

GROWERTALKS

Covering Environments

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Information Feeds Knowledge

Gene Giacomelli

I'm pleased to welcome you to the first of what I hope is many opinion columns by Dr. Gene Giacomelli, professor of Biosystems Engineering at the University of Arizona's Controlled Environment Agriculture Center. He suggested "Covering Environments" as the name of his column because that's what he'll be doing—covering all aspects of the controlled environments in which you grow. Born into agriculture on a small New Jersey vegetable farm, Gene likes to remind his engineering students that the crop, not the hardware, should always be their focus.

—Chris Beytes, Editor-in-Chief



Almost a quarter of the way into the 21st Century and Controlled Environments for Agriculture (CEA) crop production hardly resembles its past—technology wise. Plant wise, however, the basic biology and the plant needs remain the same. Hold that thought.

Over the years, people with vision and goals have grown the industry by way of meeting market demands. In the U.S., the 1990s saw the big tomato and lettuce producers create consistent national markets for branded products from the greenhouse. The markets, with their desire for quality and consistency, responded to the higher prices, and survived two economic recessions and a pandemic!

Urban interests in production agriculture were influenced by locally grown, know-your-farmer, pesticide-free veggies, much like the market gardens that surrounded most cities in the early 20th century to provide local farm crops. That was before the national highway transportation system allowed similar access, within 48 to 96 hours by refrigerated truck from the south and west. However, the greenhouse industry for food crops had been established in the U.S.

Commercial indoor growing is CEA in the greenhouse, using the sun, as well as in a multi-layered grow room, container or vertical farm, each with electrical lighting for plant growth. All must provide the required plant environment for producing quality and timely products desired by the markets. All must function within limits of available consumable resources and all must obey the laws of physics!

A manuscript of Stanghellini & Katzin in 2023 said, "The dark side of lighting: a critical analysis of vertical farms' environmental impact," contrasted the benefits of VF to the drawbacks, primarily energy use, and compared them with modern greenhouse production. The results? LED lamps made it technically doable, while energy demands of lighting and HVAC for environmental control remain a drag on financial success.

The modern technology of crop production in CEA continues to develop. Structures and glazing, heating and cooling systems, energy conservation practices, hydroponic nutrient delivery systems, and monitoring for computer climate control with electronic sensors remain the basic necessities for continuous quality production ... including an experienced grower/manager, of course. Plant genetic enhancements, plant-response climate control, LED lighting, labor-saving procedures and soon AI decision-making add to the potential improvements for resource use (energy, water, labor) resource efficiencies in production, and ultimately, profitability.

“Knowledge is power,” said Francis Bacon, while application of knowledge is the true goal that powers CEA. Information feeds knowledge and develops expertise for success.

Real-time monitoring of the plant and its environment provided by sensors within a climate control system creates the plant situation (plant status data) 24-hours each day and can organize the data into usable information (interpret the data) for decision-making. The grower may then respond to specific situational changes based on the status of the crop to maintain the plant quality, to remain on the scheduled harvest and to limit unwanted deviations from the production plan. An on-track plan improves climate, plant uniformity and pest control. With crop monitoring you can know where you’ve been and where you’re going ... so install, maintain and use data from the sensors. You gain the extra “senses” to interpret the greenhouse situation and the capability to control it, but also the data for history and projections into the future.

Regardless of the crop grown, CEA technology employed and production style practiced, the water, nutrients, energy, labor, packaging and marketing are all unavoidable costs. The priority order depends on the crop grown and the greenhouse location. They can enhance or limit production quantity and quality, and thus profits, if not readily available and carefully utilized.

Back to the basic biology for perspective: “it’s all about the plant” and its products, or ultimately the business will not thrive. If provided the basics of aerial environmental control and root zone conditions to maintain the plant physiological processes, there are many good options for successful production.

We are beholden to the plants. We struggle for their purpose and we appreciate their products, especially those from CEA. Hopefully, you appreciate that it’s all about the plant.