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COVERING ENVIRONMENTS

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Sunlight Harvesting

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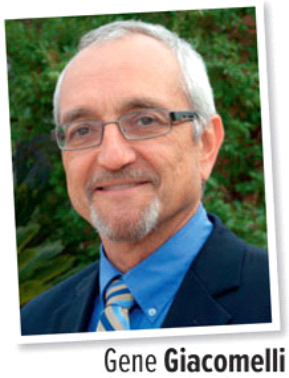

That is, one who provides photons from the sun to plants to power the plant process of photosynthesis, which uses light energy to produce plant biomass. Proteins, vitamins and minerals are produced for our dietary benefit … from light!

Although other controllable factors in CEA—such as water, nutrition and temperature contribute—we think of this as a "free" process from the sun, yet it's moderated by daylength, season and weather conditions. As emphasized at the 12th Indoor Ag-Con event, light too, can be controlled and even enhanced. LEDs for supplemental lighting remain the flavor of the decade, but let's consider how to capture the natural sunlight.

The best growers establish the "harvesting" of sunlight to produce a quality plant product beginning at the design and construction stage of their greenhouse. Greenhouse shape and size (single bay, ground-to-ground or multi-bay, gutter-connected structures), and especially construction material (type of glazing) and greenhouse orientation (direction of the long dimension), all greatly affect the amount of sunlight that enters and reaches the plants.

The amount changes slightly every day. As a grower and plant producer, you're measuring this, correct? Remember that "Information feeds knowledge and leads to success" (from the Spring Issue of *Inside Grower*).

The number of sunlight hours and sun angle reduce sunlight to the plant's dismay in the fall and winter, and to their glory in the spring. Notice I avoided summer, as excess DLI (daily available light) may require screen shading and a cooling system for environmental control from the part of sunlight that only provides heat and not useful PAR (plant growth light). Measuring PAR light can help determine when to shade and when to allow the maximum DLI for fast, quality plant growth and production without over-heating. Information leads to knowledge! Make use of environmental data by including an indoor energy/shade screen in the greenhouse that stows with minimal shade or deploys to provide 30% to 40% shade during the day and deploys at night for energy conservation and reduced heating costs.

Even Tucson, Arizona, with 300-plus sunny days per year (tourist bureau data) will lose about 50% of daily sunlight energy during a sunny winter day, compared to a summer day … why is that? Again, shorter daylight hours, lower sun angle causing more reflection and less transmission of light at the glazing.

How to proceed? Orient the long dimension of the greenhouse in the north-to-south direction for more light

transmission throughout the year than for east-to-west orientation. Such orientation will allow the shadows inside the greenhouse, created by overhead structure and hardware, to “move” west to east over the crops as the day progresses and the sun seems to move east to west (you do realize that the sun appears to move, while actually the Earth rotates?). This provides more uniform light distribution to all the plants. More light is generally more growth and uniform light distribution helps to provide equal plant growth throughout the greenhouse, meaning labor savings during production and especially at harvest.

For improved sunlight harvest, cover with a single layer of glazing (glass or plastic film). Minimize the amount of overhead structure and hardware with wider, lightweight plastic film or panels, which require fewer light-blocking roof-supporting bars. Consider light spectrum selective glazing that reduces the NIR (wavelengths, which increase the heating), but don’t reduce PAR for plant growth.

Can AI help? Sure, it’ll be similar to other existing computer controls that determine when to shade the crop and when to operate the LED supplemental lamps. That’s another future discussion about control systems. However, I anxiously await the day that a cost-effective glazing can be automatically “tuned” by computer control to transform its light transmission on demand to meet the needs of the plant growth for PAR while reducing the solar heat gain in the day and then changing each night to reduce heat loss by radiation. They currently exist as one or the other, not both … yet.

Hopefully, you can appreciate that it is all about the plant.

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