From Forest Nursery Notes, Summer 2011

71. Is it time to replace your mechanical thermostats? Bartok, J. W., Jr. Greenhouse Management and Production 30(11):46-47. 2010.

Technology | The energy savings can be considerable when mechanical thermostats are replaced with electronic controllers.

Is it time to replace your mechanical thermostats?

By John W. Bartok Jr.

Mechanical thermostats are rapidly becoming obsolete. Consider that replacing a mechanical thermostat that has a 4°F-6°F differential between on and off compared with an electronic controller that only has a 1°F differential. The energy savings are significant. Controllers are the next level of control above thermostats and time clocks. They provide better environment control while at the same time saving energy.

Energy savings

The energy savings from electronic controllers result from lower heat loss from the greenhouse surface as the heater shuts off only a degree above the set point rather than 3–5 degrees. In a 30- by 100-foot double polyethylene covered greenhouse heated to a night temperature of 60°F where the average outdoor winter temperature is 25°F, and the fuel costs are $19.50 per million Btu (equivalent to fuel oil at $2 per gallon, natural gas at $1.37 per therm and propane at $1.17 per gallon), a savings of about $1,000 per year will be the result.

Instead of heating the greenhouse air to 64°F-66°F before the heater shuts off, the electronic controller shuts the heater off at 61°F. For each degree that the temperature in the greenhouse can be lowered, there is an approximate 3 percent savings. The payback for installing an electronic controller is less than one year.

Types of electronic controllers

A programmable controller is a control device that has a logic potential but is not powerful enough to be called a computer. The simplest ones replace several thermostats and usually have five to six stages of control (two heat stages and three or four cooling stages plus a set point).

Step controllers use a solid-state integrated circuit to monitor environmental data in the greenhouse and create output signals that activate equipment based on a set of internal programmed instructions. The microprocessor is a simple, low-cost device that is reliable, accurate and works well in a greenhouse. Cost for basic step controllers usually runs from $600 to $1,500 depending on the number of steps and the amount of relays or contactors that are needed to control the equipment.

Electronic controller advantages include:

- The heating and cooling functions of the greenhouse are divided into stages and the controller steps between stages as conditions in the greenhouse change. Multiple pieces of equipment can be assigned to each stage, such as two heaters, horizontal airflow fans and an energy screen at stage two. The sequence of equipment operation and the temperature at each stage is programmed by the grower.
- All components are located in one waterproof enclosure, reducing moisture, dust and maintenance.
- Installation time is reduced as relays, switches and controls are prewired.
- The sensor is remote and can be located among the plants while the control box is out of the plant zone.
- Energy use is reduced due to more accurate sensing and control.

Controllers operate with a set point -- the air temperature that you want to maintain in the greenhouse. If the temperature falls below the set point, the heating system is activated. If the temperature exceeds the set point, the vents open or the fans start to provide cool air. With multiple cooling stages, a different setting on the vents or additional fans will start. A final stage could include the activation of an evaporative cooling system. An override is provided at each stage for manual operation.

Standard, optional features

The following features or functions may be standard or optional depending on the manufacturer and model:

LED screen: Displays the current temperature, time, date and other information.

Battery backup: Stores the settings in case of a power failure.

Alarm activation: Can be connected to a trouble alarm.

Ramping: Controls the rate of change between day and night settings.

Temperature sensitivity: Accuracy should be between 0.5°F to 1°F for best control.

Temperature difference between stages: May be fixed or variable.

Day-night temperature setting: Most manufacturers use a light sensor to detect the graying of the sky at sunrise or sunset. This can usually be adjusted for light level.

Programmable night cooling lockout: Can disable one or more ventilation stages after dark.

Aspirated sensor box: Includes a small fan that draws air over the sensors to obtain an average temperature in the greenhouse.

Tracking: Data storage of high/low temperature for each set point. Storage of data is for up to seven days. Some units have software to allow connection to a personal computer.

Advanced controllers offer many of the above features plus additional stages of control, input from a weather station and the ability to control multiple zones.

Specialized controllers

There have been many specialized controllers developed during the past few years that control other equipment.

Ventilation controller: this unit is usually designed to provide control of roof vents, side vents, roll up walls and retractable roofs. It provides operation in multiple stages or settings.

Irrigation and misting controller: A unit to control solenoid valves to automate the watering system. Activation can be based on soil moisture or vapor pressure deficit and time of day. Multiple zones can be controlled.

Energy/shade screen system controller: Designed to open and close screens either manually or automatically with a light sensor. Usually includes safety features that protect the motor and screen from overload.

Demand shedding controller: When the controller senses that the electrical demand is approaching a critical level, the unit shuts off equipment to keep the demand below that level.

Boiler controller: This device senses carbon dioxide and oxygen levels of the flue gases and adjusts the combustion air intake to yield optimum combustion efficiency.

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Up to 95 percent of the crops grown at Casa Verde Growers in Columbia Station, Ohio, end up in Petitti Garden Centers throughout the Cleveland area.
See page 10.

Photo by Jerrey Studios

COVER STORY

Casa Verde Growers in Columbia Station, Ohio, adapted its production to meet the changing needs of its retail operation, Petitti Garden Centers.

2010 BREAKTHROUGH

FEATURES

Greenhouse Management & Production, formerly GMPro, (ISSN 1080-6679) is published monthly. One-year subscription rates: Free to qualified retailers in the United States. Non-Qualified U.S. subscriptions are $96 in the United States; $120 for delivery outside the U.S.; U.S. funds drawn on a U.S. bank required for all foreign subscriptions. Single copy rate: $8, plus postage while supplies last. Periodicals postage paid at Richfield, Ohio, and additional mailing offices. Postmaster: Send address changes to **Greenhouse Management & Production,** 4020 Kinross Lakes Parkway, Suite 201, Richfield, Ohio 44286. Canada Post: Publications Mail Agreement #40612608. Canada Returns to be sent to Bleuchip International, P.O. Box 25542, London, ON N6C 6B2