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WELCOME TO *CEAG WORLD INSIGHTS*!


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THIS INNOVATIVE MULTIMEDIA EDITION has been uniquely designed for you, the leaders of the rapidly growing industry advancing produce grown under cover.

The mission for *CEAg World Insights* is to provide a forum to connect, inform and engage all segments of this diverse industry. From outdoor growers deploying new environmental control technologies to fully automated indoor greenhouses and vertical farms, along with allied industry partners, *CEAg World Insights* is your community.

Each interactive edition leverages the latest digital technology to provide a compelling, content-rich format blending articles, videos, graphics, soundbites and more for maximum impact. The printed companion distributed at key industry events provides even broader coverage.

The future editions this year in August, October and December will each have a unique theme and will explore the latest intel, perspectives and thought leadership. Each will showcase industry-leading voices, tips and best practices, data-informed strategies, business-focused solutions, and more to advance your business.

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OUTSMARTING THE SAFFRON STRUGGLE

Dana Shugrue
CEAg World Content Specialist

SAFFRON HAS BEEN SHOWN to boost the flavor of food and promote physical health. But with a short growing season and limited harvesting window from late October to early November in its traditional growing region, it's difficult to provide a fresh, consistent supply of it that allows consumers to take advantage of saffron's many benefits. That's why Saffron Tech will cultivate saffron year-round in a vertical farm.

The company launched its pilot site in Ganei Tal, Israel on May 8, 2024. It's a one-room vertical farm run by five full-time employees and daily subcontractors. CEO of Saffron Tech, Tal Wilk-Glazer, looks forward to growing saffron four times per year and cultivating the spice in an indoor environment.

Photos: Saffron Tech

"When you grow saffron outdoors, the entire field will bloom in one day. You'll need to go through the entire field in the morning, harvest all the flowers, then start the process again," Wilk-Glazer said. "You cannot decide which part you are going to harvest today and which part you're going to harvest tomorrow because everything must be harvested when the flower blooms or the quality of the saffron will drop."

RECOGNIZING A BUSINESS NEED

The decision to cultivate saffron indoors wasn't made on a whim. Wilk-Glazer spent more than three years researching the spice and developing a business plan to ensure she would see a good return on investment. Considering the high market price of saffron, she wasn't as worried about making a profit – she was more concerned with cultivating it correctly.

"When you start talking about saffron, you quickly learn how expensive it is, and it's always good to cultivate something that's expensive," she said. "Our first step was understanding what the exact requirements would be for [saffron] cultivation. Once we had a good understanding of the requirements for cultivation, we translated that into technical requirements."

Tal Wilk-Glazer

Most of these requirements meant getting the right technology for cultivation. Wilk-Glazer spoke with many service providers to get the equipment she needed but struggled to find the right pieces for a reasonable price.

"We couldn't find some [technology] that supported our requirements at a price we believed to be profitable," she said. "So, we had to take a different path and start to identify which pieces we couldn't buy and we developed those instead."

For example, Wilk-Glazer and her team developed the vertical towers used within the farm internally. Workers planted the first corms in the towers the second week of May 2024 and will monitor them throughout the first harvesting cycle.

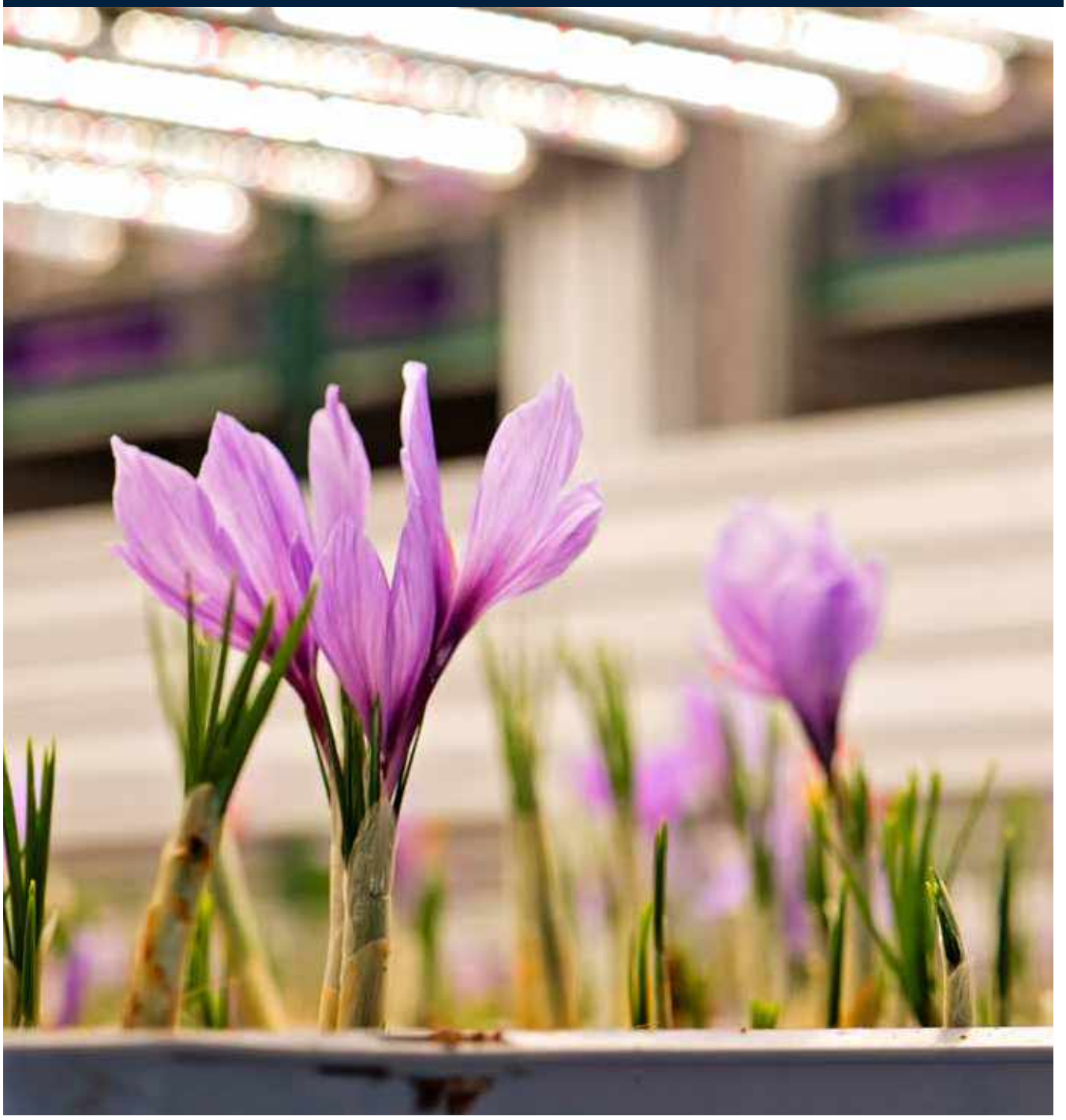
During this process, Wilk-Glazer will pay close attention to how the towers function and how much electricity is needed to run the vertical farm.

"The most expensive part [of vertical farming] is electricity. You need to take the sun, which is free, and exchange it for electricity for climate control," she said.

TESTING LIGHTING OPTIONS

Saffron Tech partnered with different organizations to develop the site, including DreamTech, a Korean tech company, and the Israeli Innovation Authority. Wilk-Glazer also worked with multiple LED companies to come up with the right lighting solution to cultivate saffron, which is still a work in progress.

"We are taking smaller groups of corms and testing different lighting solutions on each one," she said. "One group will get more red light at one point in cultivation, and another group will get more blue light at the same point. This allows us to understand exactly what's improving the [saffron] cultivation and what the exact impact is."



The pilot site will harvest saffron four times per year, but with staggered flowering times. This enables that year-round grow-harvest cycle with a consistent supply on rotation.

Once workers harvest and dry the saffron, it will be easier to distribute

in the market. Unlike lettuce and mint, which perish quickly, the spice is much easier to transfer from city to city as a dried material.

While there are many benefits to cultivating saffron, it's difficult to do for economic reasons. This is especially true when it comes to outdoor farming, as the yield per square meter in a saffron field is low. Plus, saffron is typically cultivated in a very limited number of places where the climate is conducive to growing the spice in open fields, such as Iran.

"If you have a field, it's probably better to grow anything other than saffron," she said. "You need a huge number of working hands for such a short flowering period."

With its new indoor vertical farm, Saffron Tech reduced the need for so many "working hands," as it can stagger harvesting the flowers. This is a huge win for companies that require a reliable supply.

"I expect that the ability to grow consistent, high-quality saffron is going to be a real game-changer in several markets," Wilk-Glazer said.

"The majority of companies are either using it in a very limited manner or simply don't use it because their supply is not stable."

Saffron Tech's new facility aims to boost these companies up by providing them with the saffron they need, when they need it. While the site might be a one-room vertical farm now, the company plans to have a mass production facility up and running by the second half of 2025. •

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RISING TO THE CHALLENGE OF EXTREME HEAT

By Jolene Hansen

WHEN GROWING FOOD in some of the world's most challenging climates, CEA holds the potential to change not only agriculture, but also life itself. For areas like the Middle East, U.S. Southwest, Northern Africa and others, one obstacle to fresh, local food production is eminently clear: extreme heat and its impact on every aspect of growing.

Ryan Lefers

Ryan Lefers is CEO and co-founder of iyris, a company dedicated to innovative, environmentally friendly CEA technologies that address issues such as climate-related food security. Originally launched in Saudi Arabia under the RedSea name, the company's initial focus was water-related projects involving saltwater resources for cooling or making plants more salt- and heat-tolerant. Now rebranded as iyris, the company concentrates on technologies to manage extreme heat.

Inspired by the extreme Saudi environment, Lefers explained that the company's work with freshwater

All images courtesy of iyris

SecondSky coverings provide innovative alternatives to traditonal plastics.

scarcity and water security led to an epiphany of sorts. The team recognized that the challenges associated with saltwater and salty soils are largely heat induced, and the shift to heat-conquering technologies began.

HEAT-BLOCKING INNOVATION

The primary innovation driving iyris today revolves around a first-of-its-kind greenhouse roof technology that started as a transparent photovoltaic cell. The cell could absorb heat from the sun, let the light through, and create electricity in the process.

When the technology's developers approached Lefers about possible CEA applications, he was impressed. But more than the energy production, he was intrigued by the product's ability to exclude heat — and indirectly reduce the massive energy spent trying to keep greenhouses cool in extreme environments.

He recalled telling them, "The fact that you can create electricity from this is great, but 90 to 95% of the battle is keeping that heat out." The development of heat-blocking, light-admitting greenhouse covers led to the launch of iyris.

TUNING OUT THE HEAT

As the iyris team refined its product and approach, it developed an additive inserted into the manufacturing process for the various covers offered in the iyris SecondSky line.

SecondSky technology makes soft fruits viable crops in extreme environments.

"All you do is replace your roof, and boom! You have this new cover that actually selectively filters solar radiation in such a way that it blocks a percentage of the heat from coming into your greenhouse, but it maximizes the light transmission for photosynthesis," Lefers explained.

The technology can be used with different covers, from films to polycarbonate hardcovers.

"We can also tune the amount of heat that you want to block," Lefers said. "In low, we typically think of blocking somewhere around 40 to 50% of the heat. Medium would be somewhere like 50 to 65%, and then high would be like 65 to 80% of the heat that we're actually blocking from coming into the system."

PEAK HEAT OPTIONS

In the past, growers in extreme heat environments had few choices beyond moving to a more hospitable climate.

"If you're stuck in your location, the tradeoff is that you can put on shade or you can put on whitewash, but you're going to lose some light. So, farmers have to balance," Lefers said, stressing that peak heat pressures affect growers globally, from Mexico to the U.K. to Dubai.

What follows in most cases is a balancing act between light needed for photosynthesis and the heat that comes with light.

"It's not even like maximizing production as much as it is like trading off production just for keeping the crop alive," Lefers added.

With iyris technology, growers can maximize their light and still keep out the heat.

As the company's focus shifted to heat from salinity-related technologies, it's now circled back a bit. Its original work with plant genetics revealed traits for salinity tolerance aligned with heat and drought tolerance as well as general resilience. That led to the development of several resilient tomato rootstock varieties for grafted tomatoes.

Lefers shared that the rootstocks' performance in global field trials in harsh climates has been positive and their introduction is drawing near.

"We're in the final stages of plant variety rights protection, so they'll be coming to market very soon — later this year, most likely — for wider distribution," he said. •

Jolene Hansen *is an award-winning freelance writer and editor who has covered the horticulture, specialty ag and CEA industries for more than a decade. Reach her at jolene@jolenehansen.com.*

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Hydroponic image (combined by Dr. Karthikeyan): Mustard greens. (c) Branham, Clemson University. Cucumbers. (c) Kousik, USDA-ARS. Tomatoes. (c) Ling, USDA-ARS.

Hydroponics crops under study, left to right: Mustard greens, cucumbers, tomatoes.

FRESHWATER SCARCITY AND SALINE-WATER IRRIGATION

By Jolene Hansen

Diminishing freshwater resources and related issues of saline intrusion and saline soils aren't just regional issues reserved for desert climates. These global concerns mandate changes, not only in how agriculture uses water, but also in the water it uses and the crops it grows.

In response to these challenges, a research team comprised of members from Clemson University, University of Florida and the USDA's Agricultural Research Service is tackling the problem with a CEA twist:

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the development of a hydroponic platform to grow salt-tolerant crops with saline-water irrigation, without negative environmental impact.

Boosted by a $10 million USDA National Institute of Food and Agriculture grant, the project led by agricultural scientist and project director Dr. Raghupathy Karthikeyan, Clemson's Newman Endowed Chair of Natural Resources Engineering, and co-project director and environmental engineer Dr. Gary Amy, Dean Distinguished Professor in the Clemson Department of Environmental Engineering and Earth Sciences, launched about one year ago.


Clemson University

Dr. Raghupathy Karthikeyan


Clemson University

Dr. Gary Amy

CEA TO THE RESCUE

Dr. Amy noted that people often think about climate change–induced drought in places like California or Texas in the U.S. However, low elevation makes places like South Carolina and Florida vulnerable to climate change-induced saltwater intrusion into aquifers, as well as river deltas and estuaries.

As sea levels rise and the so-called "salt line" moves inland, every aspect of crop production must adjust. Finding ways for traditional agriculture to use saline water to irrigate salt-tolerant crops simply creates more problems.

"You're using margin-quality saltwater and you're putting it on the land and you're salinating the soils," Dr. Karthikeyan explained. "The rough estimates for if you put one gallon or one liter of saltwater in the soil, it

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could take anywhere from 30 to 300 liters to flush it out depending on the site."

With a CEA platform, water is recycled, brine is controlled, saltwater is controlled, and growers know exactly where saltwater irrigation will be captured, reused and recycled.

"That's why we are advocates of hydroponics in this particular application," Dr. Amy added.

A NEW DESALTING PARADIGM

The current desalination mindset focuses on drinking water, not agriculture, Dr. Amy explained.

"It's looking at achieving very, very low levels of salt that are consumable by humans. We're looking at an opposite perspective here," he said. "We're looking at salt-tolerant crops that can tolerate higher levels of salinity where maybe we have to do what we call partial desalting."

While the energy footprint and unit costs of complete desalination for drinking water are high, Dr. Amy said, partially desalting is much less energy intensive.

"We're thinking about a new paradigm for how we desalt for salt-tolerant crops," he said.

The research goes deeper than overall salinity to explore nutrient optimization of saltwater sources; for example, by retaining beneficial ions such as calcium in the desalting process, while minimizing others.

CEA's complete control is integral to the idea.

"The crop water use in CEA could be 1/10 to 1/100 of conventional systems," Dr. Karthikeyan said. "So it's not only that partial desalination is cutting energy, but obviously we're not going to be treating humongous volumes of water. The water we are going to be using is also very small, very minimal."

TARGET CROPS, TAILORING SALINITY

The research focuses on three crops — mustard greens, cucumbers and tomatoes. Chosen not for existing salt tolerance, they represent high-value crop families from Brassicas and leafy greens to high water-usage crops to tomatoes, an obvious choice, Dr. Karthikeyan said, as it is the number one vegetable crop that is consumed.

Still early in the project, the team is now focused on pre-breeding and phenotyping well over 1,000 lines of the three vegetables for salt acclimation. The screening ranges from wild and landrace types to stable, commercially available varieties, accumulated from all over the world.

Ultimately, the program will develop new varieties with varied levels of saline tolerance for commercial production and further breeding. CEA growers will be able to choose varieties suited to saline levels in their irrigation water or tailor saline irrigation levels to match their crop.

"In terms of salt tolerance, this is not a cliff. It's a continuum," Dr. Amy said. "As you lower the salinity, you get a greater yield. But it costs money to lower the salinity, and then we have to think about the desalting investments we have to make in order to achieve that."

In the end, the researchers aim to find that sweet spot of optimum crop yield and nominal desalting energy and costs. At the core will be hydroponic CEA facilities using naturally occurring saline water to grow food crops — without jeopardizing freshwater resources or salinizing soils. •

Jolene Hansen is an award-winning freelance writer and editor who has covered the horticulture, specialty ag and CEA industries for more than a decade. Reach her at jolene@jolenehansen.com.

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John Wynne
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WATER IS ESSENTIAL FOR ALL LIFE ON EARTH, and it plays a crucial role in agriculture, the backbone of our food system. However, the availability of clean water for farming is becoming increasingly scarce worldwide, posing a significant threat to food security and agricultural sustainability.

Water scarcity is a pressing issue that affects agriculture in various ways. As the demand for food continues to rise with a growing global population, the pressure on water resources for irrigation, livestock and crop production is intensifying. Many regions around the world are already experiencing water stress, where the demand for water exceeds the available supply, leading to competition among different sectors, including agriculture.

Lack of clean water hinders crop production in several ways. Insufficient irrigation water can result in crop failure, reduced yields and poor crop quality. Farmers in water-stressed regions often resort to unsustainable practices such as over-extraction of groundwater, which leads to land degradation and depletion of aquifers. Water scarcity also limits the diversification of crops, as certain crops require more water than others, forcing farmers to focus on water-intensive crops to maximize their limited water resources.

Addressing water scarcity in agriculture requires a multi-faceted approach that involves sustainable water management practices, technological innovations, and policy interventions. Implementing efficient irrigation systems, such as drip irrigation and rainwater harvesting, along with utilizing superabsorbent polymers, can help farmers optimize water use and reduce waste. Promoting crop varieties that are drought-resistant and less water-intensive can also contribute to water conservation in agriculture.

Investing in water infrastructure, such as water storage facilities and irrigation networks, can improve water access for farmers in water-stressed regions.

Water scarcity poses a significant challenge to farming worldwide, impacting crop production, livestock farming and the environment. Addressing this issue requires collective action at the global, national and local levels to ensure sustainable water management practices and secure the future of agriculture. By prioritizing water conservation, promoting water-efficient farming techniques such as controlled environment agriculture, and utilizing sustainable tools such as Stockosorb® 660 water saving gels that are available to the farming community now, we can mitigate the impact of water scarcity on farming and safeguard food security for generations to come. •

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SHIELDING MICHIGAN SWEET CHERRIES

By Jolene Hansen

REFERENCES TO CEA AND CONTROLLED ENVIRONMENTS typically evoke thoughts of greenhouses protecting tomatoes or leafy greens. But at vertically-integrated Riveridge Land Company in Grant, Michigan, U.S.A., protected cropping means sweet cherry trees under cover.

If the idea of 30 acres of sweet cherries under protective coverings on an elaborate trellis system sounds a bit spendy, it's all relative.

Riveridge Operations Manager Justin Finkler reports the cost for the cover system, which has an eight-year lifespan, averages out at about $3,000 per acre per year. The initial installation required roughly 190 labor hours per acre to build the supporting trellis and install the protective covers. Putting the covers up and taking them down costs another 25 to 30 labor hours per acre every season.

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But Finkler is happy with the annual outlay — so happy that Riveridge plans to have 90 more acres of protected cherry trees by 2027. That includes 40 acres planted in 2023 and 50 more planted in 2024.

PUTTING COSTS IN PERSPECTIVE

To understand the ROI in action with Riveridge's sweet cherry trees, it helps to know the land is close to Lake Michigan on the U.S.'s northern border and subject to the whims of lake-effect weather, helped along by extremes of climate change.

Riveridge incorporates protective coverings and bird netting to protect its cherry crop.

Finkler explained that when rain hits, especially as harvest time grows near, unprotected cherries can sustain significant damage due to cracking.

"With us being so close to Lake Michigan in the summertime, we don't have a lot of time to react to a rain event," he said. "You get an inch of

rain within 10 days of harvest, and it can be a complete disaster. It has happened to us several times."

The grower's only choice is to harvest the fruit early or let the crop go to waste. Before the protective covers were in place, Finkler and his team would opt to pick the immature crop.

"If you get one chance to harvest it before you get the rain coming, we usually err on the side of caution," he said. "It's really forced our hand to not pick the best eating-quality fruit."

It was the risk of cracking that finally drove Riveridge to start exploring options for protective cropping in 2017.

"Being able to grow any kind of program or having confidence in any kind of volume throughout the season, you have to have a cover on it," Finkler said. "Our climate is erratic enough that you have to do some of these things as a countermeasure. It seems like there's something every year."

TRANSITIONING TREES TO PROTECTION

Riveridge's hard-earned and hard-learned lessons led the company to start prepping blocks of the orchard for a transition to protective covers. The initial installation of the system, from German manufacturer Voen Covering Systems, took place in early spring 2022. Mature trees already 12 to 15 feet tall on existing acreage complicated the process and the learning curve.

Without the equipment it needed, the company tried renting. Some equipment worked, some didn't. So, like resourceful growers are prone to do, they started customizing equipment to do the job better and easier. Customizations included skid steer platforms and attachments to simplify

SLIDESHOW »

handling the rolls and cabling involved with the covers. The grower also switched to high-density, V-trellised, upright fruiting offshoot (UFO) plantings for the new acreage.

When spring frost threatened the cherries in 2023, protective covers went up for frost protection in mid-April and stayed for the season.

"We're starting to harvest the third week of June through the third week of July, so I didn't feel like it made a lot of sense financially to pull them back in and then pull them back out with the man-hours," Finkler explained. "I don't know if we'll continue doing that across all varieties on


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Riveridge also added vertical bird netting around the perimeters of all its covered acreage.

"It does make a significant difference as far as bird damage goes," Finkler added. "When we were picking and packing cherries last year, there were virtually no bird pecks in the packs."

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Hail, which usually coincides with the rainy season, hasn't hit yet. But the covers took 70 mph wind gusts in stride, with no significant issues.

TALLYING THE EXTRA BENEFITS

While the protective covers and bird nettings achieve their purpose, Riveridge is enjoying bonus benefits from its investment. During last year's frost, Finkler reported temperatures under the covers were 3 to 5 degrees Fahrenheit higher. Heaters, able to work under the covers, raised the temps even more. (The team used wood pellet fuel for soot-free heat that wouldn't damage the covers.)

Indirect benefits of the bird netting include pest and disease protection. Riveridge doesn't target spotted wing drosophila (SWD), but some of the netting is fine enough to inhibit the pest. Rain protection leads to less pressure from diseases like bacterial canker and leaf spot. Finkler said that the netting helps block wind, which may help increase temperatures when needed.

Last, but not least, the cover system helps promote pollination as bees warm up to the under-cover temps.

"If we can gain a few degrees and get the bees to work a little better, we can spread our pollen around," Finkler said.

Finkler believes Riveridge is the only cherry grower in Michigan covering its crop, but that may soon change. Word about the protected sweet cherries crop is spreading, and growers are interested.

Finkler has high praise for the system. From a financial standpoint alone, he said, after investing money and labor in planting and maintaining the cherries, it doesn't make sense to risk a crop. Plus, bringing a consistent supply to market is crucial to developing a strong customer base as Riveridge continues expanding.

Finkler said the learning isn't over yet: "We've been happy with what we've seen so far. We're anxious to learn more as these orchards grow and figure out what we actually can do underneath these covers." •

Jolene Hansen *is an award-winning freelance writer and editor who has covered the horticulture, specialty ag and CEA industries for more than a decade. Reach her at jolene@jolenehansen.com.*

GOING THE DISTANCE WITH SANITATION

Eric Smith
BioSafe Systems

IF YOU'RE NOT LOOKING OUTSIDE THE CONFINES of your growing facility, you could be unintentionally leaving the door open for destructive pests or pathogens. It's time to think about addressing the cross-contamination sites outside the front door.

Maintaining outdoor spaces around your property reduces the risk of cross-contamination from insect pests and plant pathogens. Remember, knowledge is the best defense and will save you chemical or remedial costs in the future.

Water and weeds are two serious host sites for pests and pathogens. In both ways, they can be carried around your property by latching on to employees' shoes, equipment, through air vents, or water transport. Certain species of weeds may seem harmless, but they can be havens for harmful pests and grow pretty much anywhere.

Water sources maintenance is also important, as they are the lifeline of growing operations. Clear water isn't necessarily clean

water; it could still harbor plant and human health pathogens. Municipal waters are often tested for human health pathogens but not for plant pathogens such as *Pythium*. Algae and cyanobacteria not only look and smell bad on the surface, but they also pull vital oxygen from the water that plants need to thrive. Treating source water is imperative to maintaining a clean facility and healthy, happy crops. Make sure stock tanks get a good cleanout between crops too; they can spread pathogens just as easily as outdoor irrigation ponds.

Cleaning out dumpsters routinely and using appropriate filters in air systems are also quick and easy ways to protect your facility from potential sources of cross-contamination.

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HOW BREEDING, TECHNOLOGY AND AI PROTECT CROPS

By the *CEAg World* Content team

ERRATIC WEATHER INCIDENTS AND EXTREME CLIMATES have made it difficult to grow outdoors in recent years. According to Vonnie Estes, Vice President of Innovation at the International Fresh Produce Association (IFPA), implementing agricultural technology and AI could be the key to protecting outdoor crops, including those grown under covers such as hoop houses or high tunnels.

Using agricultural technology doesn't always require robots or fully automated greenhouses. In some cases, a hoop house, tunnel or covering might be the extra layer of protection an outdoor grower needs to protect crops from sun or storms.

"The sun is more intense nowadays with climate change," Estes said. "Some of these fruits and vegetables can't handle that extreme sunlight, so [some growers] might just need to put up a tunnel that can open and close itself so their crops don't burn."

HOW CAN AI HELP PROTECT CROPS?

AI is a huge player in today's ag tech space in many capacities. One way it will revolutionize crop production is in plant breeding as the climate continues to change. This is especially helpful for areas that experience particularly hot summers and bitter cold winters.

Meet Vonnie Estes of IFPA

WATCH HERE

"AI is beneficial when looking at things like gene editing and breeding in different climates," Estes said. "[With the right breeding], a plant might be just fine at a hotter or colder climate."

This would enable outdoor growers to protect crops from physical climate disruptions (hail, wind, sun, etc.) with semi-permanent structures while protecting the crops from heat and cold through breeding techniques.

"There's a lot of exciting technologies in crop protection that will help us grow better with a changing climate, including breeding, and looking at things like gene editing to be able to breed differently for some of those climate variations," Estes said. "So maybe you don't need as many chilling hours, or the crop can be ok if it's hotter or there's more drought. I think with breeding and things like gene editing where we can create generations much faster, I think that's going to be a huge solution."

BREEDING FOR VERTICAL FARMING

Research is continuing on how to breed outdoor plants to be weather resistant in combination with coverings, but at the same time, there are several organizations looking at the specific breeding needs of indoor-grown crops as well. Produce grown in vertical farms are subject to an environment that can be fully manipulated, and therefore, the focus of breeding programs are to develop plants of higher quality, higher yield, and lower energy consumption.

Vonnie Estes, IFPA, talks ag tech and sustainable growing practices

LISTEN HERE

North Carolina State University's Controlled Environment Ag Coalition is actively researching how to improve the quality and yield of vertical farm-grown produce. They are also looking at ways to reduce breeding time by manipulating the environment at various stages of breeding.

HOW WILL THIS AFFECT THE INDUSTRY IN THE FUTURE?

The future of the agriculture sector will require indoor and outdoor growers to work together. For outdoor growers, this likely means implementing more technology and using AI in their operations.

"It's more about getting the product to the customer than how it was grown," Estes said. "With climate change especially, I think we're going to see a lot more integration between indoor and outdoor growing." •

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BELL PEPPERS GET AN AG TECH BOOST AT TWIN CREEKS GREENHOUSE

By Jolene Hansen

When Mike Cornelissen started growing greenhouse bell peppers in 2016, he had no direct greenhouse experience. But he did have strong agricultural connections and an affinity for early adoption of technology. Twin Creeks Greenhouse launched with 10 acres in production and what Cornelissen considers fairly standard automation for the time: basic pack lines and climate controls comparable to its competitors.

Though more automation was planned, Cornelissen and Danielle, his wife and co-owner, didn't foresee the level of technology that would be in play at the Ontario greenhouse. Today, the family-owned and -operated company grows 40 acres of hydroponic red, yellow and orange bell peppers under glass. From an enhanced-accuracy packing line to autonomous picking carts, the automation at Twin Creeks Greenhouse is no longer standard.

"We went a lot further with the automation than we were expecting when we first built," Cornelissen said. "That came after a few trips to

The new pack line at Twin Creeks doubled the output with the same amount of labor.

Images courtesy of Twin Creeks Greenhouse, Inc.

Upgraded climate control systems monitor the greenhouse and incorporate intelligent algorithms in data analysis.

the Netherlands. Obviously, the technology has changed over the years as well."

EXPANSION = AUTOMATION INSPIRATION

It didn't take long for Twin Creeks Greenhouse to expand from 10 acres to 20, but automation wasn't a big component in that first expansion, which focused more on infrastructure. Once they had 20 acres in CEA bell pepper production, the team started exploring automation more.

"We did a lot of research into the automation and that kind of pushed us to go to 40 acres," Cornelissen said. "We saw that the automation cost was going to be the same if we grew at 20 acres or 40 acres, so the return on investment made more sense to go to 40 acres."

As a result, a 20-acre expansion and a major investment in automation went hand-in-hand.

Around the same time, the minimum wage in Ontario went up dramatically. The impact was significant in an industry with many employees at that wage level. Automation at Twin Creeks Greenhouse advanced rapidly from 2016 to 2020.

PACKING LINE PRIORITIES

Twin Creek's automation started with a new pack line complete with

Pick carts at Twin Creeks all operate independently, keeping the pack line supplied without delays.

palletizers and accu-fill capabilities.

"Basically, our pack line that did 20 acres and our new pack line that does 40 acres use the same amount of labor, but the new line has doubled the output," Cornelissen said.

He estimated that having palletizers saves one to two employees, plus he gets better-stacked skids. While he said the payback isn't ideal, the equipment is well-built and runs smoothly. Improving accuracy on packing weights was another major step.

"With most things in produce, there are minimum weights on everything. You don't want to give away any extra weight," he said. "With our new pack line, it's quite long to allow us to more accurately fill our boxes. [...] So, we're gaining yield by getting our box weighed more accurately."

Installed in 2021, the pack line got a major upgrade in 2022 with the addition of camera technology for sorting. This included cameras for external grading as well as a camera that scans peppers for internal defects that can't be seen on the surface. While they're still tweaking the technology, Cornelissen hopes that sorting with the cameras can streamline sorting, which now requires 10 people on the sorting table. The quality of peppers packed has also improved.

INDIVIDUAL AUTOMATED PICKING CARTS

Cornelissen had an Aha! moment on a Netherlands visit when he saw automated ATV picking carts in action.

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"When I had first seen it online, I wasn't that intrigued. But when I saw it in person, it really started making sense to me that's the way we had to go," he recalled.

While it's not uncommon for greenhouses to have ATV carts, it usually involves one automated vehicle pulling a train of eight or nine carts — as Cornelissen originally planned. But at Twin Creeks Greenhouse, all the carts are automated. With their picking bin on top, each one operates individually, so there's no hitching, re-hitching or delays. When a worker finishes their cart, another one is waiting for them and the finished cart is on its way to the pack line.

The impact on efficiency is significant.

"It's just the flow of the crop and having that buffer in front of your pipeline to keep it able to run all the time," he said. "Our pack line basically takes the same amount of labor if it's running full speed or half speed. So, it's very important we try to keep it running."

The choice to go fully automated on the picking carts required a much larger investment.

"With the other rig, you only need maybe four units. Six at most," Cornelissen said. "But in our case, we have 64, so that really increased the costs."

2021 was the first operating year for the carts, and it'll be a few more years before they've paid for themselves.

"It wasn't that quick of a return on investment," he said. "But one thing we do, we look at the long-term goal, not always the short-term. We wanted to do it right from the beginning, not regret it down the road."

ONGOING AUTOMATION ADVANCES

In addition to the pack line and pick cart advances, automation at Twin Creeks Greenhouse improves the growing environment and the growing itself. Last year, the company did a major upgrade of its climate control system, switching to a new system offering intelligent algorithms.

"It's kind of like their AI, but they call it intelligent algorithms, which is a more accurate way of defining the system," Cornelissen explained. "It's allowing us to hopefully better manage our climate and lower input costs while increasing yields."

Automated climate controls were phased in throughout the operation to automatically adjust the greenhouse climate every five minutes, constantly fine-tuning environmental conditions based on forecasts, actual conditions and settings input by the Twin Creeks team.

"It's not just learning the system. It's learning different growing ideas, so there's a little bit to it," he said. "We're very excited and happy with what we're seeing. But we want to take our time to work our way into it."

The company also utilizes targeted technologies to collect images and data for CO_2, humidity, temperature and light to help identify issues in the greenhouse and forecast production for the current week.

"We work with a lot of different partners. So they can also look at our crop visually and basically go on a crop walk from their office, wherever they are in the world," he said.

Other technology takes air samples that help identify conditions that favor problems such as powdery mildew, for example, long before

scouts see it. Early detection allows more efficient, effective and bio-friendly interventions.

LESSONS TO LEVERAGE AND LEARN

The automation at Twin Creeks Greenhouse does more than save on labor.

"Basically, everything I have either increases the quality of the product we're selling plus the labor savings, or it increases yields plus the labor savings," Cornelissen said.

Including office staff, Twin Creeks Greenhouse operates with about 60 people. Without automation, they'd need around 10 more. But there are some drawbacks.

"With better automation, like our packing system, it is very focused on bell peppers. If we had to switch our crop, our system doesn't adapt well and would struggle. Some less automated systems can adapt a little bit better between different crops," he said. "When you get more automated, it can make you a little bit more specialized, which is fine, but then it's a lot harder sometimes to change."

For Cornelissen, who spoke to *CEAg World* from a tractor while planting soybeans, being family-owned and -run plays a big part in automation, too.

"My wife and I run the company. We're a very nimble operation, so that does allow us to adopt this technology a little bit quicker sometimes, because we're a little bit more hands-on. And when we agree on it, we pretty well move ahead with it," Cornelissen said. "I grew up on a farm and my dad's always been an early adopter of technology, so I guess that's how I grew up. It's part of the way we farm." •

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LEGACY LABOR, INC.

EMBRACING THE BENEFITS OF H-2A IN CEA

Justin Bartlett
Co-CEO | Director of Sales & Marketing

AS THE GLOBAL AGRICULTURAL LANDSCAPE EVOLVES, the importance of controlled environment agriculture (CEA) continues to grow. This innovative approach to farming offers solutions to many of the challenges faced by traditional agriculture, but the success of CEA is not solely dependent on technological advancements; it also hinges on a reliable and skilled workforce, which many growers consider to be their biggest obstacle. One viable solution to these labor concerns is the H-2A visa program.

With roots tracing back to World War II, the H-2A visa program allows employers to legally and ethically bring foreign workers to the United States to fill temporary or seasonal agricultural jobs. The shortage of domestic labor willing to engage in farmwork has had a significant impact on grower productivity and profits. Migrant workers from 88 countries help bridge this labor gap while being protected under U.S. labor laws, which require fair wages, adequate housing, and safe working conditions. Due to the tightening of our southern border, we rely on the H-2A program now more than ever. It has grown tremendously in recent years, with 311,217 visas issued in 2023 compared to 89,274 issued in 2014.

Though technologically advanced, the intensive production system of CEA requires a significant amount of manual labor. From planting and harvesting to packaging and maintenance, these tasks demand consistency. H-2A workers bring a wealth of experience and tangible skillsets that prove invaluable to these operations. Their expertise in

handling various agricultural tasks, combined with the innovative techniques employed in CEA, creates a synergy that boosts productivity. For instance, tasks such as precise planting, pruning and harvesting can significantly benefit from the manual dexterity and keen eye for detail that experienced workers possess. Moreover, their involvement in CEA provides an opportunity for knowledge exchange, where they can learn about cutting-edge agricultural technologies and practices, further enhancing the efficiency of the entire system.

CEA is often lauded for its sustainability benefits, such as reduced water usage, minimized pesticide application, and lower carbon footprint. However, the ethical treatment of workers is equally important in achieving true sustainability. The H-2A visa program guidelines ensure that migrant workers are treated fairly and ethically. This alignment of ethical labor practices with environmental sustainability strengthens the overall integrity of CEA operations.

The economic impact of the H-2A visa program on the CEA sector cannot be overstated. By providing a steady stream of skilled labor, the program supports the expansion and profitability of CEA businesses. This, in turn, contributes to local economies through job creation and increased agricultural output. Furthermore, the presence of a reliable labor force allows growers to plan and execute long-term growth strategies, leading to increased investments in technology and infrastructure.

Now a cornerstone in modern U.S. agriculture, the H-2A visa program is an efficient solution for CEA labor shortages and I would encourage any grower who values productivity and sustainability to make the investment. •

LEGACY LABOR

CEA FOOD SAFETY AND THE HIGH COST OF DOING NOTHING

By Jolene Hansen

As the CEA industry continues to mature, food safety has become a frequent topic in public forums and private conversations. This increased interest has been propelled by several foodborne disease outbreaks linked to CEA produce. Even so, proactive food safety practices still fail to keep pace in many CEA facilities industrywide.

These outbreaks have weakened the argument by some growers that controlled-environment production is somehow immune to foodborne disease risks. However, the perceived cost and inconvenience of implementing food safety measures remain common reasons for the lack of proactive protocols.

CONTINUED ON 54


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Photo credit: Shawn Keehne
Dr. Darin Detwiler

To gain a better understanding and a fresh perspective on the cost of doing nothing, *CEAg World* reached out to Darin Detwiler, LP.D. An internationally recognized authority on food safety issues, Dr. Detwiler has been an integral figure in the control of foodborne illness for more than three decades. He currently serves as Chair of the National Environmental Health Association (NEHA) Food Safety Program Committee, participates in numerous advisory and editorial capacities, and consults on food safety issues with companies worldwide.

In addition, the International Association for Food Protection honored Dr. Detwiler with its 2022 Ewen C.D. Todd Control of Foodborne Illness Award for dedicated and exceptional contributions to reducing risks of foodborne illness. For CEA growers, owners and investors who are listening, the message is clear: Implementing robust food safety protocols can prevent foodborne illness outbreaks, and the cost of doing nothing significantly outweighs the cost of doing something.

PROACTIVE FOOD SAFETY AS A FINANCIAL STRATEGY

Aside from the humanitarian angle, the prevention of foodborne disease outbreaks should be a business priority for CEA growers. Dr. Detwiler shared that more than 800 foodborne disease outbreaks are reported in the U.S. alone, annually. According to the World Health Organization (WHO), there are approximately 600 million cases of foodborne illness worldwide each year, including 420,000 deaths.

While CEA-related outbreaks are the minority compared to larger industries, financial risks associated with an outbreak are major.

"The financial impact of an outbreak includes medical expenses, legal fees, product recalls and loss of consumer trust," Dr. Detwiler said. "These costs far exceed the investment in preventative measures."

The cost of a product recall and a tarnished brand should serve as a wake-up call for proactive food safety throughout CEA.

"When a contaminated product reaches the market, the cost of recalling and disposing of the product is immense," Dr. Detwiller said. "Consumer trust is vital in the food industry. A food safety incident can lead to a long-term loss of customer confidence, reduced sales and negative media coverage, impacting the brand's value and market position."

Dr. Detwiler cited a joint industry study by FMI and Grocery Manufacturers Association that puts the average direct cost of a food recall at $10 million from lost sales and potential regulatory fines, plus brand damage. Of course, investor confidence takes a hit alongside consumer trust.

Increased litigation and liability risks provide more fuel. Dr. Detwiler shared that the consequences of neglecting food safety include steadily escalating settlements or judgments, which add to financial instability. But they also include landmark prison sentences for executives and managers, which puts the cost of inaction in a very different light.

"By investing in food safety, companies can mitigate these risks and avoid the high costs associated with foodborne illness outbreaks and non-compliance," he said. "Thus, proactive food safety measures are not just a regulatory requirement but a sound financial strategy."

CEA FOOD SAFETY AND RELIABLE SUPPLIER PARTNERS

Working closely with suppliers is crucial for companies in the CEA food production industry, Dr. Detwiler said. Two notable reasons are quality assurance and traceability.

"Consistent, high-quality inputs are essential in CEA, where environmental factors such as light, temperature, and humidity are meticulously controlled," he explained. "Reliable suppliers ensure that seeds, nutrients and other inputs meet the required standards, directly impacting the quality and yield of the produce."

Reliability of those inputs is a significant component in risk assessment and regulatory compliance.

"Partnering with trustworthy suppliers enhances traceability, an essential aspect of food safety. Knowing the origin of inputs allows producers to quickly address any contamination issues, ensuring compliance with food safety standards and protecting consumer health," he said.

Dr. Detwiler explained that traceability will be critical as stricter food safety regulations and requirements take effect. Section 204 of the FDA Food Safety Modernization Act (FSMA), enforced effective January 2026, mandates additional traceability record-keeping requirements for certain high-risk foods to protect public health. (And, yes, that FDA Food Traceability List includes CEA's core food crops.)

"By establishing clear traceability requirements, FSMA 204 holds companies accountable for the safety of their products, encouraging more vigilant safety practices that, in and of themselves, will require CEA entities to work closely with all partners," Dr. Detwiler said.

Collaborations with strong supplier partners can also enhance CEA sustainability, product innovation and stability. When suppliers align with your company's commitments and goals, the advantages are immediate, from reducing carbon footprint and mitigating supply chain disruptions to improving efficiency, yields, product quality — and compliance.

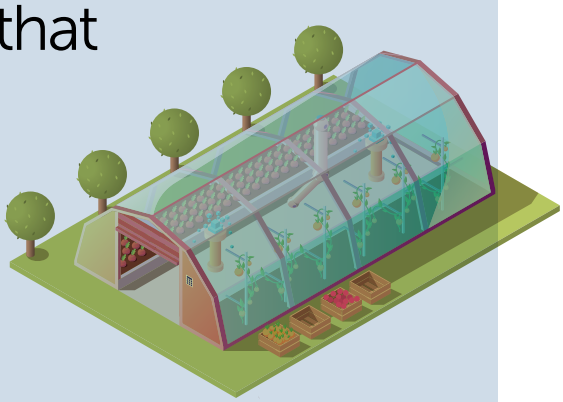
"Working with certified suppliers ensures compliance with regulatory

standards and certifications. This is particularly important in the CEA industry, where organic and other certifications can add value to the produce and meet consumer demands," Dr. Detwiler said.

TECHNOLOGIES IMPACTING CEA FOOD SAFETY

Thanks to rapid advancements in CEA technologies, circumventing food safety issues is simpler and more accessible than ever. Dr. Detwiler mentioned advanced sensors providing real-time monitoring of environmental set points such as temperature, humidity, light and CO_2 levels.

"This precision helps maintain optimal growing conditions and prevents issues that could compromise food safety. Key to this is the ability to be proactive and even predictive in mitigating issues before they become incidents," he said.



Data Analytics and AI also present significant opportunities to enhance CEA food safety.

"Machine learning algorithms analyze vast amounts of data to predict and mitigate potential food safety risks," Dr. Detwiler said. "This includes identifying patterns that may indicate contamination or system failures before they become critical."

From predictive maintenance and enhanced risk assessment to early disease and pest detection, these capabilities empower growers to reduce food safety risks.

Similarly, automation and robotics can work together to reduce human error and minimize the risk of contamination from human pathogens. If contamination occurs, blockchain technology enables unmatched supply chain traceability and transparency.

"This ensures that any contamination can be quickly traced back to its source, facilitating faster recalls and more effective responses," Dr. Detwiler said.

Dr. Detwiler explained that technology and stringent legislation have worked together to substantially reduce the risks of contamination in CEA. Bolstered by assurances of regulatory compliance and food safety certifications, consumer confidence in the safety and quality of CEA produce has grown.

As the CEA industry moves forward and consumers become more sophisticated, adoption and retention of high food safety standards will be essential to consumer confidence and trust. Growers who neglect food safety will bear the high cost of doing nothing. Growers who invest in food safety will enjoy the high ROI that proactive food safety protocols will hold. •

Jolene Hansen *is an award-winning freelance writer and editor who has covered the horticulture, specialty ag and CEA industries for more than a decade. Reach her at jolene@jolenehansen.com.*

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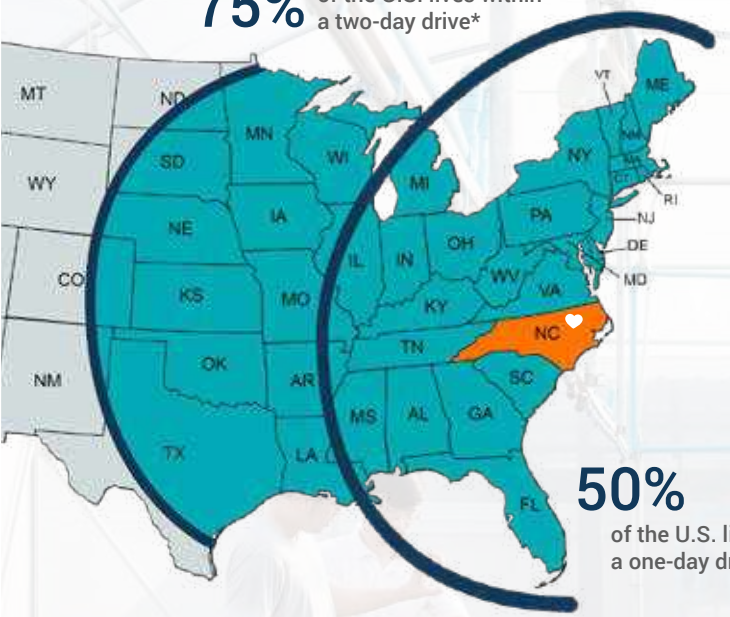

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NEW EVENT ANNOUNCEMENT

JOIN THE FUTURE OF FARMING: CEAG WORLD CONFERENCE AND EXPO SHOWCASES PRACTICAL, CUTTING-EDGE INNOVATIONS FOR GROWERS

By Amy Reddington, *Show Director, CEAg World Conference and Expo*

Discover the Latest Breakthroughs and Connect with Fellow Growers and Industry Leaders at the Premier CEA Event in Raleigh this August!

The inaugural ***CEAg World Conference and Expo,*** set to take place from August 26-28, 2024, at the Raleigh Convention Center, is poised to revolutionize the controlled environment agriculture (CEA) industry by bringing together the brightest minds and leading innovators to advance all forms of food production under cover.

Experience the Future of Food Production

CEAg World Conference and Expo is the premier event for the varied sectors within the CEA industry, including greenhouse production, indoor/vertical farming, urban farming, container farms, high tunnels/hoop houses, and aquaponic farming. This event is designed to be a comprehensive resource for anyone involved in or interested in protected cropping, offering a deep dive into production techniques, sales and marketing strategies, business tips, and operational efficiencies.

An Impressive Lineup of Keynotes and Sessions

Attendees will be inspired by two keynote presentations from industry leaders:

- **Bob Jones, Chief Executive Officer of The Chef's Garden,** will present "The Chef's Garden: Growing a Sustainable Future." He will share insights into their innovative energy management and sustainability practices, highlighting how their hybrid system produces 70% of the farm's energy through wind, solar, and AI-managed batteries.

- **Henry Gordon-Smith, Founder and CEO of Agritecture,** will deliver a keynote on the "CEA Pulse Check: What Growers Really Need," offering valuable insights from the 2024 global CEA Census.

The event also features an engaging panel on **"Unlocking Growth and Funding: Empowering Growers with Financial Strategies and Government Support"** and three tracks each day covering critical topics like production, technology, business, getting started, expanding and upgrading, and specializing in CEA. View the full agenda at CEAgWorld.com/events/agenda

Exclusive Tours and Workshops

Participants will have the opportunity to tour the North Carolina State University Plant Sciences Initiative (PSI) Center and Phytotron, gaining firsthand knowledge of cutting-edge research and technologies.

Additionally, two post-event workshops will be available:

- **How to Build Your CEA Business:** A step-by-step approach to planning or expanding a greenhouse or vertical farming operation.
- **Hydroponics 101:** Essential insights and tips for efficient hydroponic growing.

Networking and Diversity Celebrations

CEAg World Conference and Expo also places a strong emphasis on networking and diversity. The Vivid Canopy Breakfast will celebrate diversity and inclusion within the CEA industry, creating a platform for meaningful connections and collaborations.

VividCanopy
thrive together

Comprehensive Registration Package

The registration package includes access to all keynotes, the main conference program, the exhibit hall, two lunches, a welcome party, and a networking reception. Special low rates are available for growers to encourage broad participation from all sectors of produce production.

A Central Destination for Industry Leaders

Situated in The Research Triangle, at the heart of the eastern corridor, Raleigh is an ideal location for this groundbreaking event. ***CEAg World Conference and Expo*** will attract hundreds of attendees and exhibiting companies, making it the central hub for the latest innovations and technologies in CEA, from in-ground production under cover to fully indoor production systems.

Backed by Meister Media Worldwide's decades of experience and leadership in the agriculture sector, ***CEAg World Conference and Expo*** will be an invaluable resource for CEA businesses. With national brands like *American Fruit Grower, American Vegetable Grower,* and *Greenhouse Grower,* and now the newly launched *CEAg World* along with extensive event experience, Meister Media ensures that this event will be the gateway to success for the emerging CEA sector.

CEAg World Conference and Expo is more than just a conference; it's a movement towards a sustainable and innovative future in food production. Don't miss the unique opportunity to connect with other growers, thought leaders, explore cutting-edge technologies, and gain the tools and knowledge to succeed in the rapidly evolving CEA market. To learn more about the ***CEAg World Conference and Expo,*** register, or explore exhibit and sponsorship opportunities, visit CEAgWorld.com/events

Join us this August in Raleigh and be a part of the community shaping the future of food grown under cover!

CEAg World™
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ADVANCING FOOD UNDER COVER
August 26-28, 2024 • Raleigh, North Carolina

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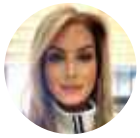

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