Dealing with HUMIDITY in the GREENHOUSE

Addressing this quality control challenge in a cost-effective way is critical. Begin with structure awareness, proper irrigation and use of environmental systems.

A hygrometer is an instrument used for measuring the amount of humidity and water vapor in the atmosphere.

BY MATT KRUM

After a spring or fall day of irrigation and plant transpiration, and when ventilation gives way to heating as evening temperatures fall, the relative humidity in the greenhouse will rise as moist air becomes captive. Condensation occurs when the dewpoint is reached, and moisture collects on cooler surfaces like the plant canopy and glazing surfaces of the structure. Resulting drips from the structure can add to the canopy moisture. The resulting conditions will benefit the growth of damaging pathogens like Botrytis and downy or powdery mildew.

Reducing the occurrence of pathogens has long been the challenge that many greenhouse growers have faced. Addressing this quality control challenge in a cost-effective way is critical in terms of a greenhouse operation's profitability. But the practice of high humidity mitigation hasn't, traditionally, lent itself to a cost-effective solution for many small to medium sized operations.

The most economically viable methods of reducing humidity in a greenhouse begin with an awareness of the structure, proper irrigation practices and the utilization of available environmental systems.

The drip-reducing designs of greenhouse structures and the anti-condensate properties of glazing materials have been available for many years. Growers should become familiar with the qualities of their structure(s) and its glazing materials so that any shortcomings can be compensated for, if not improved upon with upgrades.

Irrigation methods and practices that result in wet surfaces and standing water in the greenhouse will contribute to evaporation and an increase in relative humidity levels. Dripper systems, though more expensive, are less likely to contribute to evaporation than other watering methods. Though effective, not every operation will lend itself to drip irrigation. Hand watering, misting or sub-irrigation will cause wet surfaces and, therefore, should be done early in the day so that afternoon ventilation will exchange humid for drier air. Good floor and bench drainage will help reduce the occurrence of evaporation from standing water.

When the air in the greenhouse is humid and ambient air temperature begins to approach dewpoint temperature, the only way to avoid surface moisture from condensation is to replace the moist air with drier air. The most cost-effective way to do this is with ventilation. But as with heating, and being a nighttime function, dehumidification requires the ability to automate that function. In a greenhouse, the basic environmental systems we have at our disposal are heating, ventilation and air circulation. These three assets, when coordinated by automation, can provide an effective dehumidification strategy.

AUTOMATED DEHUMIDIFICATION

Even some of the most basic environmental controllers on the market today include dehumidification capabilities. Surprisingly, the greenhouse automation that some growers are using to maintain a temperature may only be a humidity sensor away from controlling pathogens. A grower with an environmental controller should check the specifications or call the manufacture for what may be an inexpensive crop quality control upgrade.

With circulation fans "blending" the air qualities of temperature and humidity, the controller can take a reading from the sensor (or humidistat) and activate ventilation curtains, fans and heaters based on the parameters set by the grower. Heating could increase the moisture carrying ability and buoyancy of air that could then be exhausted by passive or mechanical ventilation.

Inevitably, the more sophisticated the environmental controller, the more expensive. But with sophistication comes more dehumidification strategies. Advanced strategies may include the ability to time dehumidification just before sunrise and sunset when condensation is most likely to occur and time an alternate heating set point just prior to ventilation/dehumidification so that more moisture is expelled. Furthermore, with settings that include time, temperature and relative humidity, a dehumidification strategy can be designed to maximize energy efficiency.

HUMIDITY OVERRIDE

Some creativity can be used for purposes of reducing energy costs associated with dehumidification. Though air at 70° F will hold twice as much moisture as air at 50° F, the relative humidity will be relatively lower at that higher temperature. Therefore, and especially in the case of less sophisticated environmental controllers, the setting of your controller's humidity override should be based on the temperature being maintained in the greenhouse. In the 70° F case, vents or fans can be designated for dehumidification and the relative humidity setpoint lowered to assure moist air replacement. With a more sophisticated controller, a higher relative humidity setpoint can be programmed since condensation won't occur as readily at higher temperatures. Then a timed strategy (dusk and dawn) can be employed to reduce energy consumption associated with the use of fans and heaters over the course of the greenhouse night. Remember that if you're maintaining a lower internal temperature, the water carrying capacity of the air is less and a dewpoint temperature that is closer to the air temperature can be expected.

PASSIVE DEHUMIDIFICATION

Thankfully, the process of dehumidification is becoming less complicated and expensive. The downward trend of technology costs can offer growers a more attainable level of quality (humidity) control. The capabilities of affordable greenhouse controls have greatly increased recently, to the point where automating dehumidification is easier to budget for. So, when cooling is automated using passive ventilation, so then can dehumidification be passive. The same principals of air movement and buoyancy that apply to cooling a greenhouse by opening portions of the structure, will also aid in dehumidification where air exchanging is necessary. The same energy savings can be realized when passive dehumidification is utilized over mechanical means.

Entry-level costs of passive dehumidification have trended lower with the emergence of reliable low voltage (24 DC) ventilation drive motors that are as rugged (and much less expensive) than their 110 VAC counterparts. Some environmental controllers have transformers that convert 110-volt AC power to 24 DC, built in to a single box. Others have the capability to utilize 12- or 24-volt solar-supplied power. Most noteworthy are the evolving capabilities of these controls that enable a grower to assign advanced temperature and humidity control strategies. Some have the timed functionality that is programed via easy-to-understand touchscreen controls. Almost all incorporate heating, air circulation as well as mechanical cooling assets to reduce the damaging effects of condensation in a greenhouse.

These features and capabilities have never been more approachable to as many growers. As the cost of technology decreases and the advancements in greenhouse environmental controller technology increase, more growers can automate a humidity control strategy that is effective and, above all, affordable. gpn

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