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CREATING CHANGE BY SHARING SCIENCE



The OptimIA project, which was funded by USDA in Sept. 2019, is focused on the study of the aerial environment and economics for producing indoor leafy greens. Photo by Rosemary Brandt, College of Ag and Life Sciences, Univ. of Ariz.

How Is OptimIA Helping Vertical Farms Grow More Efficiently And Economically?

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By David Kuack, UrbanAgNews.Com

OptimIA is a research and outreach project aimed at offering production and economic information that is useful and can be applied to the indoor farm industry.

The concept of [OptimIA](#) originated when Erik Runkle at Michigan State University, Chieri Kubota at Ohio State University and Cary Mitchell at Purdue University were involved in an LED lighting project focused on greenhouse applications.

“It was getting to the end of the project and we asked ourselves what is the next frontier of lighting and growing,” said Runkle, who is a horticulture professor at Michigan State. “We came to the realization that the greatest opportunity and need for information was managing the environment for vertical farming production. We saw the next frontier as growing indoors and the need for research-based information. The name OptimIA came from our focus on optimizing indoor agriculture—Opti for optimizing and IA for indoor agriculture.”

In 2015 the three researchers submitted a USDA Specialty Crop Research Initiative grant proposal for funding that would focus on lighting, but would include other aspects of growing indoors.

“We went through the proposal submission process for several years before the USDA approved the grant for the OptimIA project,” Runkle said. “The proposal that was finally approved was to study the aerial environment as well as economics for indoor leafy greens. The aerial environment refers to air circulation, humidity, carbon dioxide concentration, light and temperature. Some of our team members are also studying root zone management of hydroponic crops using additional funding.”

USDA awarded \$2.4 million to the OptimIA project in September 2019, which was scheduled to be completed in four years. Runkle is the project director with the funding split between six researchers. In addition to Runkle, Kubota and Mitchell, the OptimIA team consists of Roberto Lopez, horticulture professor at Michigan State, Simone Valle de Souza, ag economist at Michigan State, and Murat Kacira, director of the Controlled Environment Agriculture Center at University of Arizona. Besides these co-principal investigators, other collaborators on the project include Chris Peterson, ag economist emeritus at Michigan State, Jennifer Boldt, a research horticulturist at USDA-ARS, and Nadia Sabeh, president and founder of Dr. Greenhouse Inc., which specializes in the design of HVAC systems for indoor plant environments.

Focused on the needs of indoor growing

The OptimIA project objectives were based on feedback from commercial vertical farms.

“Erik, Cary and I visited several commercial vertical farms before we started this project,” said Chieri Kubota, who is director of the Ohio Controlled Environment Agriculture Center at Ohio State University. “We received feedback from growers as to what to work on using USDA funding.”

Based on input from commercial indoor growers, three areas of research were identified:

- 1.** Develop economic information, including the costs, potential profits and conduct an economic analysis to determine the strategies to improve profitability based on that information.
- 2.** Vertical farms have the capacity to optimize multiple environmental factors at the same time. The information for co-optimizing more than two of these factors together didn't exist. OptimIA is looking at co-optimization of multiple factors in order to optimize production performance of plants to increase yields.
- 3.** OptimIA is looking to provide extension outreach to educate the professionals who are involved in vertical farming. Often the people who are trying to develop commercial indoor farms are educated in the business sector or other sectors like agronomy and may not have training in controlled environment production.

“Economics is a major part of this project,” Runkle said. “There is no doubt that high quality leafy greens can be grown in indoor farms. The challenge is how to do this profitably and sustainably. The economists on our team are working to quantify the costs of production and then determine the greatest opportunities to reduce input costs.

“There is very little financial information available about this sector of the controlled environment industry. It is very competitive and secretive, so it is difficult to get a clear sense of the economics. There are more researchers studying the plant production side, but the OptimIA team realizes the importance of the economics.”

Industry participation opportunities

Commercial growers and allied trades people can become involved with OptimIA by attending OptimIA's annual stakeholder meeting.

"In the stakeholder meetings those people or companies willing to collaborate or who have been collaborating with us can participate in determining specific collaboration opportunities and to provide feedback to our research outcomes," Kubota said. "We have on-site trials planned for testing some of OptimIA's research findings in commercial settings. These findings might include the optimum light spectra for growing specific leafy greens or sensing the environmental inputs that might cause nutrient disorders like tipburn. If any stakeholders or companies are interested in testing a new approach in their facilities through this on-site collaboration we welcome that opportunity."

Another form of support from the industry can come through in-kind support pledges.

"Initially this project proposal was submitted to USDA with a pledge of in-kind support," Kubota said. "Many companies, including lighting, growing media and fertilizer manufacturers have provided in-kind support pledges. We can add additional in-kind support contributions if other companies want to provide technologies useable in the project, as well as on-site trials if a company wants to conduct trials. Doing the trials means a company has to be willing to spend the time, production space and employee participation. These are evaluated as in-kind support."



Vertical farms have the capacity to optimize multiple environmental factors at the same time. OptimIA is looking at co-optimization of multiple factors in order to optimize production performance of plants to increase yields. Photo courtesy of Erik Runkle, Mich. St. Univ.

Need for more grower collaboration

Because of the competitiveness currently within the indoor farm sector, there has been some hesitancy from commercial growers to share production and economic information.

"Some of these indoor farm growers are of the mindset that they want to dominate their sector," Kubota said. "They aren't thinking that the industry is new so let's help each other in order to establish the sector together so that it can grow.

"Another issue is most of the funding for the indoor farming sector comes from venture capital. These indoor farms are chasing a limited number of investors. The potential leafy greens and other indoor farm crops market is huge. If growers work together to try to bring the technology together and develop some type of standardization, it would be easier to introduce new supporting technologies."

Kubota said many indoor farms are designing and developing unique production systems.

"Because of the unique technology being incorporated into these farms, it is not easy to develop automation or adapt other existing technologies to support current systems because they are not standardized," she said. "Because of the funding issues and the culture it can be difficult to get started in the indoor farm sector."

OptimIA researchers said at times it has been difficult collecting specific information from indoor farm companies.

"The challenge is indoor farm companies don't like to share much about their technology or about their production," Runkle said. "They don't like to share what their light set points are or what their production cycles are. They don't like to get into specifics because it is their intellectual property.

"When we have opportunities for input on our research, we do receive some helpful information. One example is with our light studies, we have been delivering light intensities that were common three years ago, but now indoor farms are delivering more light. Growers would like to see studies done with higher light intensities, which shows the industry is developing very quickly. It's good that the indoor farms provide input, but they need to share more of their interests and feedback related to our studies. This could influence what our treatments might be."

Disseminating research findings, educational information

One of the major ways OptimIA is disseminating information about its research findings is through its monthly Indoor Ag Science Café webinars.

"We often include our own research findings in the webinars, but we also invite other presenters to share educational information," Kubota said. "Originally the webinars were supposed to be a closed forum so that people could discuss things without having to worry about comments or information being publicized. When the Café started in 2018 there were about 60 participants in the listserv who received information of the monthly topics. Since then the number of people participating in the webinars has increased to over 1,300.

"Many of the participants are international because they don't have these kinds of events in their own countries. That is one of the reasons we wanted to improve communication. We want to respond to their needs more effectively. We keep looking for ways to provide information to the indoor farm industry."

Researchers, who are not members of the OptimIA team, have also done presentations for the Café.

"These other researchers are working on critical areas of indoor vertical farms," Kubota said. "For example, Paul Fisher at the University of Florida has discussed biofilm, food safety and water quality. A.J. Both at

Rutgers University talked about the basics of sensors, how to use them and how to install the appropriate sensors.”

Although some commercial indoor farms, including Plenty, 80Acres Farms, Oishi and Harvest Moon Farms have done webinars, some have declined because the presentations are usually recorded.

“Many representatives from commercial indoor farms do not like to be recorded. Consequently there aren’t as many commercial corporation presentations on the OptimIA archive page. Some companies do not want me to record their presentations. Companies that do presentations sometimes deliver very general information that lacks specifics.”

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