GROWERTALKS

Features

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Putting the Plants First

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For controlled environments such as greenhouses and indoor grows, companies have developed sophisticated systems to automate the process of creating and maintaining plant growth environments, providing capabilities for automatically adjusting climate targets based on dynamically changing conditions.

The challenge is that each plant is unique in the way it grows, looks and reproduces, and the nature or genetic makeup of the plant determines the range of possibilities for its size, habit, flowering and fruiting. Even under similar circumstances, the same plants may perform differently and, depending on its environment, may produce many large fruits, or fewer small fruits, or no fruit at all.

For growers and researchers alike, the key to successfully adapting to the unique requirements of plants is to implement a plant-centric control system that's able to monitor and respond to the wide range of environments necessary to optimize plant outcomes.

Not all control systems approach the plants in the same way

Plant growers have many options to choose from for controlling and automating their greenhouse or indoor operation. Building Management Solutions (BMS), for example, are usually intended for managing the climate of buildings typically with human occupancy requirements in mind. Environmental control systems specializing in horticulture have the plant as the focal point for all monitoring and control strategies within the room.

Plant production modeling systems are designed to assist in analyzing the growth and development of crops and controlling the environmental variables to which they're exposed. This information is then used to try to predict how changes in the factors of production will affect growth and yield.

Argus Controls programs can help manipulate light intensity and spectrum.

Cycle	On/Off	Intensity	Wavelength
Seedling	16 hrs. on, 8 hrs. off	650 µmol/m²/s	Yellow/blue and circulate air
Vegetative	18 hrs. on, 6 hrs. off	850 µmol/m²/s	More blue, less red—stop stretching, more leaves/bush out
Flowering	12 hrs. on, 12 hrs. off	1,000 µmol/m²/s	More red to boost bud production, add green and UV to boost THC

Plant-centric controls provide growers with production modeling systems that respond to the plant's needs and are more likely to directly control the environment to tighter tolerances while delivering more precise controls for processes inherent to horticulture.

Technologically advanced environmental control systems, like Argus Controls, have developed specific programs that aid in optimizing growth or yield as a

result of their plant-centric approach by creating mathematical expressions of the components of growth and their interrelations. These may include growth determining factors, growth limiting factors and growth reducing factors.

Modeling systems for crop production are usually only available on control systems for horticulture. These systems predict growth rates and other crop-related outcomes based on mathematically derived relationships between the multiple factors of growth and known properties of the target crop.

Commonly, an environmental control system for horticulture is focused on achieving targets within the defined limitations of the controlled equipment and the tolerances of the crop. Its primary function is to automate the operation of the connected greenhouse equipment to maintain climate parameters such as temperature, humidity, light, carbon dioxide, root zone moisture and nutrient levels within the target thresholds.

In order to do so, the system must consider certain rules and protocols that ensure proper and safe equipment operation, the specific needs and tolerances of the crop, and economic considerations such as energy use. Greenhouse and indoor grow control systems are meant to operate the equipment to meet the targets while respecting any limitations that may be imposed, regardless if the targets are entered as fixed operator setpoints, modified by other measured parameters or passed in from an external decision support system.

An Argus Controls system, for example, can program light schedules for the growth stages in cannabis production by manipulating the light intensity and spectrum to ensure plants maximize chlorophyll absorption, which peaks between 450 and 660 nm.

To achieve this, Argus schedules intensity and wavelength for the target profile. If the ratio of red to blue light increases, the plant perceives more intense light and leaves don't stretch vertically as they grow, resulting in a tighter branching pattern. With Argus, the grower can change light spectra to manipulate plant properties, such as cannabinoid and terpene profiles, and THC content.

Flexibility is key

Some controls system vendors focus on incorporating crop-specific modeling intelligence into their systems. This "closed systems" approach to model integration means that growers using these systems are limited to the range of offerings provided by their automated controls provider. An "open system" accommodates as wide a spectrum of crop applications as possible. Rather than embed simulation software into the systems, an open system provides methods for working and communicating with external third-party systems.

Using an open-system approach, users are free to take advantage of a full range of emerging decision-support products. Researchers may also benefit from this interconnectivity since they can use the control system to provide the input measurements and the controlled outputs for testing their experiment models.

Focus on the plant

Consistency in the production and an efficient use of the resources are key elements in a successful horticultural operation. To achieve these goals, it's important to consider that a control system for horticulture should not only automate the environment, it should also be able to provide programs that can monitor and react to the needs of the plants and even anticipate specific requirements, such as watering or feeding cycles.

Production modeling systems are what set apart plant-centric environmental control systems from traditional BMS solutions, providing growers and researchers more control and better outcomes. **GT**

Pictured below: Consistency in the production and an efficient use of the resources are key elements in a successful horticultural operation. • Modelling systems for crop production are usually only available on control systems for horticulture. • An Argus Controls system can program light schedules for the growth stages in

cannabis production by manipulating the light intensity and spectrum.

Production modeling systems available with environmental control systems for horticulture:

• Integration of climate, light, CO2, irrigation, nutrient—all with a single modeling program

• Management of Daily Light Integral at the plant level by measuring the light received by the plant and controlling LED lighting (intensity and/or wavelength) according to the plant growth phase

• Calculation and control of Vapor Pressure Deficit (VPD) and Humidity Deficit

• Evapotranspiration Model: Uses calculation of VPD and measurements of inputs and outputs to calculate plant transpiration vs. evaporation to determine irrigation and nutrient requirements that ensures plants maintain transpiration through the lighting phase, which maximizes nutrient uptake

(Example based on features available on an Argus Controls system.)

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