

GREENHOUSE CLIMATE CONTROLS

Jay S. Koths, Extension Floriculturist

Temperature and air movement controls are very important in producing quality plants economically. A greenhouse should have a minimum of 4 stages of controls for temperature regulation. These may be:

1. Heat with air movement (HAF)
2. Ambient with air movement (HAF only)
3. Slight ventilation
4. Full ventilation

This may be accomplished with 2 thermostats, one single-stage heating and one two-stage cooling. The heating thermostat only activates the heating system. The cooling thermostat should be equipped with double throw switches. As the temperature increases from stage 2 (HAF horizontal air flow only), to stage 3 (slight ventilation), the HAF fans are turned off and an exhaust fan(s) is turned on to pull air in through an overhead tube for cold weather ventilation. As the temperature increases from slight to full ventilation, the exhaust fans are turned on full and louvres in the far end are opened for full (one exchange per minute) ventilation.

This system may be refined greatly. Suppose that heat is being supplied by a perimeter line and four unit heaters. Stage 1 may be divided into 3 phases.

- 1a. Perimeter heat with HAF
- 1b. Perimeter heat, 2 unit heaters and HAF
- 1c. Perimeter heat, 4 unit heaters and HAF

This will require 3 thermostats, rather difficult to balance for close temperature control. A 3 stage thermostat might be used but in commercial practice it is sufficient to have two (or a two stage thermostat), one activating stage 1a, the other activating 1b and 1c.

Horizontal air flow (HAF) is recommended over other types of air movement. Air is moved down one side of the greenhouse and back the other with small fans. If unit heaters are used, their fans are set to operate continuously, independent of heating requirements through stages 1 and 2 as part of the HAF air movement pattern. The air should move up to 100 feet per minute (Prof. Walker says that 50 fpm is adequate). This is easily checked with a smoke bomb.

In ridge and furrow houses the air is moved down one house and back the next. In four ridge and furrow houses, the 2 middle houses should move the same direction. For more information see the Connecticut Greenhouse Newsletter #56, January 1974.

In stage 3, slight ventilation, a perforated tube is connected in the ridge to an opening in one end (or to both ends in larger houses) with a motorized louvre. The exhaust fan produces a pressure deficit in the house causing air to enter the tube which is distributed throughout the house. Air also enters any cracks or openings in the house. In fact, some glass houses may leak enough to provide gentle, uniform cooling.

When the temperature increases to actuate Stage 4, the exhaust fans turn on full and louvres open. Stage 4 may also be divided into phases so that all exhaust fans do not turn on full at once. This also requires separate thermostats or a multiple stage thermostat.

Several multiple stage controls are available (Acme, Wadsworth, Phillips) that provide excellent integrated control through all stages of temperature regulation. These are well engineered and give good sequential control. For small operations they become expensive. They are a bit complicated.

A single diagrammatic representation of a 2-thermostat control sequence might be as follows for a 60° house.

	Below 60°	60-70°	70-75°*	Over 75°*
1. Heat & HAF	ON	OFF	OFF	OFF
2. Ambient & HAF	ON	ON	OFF	OFF
3. Slight Vent	OFF	OFF	ON	OFF
4. Full Vent	OFF	OFF	OFF	ON

*If using CO₂, increase these temperatures 5°.

The Stage 4 may be further divided if evaporative cooling pads are used. These are not common in New England for two reasons: 1) the high humidity reduces their effectiveness and 2) the relative infrequency of excessively hot days. The expense is not usually warranted.

For a house with two stage heating (such as perimeter lines and unit heaters) and 2 fans, the six stage control sequence might be as follows:

	Below 59°	Below 61°	61-70°	70-74° 70-74°	74-78°	Over 78°
--	--------------	--------------	--------	------------------	--------	-------------

1a. Peri- meter heat & HAF	ON	ON(W)	OFF	OFF	OFF	OFF
1b. Unit heat- ers & HAF	ON(V)	OFF	OFF	OFF	OFF	OFF
2. Ambient & HAF	ON	ON	ON(X)	OFF	OFF	OFF
3a. Slight Vent* (Half Speed)	OFF	OFF	OFF(X)	ON(Y)	---	---
3b. Half Vent* (one fan)	OFF	OFF	OFF	OFF(Y)	ON	ON
4. Full Vent (two fans)	OFF	OFF	OFF	OFF	OFF(Z)	ON

*These stages operate with the overhead ventilation tube.

This six stage system may be set up with three thermostats.

1. A two-stage heating thermostat to actuate signals V and W

2. A two-stage, double throw thermostat to actuate signals X (turn off HAF, start fan 1 at half speed and actuate louvre for vent tube) and Y (which turns fan 1 on full speed).

3. A single stage cooling thermostat which actuates signal Z (starts fan 2 at full speed and opens full vent louvres. It may also close the vent tube louvre but this is not necessary.)