CEA Systems Offers Efficient Ways To Bring Food To The Table, Lab

CEA Systems

CEA Systems, and its partner, Cornell University, have developed an agricultural technology that could save energy, provide better food security and control, and lead to the creation of products for pharmaceuticals and other high-value plant-based compounds.

A vast majority of people in the world live within 10 miles of their major food sources, but in the United States much of our food travels as far as 2,000 miles from the farm to the table.

CEA Systems, and its partner, Cornell University in Ithaca, N.Y., think they have the technology that could change that, thus saving energy while providing better food security and control, as well as developing products for pharmaceuticals and other high-value plant-based compounds.

CEA, which stands for Controlled Environment Agriculture, is an advanced and intensive form of hydroponically based agriculture. Plants are grown within a controlled environment so that horticultural practices can be optimized. Cornell has long been a leader in this research.

Techniques are not simpler than older systems for growing plants. Indeed, they demand sound knowledge of chemistry, horticulture, engineering, plant physiology, plant pathology, computers and entomology.

“We basically use the control of light, and an optimized solution of nutrients, in our agriculture,” says Louis Albright, Ph.D., one of the founders of the CEA program at Cornell and current director of the program.

The plants are grown in a high-tech greenhouse, where the environmental variables — total amount of daily light, carbon dioxide concentration and temperature — are controlled by a computer. The environmental variables monitored include relative humidity, temperature, carbon dioxide and light intensity.

“By using the computer, we can predict temperatures, light and other factors and adjust the process through shades and supplemental light,” Professor Albright explains.

The hydroponic system used is called the deep trough system. In this system, the tank is filled with a nutrient solution and the plants are grown on Styrofoam with holes, which floats on the surface.

In a deep trough system, aeration is necessary since the water surface is completely covered by Styrofoam, which minimizes evaporation and discourages algae growth. Pure oxygen is injected into the system to ensure that enough oxygen is supplied to the roots. Acid and base injections also are made to maintain pH.

A dedicated computer is used to control and monitor variables in the nutrient solution, which include temperature, electrical conductivity, pH, dissolved oxygen, nitrate concentration and nutrient solution volume.

All Grown Up and No Place to Go

Cornell originally had a commercial partner, Agway, in its greenhouse research, but that Northeast-based cooperative pulled out because of their own financial concerns. Cornell was left with a CEA operation with market possibilities, but no commercial partner.

Mike Hall, a retired Air Force pilot and Cornell graduate, was interested in the Cornell CEA work and stepped in.

“I was raised on a small farm in upstate New York and remained interested in agriculture,” says Hall, who is now with CEA Systems, a business and commercial development firm. “I also worked with cutting edge technology while in the Air Force and was aware of what was being done at Cornell. So, these things sort of came together.”

CEA Systems, which grew out of Hall’s efforts, is a privately held corporation based in Ithaca, N.Y. CEA Systems is in partnership with the Cornell Center for Technology, Enterprise and Commercialization, which manages Cornell University’s intellectual property. It is charged with the development and deployment of CEA technology and know-how for the profit of the partners. The exclusive license for the CEA technology was granted to CEA Systems in 2002.

“Our mission is to identify and develop commercial applications for the intellectual property and technology flowing from the Cornell University CEA research program,” Hall said.

John Brenner, senior technology manager of the Cornell Center for Technology, Enterprise and Commercialization, says, “CEA represents the enormous potential, the complexity and the unexpected outcomes related to university-based technology transfer. From the standpoint of potential, CEA is a platform to launch a completely new paradigm in plant-based science research and education. All of production agriculture has been focused on the plant’s survivability in field-grown batch agriculture.

> *“We like to think we are doing organic farming, only better,.*

"CEA offers the ability to optimize a plant's growing environment such that it concentrates its energy on productivity, not simply survival, while at the same time offering continuous production in place of batch production. The simple shift from survivability to productivity offers wide scientific research opportunities to learn exactly what are the optimal conditions for various plants and then how to breed or otherwise modify the plants for even greater productivity once you can control the plant's environmental parameters.

"The potential extends to other plant-based products that are currently impossible to produce reliably such as pharmaceuticals and other industrial products. In each case the potential represents decades of research, education and economic opportunity."

Potential Growth Opportunities

CEA Systems continues to seek commercial partners for joint venture opportunities in high quality, nutritionally-enhanced crops; environmental systems; energy-efficient food production and distribution and pharmaceutical production.

The latter in that list might come first, according to Hall.

"When I was in the Air Force, the move to jets in commercial airlines might not have happened if the military had not worked in that area first," Hall says.

"There is somewhat of an analogy to CEA. There is resistance to change in the produce and food industry. We have regionalized it, with much of our leafy vegetables raised in California and other western areas and trucked to the population centers in the Northeast and elsewhere. We believe that will change eventually because of escalating petroleum costs and other factors."

"At this point, however, we also can provide pharmaceuticals from the nutrients in the produce we grow. We can control that effectively because of the controlled environment. So that might develop first, with a trickle down into the food industry over time."

Hall and Professor Albright emphasized that 70 percent of the light in the CEA system comes from natural, outside sources, even in the somewhat cloudy rthe Northeast. Supplemental light from electricity can be produced cheaper than petroleum for transport if the latter continues to go up in price. Contaminants from pesticides, manure and other additives used in conventional agriculture, and even organic agriculture, can be eliminated through hydroponic agriculture.

Hall said that incidents like the e. coli outbreak in spinach and onions in 2006 only spark more interest in CEA.

The CEA research has attracted funding from the New York State Energy Research and Development Authority, the Empire State Electric Energy Research Corporation, Agway, Inc., Country Products Group, the New York State Electric and Gas Corporation, the Niagara Mohawk Power Corporation, the Electric Power Research Institute, NASA and Westbrook Greenhouses.

CEA at Cornell has published research on dry bean growth for a NASA mission to Mars, a host of work on hydroponic lettuce and spinach production, supplemental lighting in indoor agriculture and a variety of related topics.

Various related courses are offered through Cornell's departments. Handbooks for growers of hydroponic lettuce, spinach and bok choy are available.

CEA Systems also has instituted a sub-licensing program to provide the system to local sheltered workshop organizations for client employment in a cash flow business model so that such agencies are able to deliver a product to the marketplace. The first example is Finger Lakes Fresh Lettuce, produced by Challenge Industries in Ithaca, N.Y.

“People who might not get a chance to work in a high-tech agriculture environment are getting practical experience and do a wonderful job in packaging and a variety of other areas,” Hall says.

Hall and Professor Albright feel strongly that the day is approaching when we will want to move our food production closer to where people live. “I don’t know exactly when it will happen, but I believe it is coming within the next 10 years,” Hall said.

Professor Albright adds, “We want to be ready.”

This story was originally published in 2007.

To see available technologies from research institutions, click here to visit the AUTM Innovation Marketplace.