse Design Basics** Dr. Gene Giacomelli - Professor, Biosystems Engineering, The University of Arizona
9:45 am - 10:00 am	**Discussion and Q&A**
10:00 am - 10:45 am	**Climate Control** Dr. Murat Kacira - CEAC Director, Interim Head and Professor, Biosystems Engineering Department, The University of Arizona
10:45 am - 11:00 am	**Discussion and Q&A**
11:00 am - 11:30 am	**Break & Exhibitor Networking**
11:30 am - 12:15 pm	**Integrated Pest Management** Dr. Triston Hooks - Assistant Professor, Biosystems Engineering, The University of Arizona
12:15 pm - 12:30 pm	**Discussion and Q&A**
12:30 pm - 1:30 pm	**Lunch**
1:30 pm - 2:15 pm	**Hydroponic Plant Production Basics** Dr. Triston Hooks - Assistant Professor, Biosystems Engineering, The University of Arizona
2:15 pm - 2:30 pm	**Discussion and Q&A**
2:30 pm - 3:00 pm	**Sponsor Presentations**
3:00 pm - 4:30 pm	**CEAC Tour Day 1** Teaching Greenhouse & AdvanCEA Greenhouse

Day 2: Sustainability and Innovation in CEA| Thursday, April 16th

9:00 am - 9:45 am	**Grower of the future** Mats Kleemans, Customer Success Manager, Hoogendoorn
9:45 am - 10:00 am	**Discussion and Q&A**
10:00 am - 10:45 am	**Space Crop Production Gaps and Challenges** Dr. Gioia Massa, Project Scientist, NASA Kennedy Space Center
10:45 am - 11:00 am	**Discussion and Q&A**
11:00 am - 11:30 am	**Break & Exhibitor Networking**
11:30 am - 12:15 pm	**Organic Herb Production in Vertical Farming System** Erico Mattos, Research & Development Program Manager, SoliOrganics/80AcresFarms
12:15 pm - 12:30 pm	**Discussion and Q&A**
12:30 pm - 1:30 pm	**Lunch**
1:30 pm - 1:45 pm	**CEAC Mission Award**
1:45 pm - 2:45 pm	**Sustainability and Innovation in CEA Panel** Mats Kleemans, Jose Chen Lopez, Matthew 'Rex' Recsetar
2:45 pm - 3:15 pm	**Sponsor Presentations CEAC**
3:15 pm - 4:30 pm	**Tour Day 2** Mushroom Lab Mars Lunar Greenhouse

Day 3: Microgreens, Aquaponics, and Mushrooms Production in CEA| Friday, April 17th

9:00 am - 9:45 am	**Microgreens and Herb Production in CEA** Dr. Kellie Walters, Assistant Professor, University of Tennessee
9:45 am - 10:00 am	**Discussion and Q&A**
10:00 am - 10:45 am	**Berry Production in CEA** Karla Garcia, Technical Service Specialist, Hort Americas
10:45 am - 11:00 am	**Discussion and Q&A**
11:00 am - 11:30 am	**Break & Exhibitor Networking**
11:30 am - 12:15 pm	**Mushrooms in CEA** Bree Gomez, Research Specialist, Biosystems Engineering, The University of Arizona
12:15 pm - 12:30 pm	**Discussion and Q&A**
12:30 pm - 1:30 pm	**Lunch**
1:30 pm - 2:15 pm	**Aquaponics in CEA** Dr. Matthew Recsetar, Assistant Professor, Biosystems Engineering, The University of Arizona
2:15 pm - 2:30 pm	**Discussion and Q&A**
2:30 pm - 4:00 pm	**CEAC Tour Day 3** Aquaponics Greenhouse & Vertical Farm

1- UA - CEAC CLASSROOM

2- MUSHROOM CULTIVATION DEMONSTRATION

3- TEACHING GREENHOUSE

4- ADVANCEA GREENHOUSE

5- VERTICAL FARM

6- STRAWBERRY GREENHOUSE

7- AQUAPONICS GREENHOUSE

8- SPONSOR/EXHIBITOR NETWORKING HALLWAY

Greenhouse Design Basics- Structures, Glazing, & Cooling

Dr. Gene Giacomelli
Professor Emeritus, The University of Arizona Biosystems Engineering, The Universityo f Arizona

Dr. Gene Giacomelli is a faculty member in the University of Arizona's Biosystems Engineering Department. and former & founding director of the CEAC. He received a Ph.D. in Horticultural Engineering from Rutgers University in 1983. He also has a Master's degree in Agricultural Engineering from the University of California-Davis and two bachelor's degrees in Horticultural Science and Biological and Agricultural Engineering from Rutgers University. Here at the University of Arizona,
he teaches Controlled Environment Systems which is an introduction to the technical aspects of greenhouse design, environmental control, nutrient delivery systems, hydroponic crop production, and intensive field production systems. His research interests include controlled environment
plant productions systems (greenhouse and growth chamber research, design, development and applications, with emphases on: crop production systems, nutrient delivery systems, environmental control, mechanization, and labor productivity.

Greenhouse Design Basics - Structures, Glazing, & Cooling:

Greenhouses are controlled environment crop production systems used to overcome difficulties in climatic conditions to optimize the production. Greenhouses use a free energy source, the sun. The design and structures selected depends on the climate, and depending on your region, you'll want to take advantage of the proper design, glazing or screens, and heating or cooling systems to overcome the limitations of your environment.

The productivity and quality in greenhouse production depends on the level of technology chosen, therefore understanding of the technology and its influences on the production can help investors to make better business plans and lead to success in the operation.

Introductory Thinking

- ***Providing a Production Space***
- ***Selecting a Greenhouse Cover***
- ***Ventilating & Cooling daily***
- ***Heating nightly (& daily)***
- ***Monitoring and Control***

Growing the Crop(s)

Transport, Handling, Packaging, Marketing

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Thought[ful] List for Greenhouse Design Planning
25th CEAC Greenhouse Short Course
Dr. Gene Giacomelli giacomel@ag.arizona.edu
April 2026

Crop[s] to be grown

Environmental needs? Plant physical needs? Labor requirements? Market availability?
Understand every task to meet the plant's demand required in the production process

Climate conditions at the location of the greenhouse

Need climate for the time of year to produce crops
Required: Temperature [minimum night and maximum day]
Optional : cloud cover, wind, body of water, elevation

Grower's production experience

Soilless culture in pots, hydroponics [what specific type], aquaponics

Market

Researched? Established? Neither?---go back, begin again!

Heating

If the outside air temperature at your site during crop production will be significantly less than the minimum night air temperature required for the crop[s]….then a source of heat is required to produce a quality crop in a prescribed timeframe.

Passive solar for high tunnel for portion of the warm seasons - electrical power not required
Controlled fossil fuel heater - electrical service required, or see CEAC off-grid greenhouse
Source: Hot air or hot water heater
Distribution: fan heat exchanger, overhead hot water pipes, under bench or floor heating
Goal: Maintain setpoint air temperatures for day and night

Ventilation

Once a greenhouse structure is covered, a ventilation system is always required [sometimes immediately!].

Ventilation is air exchange from outside into greenhouse for cooling, moisture reduction, and CO2 exchange

Exhaust fans for positive, controlled ventilation. Roof peak and sidewall openings for natural air exchange based on winds, height of roof peak and size & number of openings.

Neither system can control to below [or even equal to] outside air temperature.

Cooling

Evaporative cooling can control to below outside air temperature [5 – 30 ^{o}F cooling], and is limited by the outside air humidity [greater humidity less cooling]

Wet pad wall opposite exhaust fan wall most common

Water cools the air by evaporating within the wet pad of the end wall and humidifies the incoming air which is moved through the greenhouse by the exhaust fan

Fog [or mist] cooling by spray nozzles located overhead throughout the greenhouse. More uniform within greenhouse and efficient cooling than wet pad, but challenging to maintain [water quality will block nozzles] and control [must cycle to prevent wetted plants]

Supplemental Lighting

Photosynthetic lighting and/or photoperiod control to compensate for natural environment.

Shade/Energy Screen

Indoor mechanical system to deploy screen in the night for energy conservation [20 – 40% savings], or for use in day for shading [20 – 30% light reduction] and some cooling [1 or 2 degrees] to reduce plant water stress

Monitoring and Control

Monitor air temperature and humidity, sunlight and CO2 but control mostly based on air temperature [easiest to do]. Computer control can do more complex controls with more types and numbers of sensors, as well as store and analyze data, communicate with operator, and overall provide much valuable information to the grower who can make better decisions for more efficient production.

Structure and Glazing

Structure: Single bay ground-to-ground [high tunnel] or single bay greenhouse, or multiple-bay, gutter connected

Glazing: Glass or plastic [film or rigid], single or double-layers are general choices

Glass is forever, but expensive. Plastic life is 20 – 25 years for double-wall rigids and 2 – 4 years life for the films [except ETFE, Tradename: F-Clean], and less expensive.

Double-layer air-inflated polyethylene film is very cost effective

Various additives in the plastics modify qualities [longevity, heat loss, condensation dripping, light quality change, and heat gain from the sun]

Utilities

Necessary for operations: heating fuel, water source, electrical, communications, transport access, market access, sanitary disposal

Headhouse

Storage, packing, office, restrooms, lunchroom

Plant Nutrient and Water Delivery

Water quality, get a lab test of your water source!

Fertigation – creating nutrient formulation, deliver consistently and on-demand

Delivery to plant roots: top drip, NFT, DWC [or floating rafts], Ebb & Flow [or Flood & Drain], aeroponics. All must provide the same: water, nutrients, oxygen, removing salts, maintaining pH, without light. Match system type to the crop [size, access requirements, opportunity to automate, ease of turnover, sanitation, maintenance, skill of labor required, logistics of plant and materials handling, failsafe!]

Control of irrigation cycle: timer, substrate moisture content, %drainage

Final considerations for the profitable grower

Continually learn about plant care and needs. Share your experiences. Visit trade shows.

Listen to the next generation of growers in your family and business community

Don’t block your future moves for development/expansion. Plan your production space

Attend short courses until becoming board with having more experience than the teachers

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Climate Control

Dr. Murat Kacira
Director of CEAC Interim Head,
Biosystems Engineering Department,
The University of Arizona

Dr. Murat Kacira is the Controlled Environment Agriculture Center Director and a professor in the Biosystems Engineering Department at the University of Arizona. He received his B.S. degree in Agricultural Engineering from Cukurova University in Turkey and his M.S. and Ph.D. degrees in Food, Agricultural and Biological Engineering from The Ohio State University. His research involves automation, environmental control, alternative energy integrated CEA systems, and resource use optimization in controlled environment agriculture systems, including greenhouses and vertical farming-based plant factories with artificial lighting. He is a member of the American Society of Agricultural and Biological Engineers (ASABE), American Society of Horticultural Sciences and the International Society for Horticultural Science (ISHS). He serves as Chair of the Division Precision Horticulture and Engineering under ISHS.

Climate Control:

Good crop and production system management in controlled environments rely on grower's skills, integration and use of appropriate tools and environmental monitoring and control system, making accurate measurements of key environmental and crop-specific variables, having access to meaningful data and information, and capabilities to interpret the data collected and communicate it with others timely. This lecture will focus on simple tools to technology trends on environmental monitoring in controlled environment agriculture systems for successful and resource-conserving farming in controlled environments.

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Integrated Pest Management in CEA

Dr. Triston Hooks
Assistant Professor of Practice,
Biosystems Engineering,
The University of Arizona

Dr. Triston Hooks graduated with a Ph.D. in Plant and Environmental Sciences from New Mexico State University in 2020, where he researched rangeland ecology and plant salinity tolerance. Additionally, he has worked as a Research Associate at Texas A&M AgriLife Research Center in Dallas, where his research focused on Urban Agriculture and Controlled Environment Agriculture (CEA) technology, including hydroponic systems and LED lighting. Dr. Hooks has conducted research on organic hydroponic production of lettuce and the application of ultra-violet (UV) light to enhance plant quality in greenhouse production systems. Dr. Hooks now serves as an Assistant Professor of Practice in the Department of Biosystems Engineering at the University of Arizona. He teaches Introduction
to Hydroponics, Advanced Hydroponic Crop Production, Integrated Pest Management, and is an instructor for many of our offerings, including our CEAC intensive Workshops.

Integrated Pest Management in CEA:

We know that CEA can use less water and fertilizer, but what about pesticides? Many growers overlook pest management thinking that CEA in invulnerable, but nothing could be further from the truth. This presentation covers the basics of common CEA pests and how to manage then using Integrated Pest Management (IPM) techniques such as cultural, mechanical, biological, and chemical practices so that you can become a more resilient and sustainable grower!

Notes

Hydroponic Plant Production Basics

Dr. Triston Hooks
Assistant Professor of Practice,
Biosystems Engineering,
The University of Arizona

Dr. Triston Hooks graduated with a Ph.D. in Plant and Environmental Sciences from New Mexico State University in 2020, where he researched rangeland ecology and plant salinity tolerance. Additionally, he has worked as a Research Associate at Texas A&M AgriLife Research Center in Dallas, where his research focused on Urban Agriculture and Controlled Environment Agriculture (CEA) technology, including hydroponic systems and LED lighting. Dr. Hooks has conducted research on organic hydroponic production of lettuce and the application of ultra-violet (UV) light to enhance plant quality in greenhouse production systems. Dr. Hooks now serves as an Assistant Professor of Practice in the Department of Biosystems Engineering at the University of Arizona. He teaches Introduction
to Hydroponics, Advanced Hydroponic Crop Production, Integrated Pest Management, and is an instructor for many of our offerings, including our CEAC intensive Workshops.

Integrated Pest Management in CEA:

Systems, substrates, and nutrient solutions, oh my! Feeling intimidated by hydroponics? This presentation covers the basics for both leafy greens and vine crops and attempts to demystify hydroponic plant production so that you can be a confident and better grower!

Notes

Grower of the Future:

Mats Kleemans

Customer Success Manager, Hoogendoorn

Mats Clemans grew up on his parents' chicory farm, where he developed an early passion for agriculture and food production. After studying at several universities in the Netherlands and completing internships across Europe and Asia, he transitioned into horticultural technology software. For several years now, Mats has worked as a global customer success manager at Hoogendoorn, advising customers on horticultural systems worldwide. Through this work, he encounters diverse local challenges and focuses on optimizing systems by bridging biology and software, with a strong emphasis on sustainability, biology, and artificial intelligence.

Grower of the Future:

The lecture Grower of the future will take the audience on a journey into the greenhouse of tomorrow, seen through a Dutch lens of innovation, efficiency, and sustainability. As global Controlled Environment Agriculture (CEA) faces mounting challenges around energy, labour, and climate, this lecture explores how artificial intelligence, algorithms, and robotics are reshaping food production. What role will data-driven decision-making play? How can automation address labour shortages while improving yields? And how can growers and agribusinesses remain both sustainable and financially viable? Blending real-world insights with emerging trends, this session offers a forward-looking perspective on how technology can empower the next generation of resilient, intelligent farms.

Notes

Space Crop Production Gaps and Challenges

Dr. Gioia Massa

Project Scientist, NASA Kennedy Space Center

Gioia Massa is the principal scientist at NASA's Kennedy Space Center working on space crop production for the International Space Station, the moon, and future exploration endeavors. She led the science team for the Veggie validation, and she heads interdisciplinary teams to study nutrition, flavor, microbial composition, and stress responses of space-grown crops. She has a BS in Plant Science from Cornell, a PhD in Plant Biology from Penn State, and conducted postdoctoral research at Purdue University and Kennedy Space Center. She has worked in the areas of plant space biology and bioregenerative life support.

Space Crop Production Gaps and Challenges:

As astronauts venture farther from Earth, and stay for longer periods, the space food system will increase in importance. Crop production can supplement a pre-packaged space diet to provide nutrition and dietary variety for space crews. In future missions, bioregenerative approaches may be used to generate a larger percentage of the diet, as well as help to reduce life support system burdens and resupply from Earth. Plants may also provide behavioral health benefits to crew members living in the isolated, confined environment of a space habitat. A number of unique challenges exist for growth of plants in microgravity and on other reduced gravity surfaces like the moon and Mars. Testing with the Veggie and Advanced Plant Habitat (APH) chambers on the International Space Station is allowing us to understand the impacts of gravity and spaceflight on crop growth, nutritional content, acceptability, and the importance of plants to astronauts living and working away from Earth. We are also gaining a better understanding of food safety concerns and the behavior of space plant microbiomes and plant pathogens, but major gaps in knowledge remain. As we move from research towards operational space crop production to enable exploration, there are numerous gaps in technology, knowledge, and practice related to space crop growth that must be addressed. Research and development in key focus areas such as effective water and nutrient delivery at variable gravity levels, autonomous plant health monitoring, and selection of ideal space crops are needed to fill these gaps. Breeding or engineering custom space crops may impact areas including plant growth and development, plant physiology, produce nutrition, sensory acceptability, and post-harvest characteristics, and these may further enable space crop production scenarios. Space crop challenges are multifaceted and require diverse interdisciplinary teams working together to develop effective solutions. Solving these requires an array of skill sets from across the biological and physical sciences, engineering, and human social sciences. Solutions to help ensure food security off-Earth may also translate to more sustainable terrestrial crop production approaches, and regular dialog between industry, academia, and government organizations working in related fields benefit all. Additional help can come from engagement with student researchers at various levels through courses, participatory science projects, and open science activities which can provide useful data. Global coordination and integration between space agencies and partners will be essential.

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Organic Herb Production in Vertical Farming Systems

Dr. Erico Mattos
Research & Development Program Manager, SoliOrganics/80AcresFarms

Erico Mattos holds a PhD in Crop and Soil Sciences from the University of Georgia, where he co-developed a chlorophyll fluorescence–based biofeedback control system to improve LED lighting efficiency in controlled environment agriculture. He later co-founded two companies focused on dynamic lighting control systems for greenhouses, aimed at improving energy efficiency and crop productivity. Erico went on to serve as the first Executive Director of the Greenhouse Lighting and Systems Engineering (GLASE) Consortium at Cornell University, a public–private partnership connecting growers, technology manufacturers, academics, and government agencies to develop and implement energy-efficient technologies for controlled environment agriculture. Since 2023, he has served as R&D and Agronomy Program Manager at Soli Organic / 80 Acres Farms, where he leads cross-functional initiatives to develop and implement new technologies and operational improvements to optimize organic herb production systems.

Organic Herb Production in Vertical Farming Systems:

Organic herb production in vertical farming systems combines the precision of controlled environment agriculture (CEA) with the regulatory and biological constraints of organic certification. While vertical farms allow tight control of environmental conditions, organic production requires careful selection and management of certified inputs, including propagation materials, growing substrates, and nutrient sources. This lecture will provide an overview of the key components of organic herb production in vertical farms, with emphasis on input requirements, certification considerations, and operational strategies to maintain consistent crop performance. The session will also discuss the main challenges and opportunities of organic production compared to conventional CEA systems, and highlight practical approaches to integrating organic standards into indoor farming operations.

Notes

Microgreens and Herb Production in CEA

Dr. Kellie Walters

Assistant Professor,
University of Tennessee

Kellie is an Assistant Professor in the Department of Plant Sciences at the University of Tennessee (UT). Since joining UT September of 2020, she created the Controlled Environment Plant Physiology Lab where her research team focuses on food crop physiology in controlled environments including greenhouse and indoor production systems, spanning from potted culture to hydroponics. The overall goal is to determine how to leverage environmental controls (i.e. light intensity, duration, and quality, temperature, and CO2), plant nutrition, and plant growth regulators and hormones to improve vegetable, leafy green, and culinary herb production efficiencies, yield, and crop quality. In addition to general physiology and production research, her lab is focusing on metabolites contributing to crop flavor and nutritional value to improve taste, appearance, overall consumer appeal, and producer profitability and sustainability.

Microgreens and Herb Production in CEA:

Controlled-environment agriculture gives us the opportunity to precisely control the growing environment to elicit our desired plant responses. The problem is, what should that environment be? In this session, we will focus on culinary herb responses to temperature, light, CO2, and nutrient solutions both during propagation and throughout production. We will also discuss microgreens including species selection and production from sowing to harvest. Learn how the production environment and cultural practices influence yield, color, flavor, and consumer perceptions.

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Berry Production in CEA: Strawberry, Blueberry, and Blackberry

Karla Garcia
Technical Service Specialist, Hort Americas

Karla Garcia is a passionate plant physiologist with over 12 years of experience in the field. Her journey began in her hometown of Hermosillo, Sonora, Mexico, where she joined an Eco-physiology Lab as an undergraduate student. Karla holds a Master's Degree in Plant Science from The University of Arizona and specializes in plant physiology in controlled environments. She is deeply committed to promoting sustainable horticultural practices for food production.

Throughout her career, Karla has served as a technical adviser and consultant for various companies and has taught short courses in hydroponics, urban farming, and greenhouse design across the Americas. She has also successfully managed a microgreens company for over 7 years. Now, as part of the Hort Americas team, Karla is focused on supporting customers with their horticultural needs, guiding them to successful projects, and leading sales efforts in Mexico.

Berry Production in CEA: Strawberry, Blueberry, and Blackberry

Controlled environment agriculture (CEA) offers powerful tools to enhance yield, fruit quality, and resource-use efficiency for strawberry, blueberry, and blackberry production. This presentation synthesizes recent research and practical strategies for greenhouse and plant-factory production of these berries, emphasizing species-specific and shared approaches to environmental management. Key topics include optimized light spectra and photoperiod strategies, temperature regimes linked to fruit quality and phenology, and tactics to maximize photosynthesis across crops. We will examine the roles of relative humidity, ventilation, and pollination management on fruit set and development, plus best practices for substrate choice, irrigation scheduling, and crop-tailored nutrient programs. Additional focus areas include cultivar selection, integrated pest and disease management, and the use of sensors and automated controls to maintain stable, high-quality production. We will also review grower-applied data from commercial systems to evaluate real-world performance and practical adaptations. Understanding interactions among these factors is essential for consistent, efficient berry production in diverse CEA systems.

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An Argument for Mushrooms

Bree Gomez
Researcher, Edible Mushroom Cultivation
The University of Arizona

Bree Gomez holds a B.S. in Environmental Science with an emphasis in Microbiology and an M.S. in Geographic Information Systems from the University of Arizona. Based at the Controlled Environment Agriculture Center, Bree brings over a decade of experience in mycology laboratory work, specializing in the cultivation of edible mushrooms.

Bree's current work explores the potential of mushroom cultivation systems to transform non-edible biomass into nutrient-rich food. This closed-loop approach reflects a broader commitment to practical, scalable sustainability, demonstrating how food production can create abundance while reducing waste.

With a deep interest in maintaining healthy, functioning natural systems, Bree is especially motivated by work that bridges ecological stewardship and community resilience. Agriculture and food production remain central to that mission, serving as both a professional focus and a personal passion.

An Argument for Mushrooms:

Humans have been using mushrooms as far back as we know of. Otzi, the ice man, who is estimated to have lived 5000 years ago had with him two different fungal species, a birch fungus, known to have anti parasitic properties along with a Fomes fomentarius conk, also known as a tinder fungus, thought to have been used to carry embers around to facilitate getting a fire started.

Here at the Controlled Environment Agricultural Center we are taking a closer look at how some of the cultured mushrooms can be further incorporated into our CEA efforts both with regards to CO2 production, potential for plant substrate materials, the recycling of non-edible biomass, and all of this in addition to edible mushrooms.

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Aquaponics in CEA

Dr. Matthew "Rex" Recsetar

Assistant Professor,
Biosystems Engineering,
The University of Arizona

Dr. Matthew “Rex” Recsetar has over 13 years of hands-on experience with aquaponics systems, excelling in the construction, design and operation of various system setups. His capabilities extends to cultivating a diverse range of plants and fish, alongside imparting his knowledge through teaching and training initiatives. He runs a consulting business called ZonaPonics where he channels his expertise into developing and optimizing commercial aquaponics farms. Dr. Recsetar’s commitment to education is evident as he teaches courses on Aquaponics Design and Aquaponics Engineering at the University of Arizona. In addition, he teaches a class on the Future of Food focusing on food production technologies.Dr. Recsetar’s research ventures delve into diverse aspects of aquaponics, including nutrient dynamics, decoupled aquaponics, sludge mineralization, system optimization, root microbiome and aquaponic feed alternatives. Outside of aquaponics, he has also focused extensively on aquaculture, hydroponics, sustainable food production and wastewater treatment.

In 2019, he developed and patented a phyto-mediated wastewater treatment bio-reactor (PWBR which demonstrated removal capabilities of 90% or better of nearly all contaminants of emerging concern (CECs found in tertiary-treated wastewater effluent from a Tucson WRF. He has also examined the potential for aquaculture biosolids to be used as a soil amendment for growing wheat. Recently, he performed research that examined various nutrient management techniques and optimized water-use efficiency in commercial decoupled aquaponics systems growing Cannabis sativa (hemp. His current research topics include the examination of root microbiomes in aquaponics systems and hydroponic systems seeded with aquaculture effluent, optimization of sludge mineralization, and fishmeal replacement in aquaculture feeds that can be tailored to meet nutrient demands of aquaponics systems growing high-value crops.

Aquaponics in CEA:

Aquaponics, a complex method of growing fish and plants together presents a unique approach to sustainable agriculture. While similar in most respects to hydroponics, aquaponics utilizes aquaculture effluent as a natural nutrient source for plants, replacing inorganic salts. This not only facilitates organic plant production, but improves water use efficiency. Initially adopted on a small-scale by hobbyists, schools and individual greenhouse operations, aquaponics has gradually transitioned into large-scale commercial production with increased use of technology and environmental control. Challenges in scaling aquaponics historically impeded large-scale adoption, but ongoing research into nutrient dynamics and management as well other innovations has made this a more desirable endeavor, especially for high-value crops or for growing in arid regions.

Notes

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