GROWERTALKS

Features

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Growing Knowledge

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Growing edible crops in controlled environments is both an exciting and challenging business to be in. Keeping up with the latest research and advancements in this technology-laden and rapidly changing industry can sometimes be daunting—even for the most experienced professionals. But with new research and knowledge being shared daily within the industry, the inspiration for new controlled environment agriculture (CEA) businesses and new growing plans are bountiful.

Dr. Murat Kacira examines plant growth in his prototype, off-the-grid, low-cost and easily deployable greenhouse crop production syste

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This past spring, I attended an information-packed week of seminars and workshops at the University of Arizona's Greenhouse Crop Production & Engineering Design Short Course. There was a common goal among the engineers, scientists and growers who shared their research and knowledge: to optimize plant productivity while allocating resources, including water, energy, labor, land and other resources as efficiently as possible.

Dr. Gene Giacomelli, director of the Controlled Environment Agriculture Center (CEAC) at the University of Arizona reminded us of the news headlines throughout the world that make the efforts of our industry so important. The greenhouse industry has the knowledge and resources to produce food that is clean, safe, abundant and affordable. Now, more than ever, we're needed to grow safer and more sustainable produce and in all climates of the world.

"CEA and the food systems that are developing, that can develop, and that will certainly evolve within the next few years will add an exciting component to CEA worldwide," explained Dr. Giacomelli. "The issues of water, energy, labor, environment and education will remain the challenges for economical vegetable production within CEA."

If you keep up with the Inside Grower e-newsletter, you'll regularly find information about new research in CEA, but here's a closer glance at some of the more fun, fascinating and functional research that's being conducted in our field right now. Let's start by taking a look inside the Controlled Environment Agriculture Center at the University of Arizona.

To the moon and back

The Controlled Environment Agriculture Center at the University of Arizona has a multi-disciplinary, international team of engineers and scientists, students, faculty and small-business collaborators who are all striving to develop CEA as an economically, environmentally and socially sustainable agricultural option. While most of their research is focused here on Earth, Dr. Gene Giacomelli brings CEA to the moon as the principal technical investigator for the lunar greenhouse project. For more than 12 years, Dr. Giacomelli and his team of scientists and engineers have researched strategies for growing sustainable food crops in outer space. Their prototype greenhouse is designed as a so-called Bioregenerative Life Support System (BLSS). The innovative hydroponic plant growth chamber grows edible plants to sustain a vegetarian diet for astronauts, while also providing air revitalization, water recycling and waste recycling.

Focused back on Earth, Dr. Murat Kacira and his lab at the U of A have developed a prototype, off-the-grid, low-cost and easily deployable greenhouse crop production system. The greenhouse system is designed for growing fresh, local produce in challenging areas, such as remote locations or disaster zones where crop production materials are limited.

Dr. Kacira's current research in the off-the-grid greenhouse system is evaluating its resource consumption, production outputs, limitations and capabilities, and the technical and economic feasibility of the system.

Growing in the world's most challenging places

Exploring agricultural possibilities in some of world's most inhospitable places is a common theme today in CEA research. A team of scientists and engineers in Qatar are implementing a system for growing produce in the arid Middle Eastern country. Called the Sahara Forest Project, the pilot site is designed to utilize what they have enough of to produce what they need more of—using deserts, saltwater and CO2 to produce food, water and clean energy.

The Sahara Forest Project's pilot facility in Qatar. Seawater from

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he Persian Gulf is used for greenhouse climate con

trol, growing algae for biofuel and irrigation for crops.

The Sahara Forest Project is expensive and experimental, but the potential benefits of bringing fresh produce to desert communities are worth it, according to the organization. The project employs existing and proven environmental technologies, including saltwater-cooled greenhouses, concentrated solar power and technologies for desert revegetation around a saltwater infrastructure.

The temperature is kept down and humidity up in the 2.5-acre prototype facility through evaporative cooling with seawater that's pumped from the nearby Persian Gulf. They also use the seawater to grow algae in order to produce a biofuel. And they have a solar-powered desalination unit to get fresh water for the plants.

The project is focused on developing such facilities in low lying, arid and sunny areas that normally have little agricultural activity or natural vegetation. The Sahara Forest Project reports that a single facility with 50 megawatts of concentrated solar power and 50 hectares (124 acres) of seawater greenhouses would annually produce 34,000 tons of vegetables, employ more than 800 people, export 155 gigawatt hours of electricity and sequester more than 8,250 tons of CO2.

Breeding better tomatoes

Our favorite seed companies are continuously revealing new and improved tomato cultivars for greenhouse production. Behind the scenes, plant breeders and geneticists are busily decoding the secrets to what makes a tomato grow, pack and ship well; beam crimson red on the store shelf; and taste sweet and garden fresh when it hits our mouths.

One plant breeder at Cornell University is exploring another aspect of breeding a better tomato, which growers will be particularly interested in. Martha Mutschler-Chu is researching how to make tomato varieties with dual-resistance against thrips and the viruses they transmit. Thrips, which suck fluids from tomato plants and transmit diseases such as tomato spotted wilt virus, cause millions of dollars in damage to U.S. agricultural crops each year.

Martha, a professor of plant breeding and genetics at Cornell University, first isolated the resistance by adapting a novel form of insect resistance discovered in a wild plant native to Peru. She found that it was mediated by droplets of sugar esters, called acylsugars, which are produced and exuded from hairs (trichomes) that cover the plants. The acylsugars don't kill the insects, but deter them from feeding or laying eggs on the plants.

After successfully adding the thrips resistance to new tomato lines, her team added natural genes to resist so -called TOSPO viruses, which include tomato spotted wilt virus.
"If some thrips get through with the virus, the virus resistance genes are there to mop it up," Martha said.

The thrips and virus-resistant tomato lines will continue to be studied by Martha and an interdisciplinary team of eight other scientists from seven other institutions nationwide as part of a five-year project to research thrips and TOSPO viruses in tomatoes. The process does not require the use of genetic engineering techniques.

Martha will test her varieties in different regions and use the feedback to further refine her lines and create new, improved ones. She intends to share her knowledge with seed companies so they can transfer the traits into their varieties.

Bumblebees moonlight as flying doctors

Relevant CEA research, of course, isn't limited to academia. Industry suppliers are also carrying out research

projects to better serve CEA growers. Biobest, for one, is pioneering a new way to deliver biological protection to plants. The company recently introduced the “flying doctors” concept. Bumblebees, which are already available from Biobest for greenhouse crop pollination, can now also bring microbial “medicine” to plants to help control major diseases, such as grey mold in strawberries and raspberries.

Grey mold is spread through airborne particles and infects strawberries and raspberries during the flowering period. The disease generally becomes visible when the fruit ripens or during storage, at which point it’s too late to be controlled.

The new “flying doctors” system consists of a patented dispenser system that’s available as a supplemental option to Biobest’s standard bumblebee hive.

“As the bumblebees leave their hive, they walk through a tray of specially formulated microbial fungicide or microbial insecticide preparation, which clings to their legs and body,” explains the company. “They then deliver this product directly to each flower they visit. The bumblebees’ hairy bodies and unique ‘buzz’ pollination make them especially effective as delivery vehicles. It’s just what the doctor ordered: regular applications when and where you need it.”

Biobest says that the “flying doctors” system is a simple and effective way to reduce labor and reduce the volume of pesticide product used. They say they’ve had good results using the system under test conditions at the Biobest Green Lab, as well as in commercial crops.

Biobest says they plan to launch a new Western bumblebee species that will allow growers here in North America and Canada to utilize the system with our own local “flying doctors.”

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