



By Erik Runkle



Measuring Greenhouse Temperature

The single largest advantage of using greenhouses to grow ornamental and food crops is the ability to provide desirable temperatures for plant growth and development. Providing a desired temperature is neither easy nor cheap; building greenhouses with effective and efficient heating and cooling systems is expensive. Once built, a significant amount of energy is used to heat and ventilate them to maintain desirable temperature setpoints. In addition, since temperature controls maturation rate (e.g., cropping time), delivering the desired temperature is necessary if crops are to be marketed on time.

and lights, and that a constant stream of air moves by the sensor. Therefore, the sensor should be in an aspirated box or tube that is reflective (for example, white in color). Ideally, this temperature chamber should be positioned away from heat pipes and walls and at the height of the crop canopy (Figure 1). If temperature is measured several feet above the crop, it's probably a few degrees warmer than at crop level.

A thermocouple is the most common device used to measure air temperature. A thermocouple consists of two different metals that are combined (usually by twisting them) to produce a voltage related to their temperature difference. There are several types of thermocouples that contain different metals, wire thicknesses, and thus have different costs and degrees of accuracy. Mercury thermometers are inadequate for most commercial production situations; they are hazardous if broken, don't allow automated measurements and lack precision.

Media temperature. The temperature of the root zone can be measured by inserting a thermocouple or temperature probe into the media. They should be positioned 1 to 2 inches below the media surface, depending on the size of the container, but not touch the bottom of the container. As with air temperature, media temperature should be measured and recorded on an automatic and frequent basis to determine average daily temperatures.

Plant temperature. The temperature of the growing point is what determines cell division, and thus, plant development rate. Although air temperature has the largest effect on shoot-tip temperature, light, humidity, media temperature and wind also have impacts. To measure the shoot-tip temperature, a fine-wired thermocouple can be inserted into the stem about 1/4-inch below the shoot apex, preferably on the north side so that it is shielded from direct sunlight. Alternatively, infrared (IR) sensors can be used to record plant canopy temperature. They should be positioned relatively close to a crop (typically within 3 feet, depending on the viewing angle of the sensor) and placed at a 45-degree angle so that the field of view is plant leaves and not the media, container, bench, floor or wall.

All temperature sensors should be periodically checked for proper placement and accuracy. Inaccurate readings can lead to unnecessary heating or venting and over the longer term, crops may be ready for market too early or too late. ☒



Figure 1. Air temperature should be measured in an aspirated box positioned very close to the plant canopy and away from wall, aisles and heating pipes.

Regardless of the greenhouse environmental control system capability, desired temperature delivery requires proper temperature measurement. Measuring and controlling air temperature is sufficient in many production situations, since it is easy and inexpensive to do, and because it has the largest effect on plant temperature. In propagation houses, media temperature should also be measured and controlled to promote rapid rooting of plugs and liners. Finally, by measuring plant temperature, you can determine whether plants are warmer or cooler than the air temperature.

Air temperature. Accurate greenhouse air measurement necessitates that the sensor be shielded from the sun

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