

Air, Leaf and Root-Zone Temperature

Temperature is the primary factor that influences the rate of cell division, which is the driving force for plant development. The rate of development typically increases linearly as temperature increases from a crop's base temperature to its optimum. The base temperature of many popular floriculture crops ranges from 32 to 39° F for cold-tolerant crops to as high as 46 to 54° F for cold-sensitive crops. The optimum temperature also varies widely, and is typically higher for plants with high base temperatures.

In addition to crop timing, temperature also influences other plant processes including photosynthesis and crop quality (with light and carbon dioxide concentration), the rate of water loss (with humidity), rooting, and flowering.

While the importance of temperature in greenhouse crop production is unquestionable, where or how should it be measured? Should we measure the temperature of the air, the substrate, the shoot tip, a leaf or a plant canopy? The answer is somewhat situational.

Air temperature. The most common, easiest and least expensive measurement of temperature is that of the air. It is usually measured by a thermocouple, which should be positioned inside a shield or box with constant air flow. Thermocouples exposed to light and/or inside a box without adequate air flow

will create an erroneously high reading. For the most accurate measurement, each temperature sensor should be placed near the center of the greenhouse and at crop height. While air temperature has a major influence on plant temperature, more direct measurements of plants or their root zones can give more accurate and meaningful information.

Root-zone temperature. Measurement of the substrate temperature is particularly important when propagating plants for rapid callus formation of cuttings and rooting of young plants. It also controls emergence and initial development of potted bulbs, rhizomes, and tubers. Factors that influence substrate temperature include the air temperature, the surface temperature on which containers are placed (e.g., bench or floor), water temperature, color of the container and light intensity.

A recommended root-zone temperature during propagation of many ornamentals is around 72 to 76° F. Cold water, whether delivered by mist or direct to the root zone, can decrease its temperature, while sunlight, especially with dark-colored pots, can increase it.

The root-zone temperature can be measured by sensors (thermocouples or thermometer probes) that are placed inside flats or pots one to two inches below the surface of the

“ Measurement of the substrate temperature is particularly important when propagating plants. ”

substrate. When available, floor or bench heating that operates based on the root-zone temperature, as well as sufficient light to promote shoot and root growth, can create the desired aerial- and root-zone environments for rapid rooting.

Leaf and canopy temperature. While less commonly measured, the temperature of leaves or a plant canopy can be useful to assess. During the winter, plants can be as much as 5 to 8° F colder than the air, particularly at night and when energy curtains are not used. During high-light periods, canopy temperature can be higher than the air temperature, especially when leaves are drought-stressed. High leaf temperature can decrease photosynthesis and plant growth, and cause plant stress.

Canopy temperature is usually measured by an infrared sensor positioned a few feet above a crop and pointing downward at a 45-to-60-degree angle. Measurement of an individual leaf is usually less useful information because temperature will vary from one to another, depending in part on its position and orientation.

Shoot-tip temperature. While difficult to measure, the temperature of the growing point is ultimately what determines plant growth rate. This can be measured by inserting a fine thermocouple just under the growing point. Challenges include moving the thermocouple every few days as the plants grow, and securing the thermocouple so that it does not fall out.

Assuming greenhouse air temperature is measured properly, it alone is often sufficient for many production situations. However, measurements of the root zone, canopy and/or shoot-tip temperature can provide additional information that can motivate you to adjust the greenhouse air temperature setpoints. [gpn](#)



Erik Runkle is a professor and floriculture Extension specialist in the department of horticulture at Michigan State University. He can be reached at runkleer@msu.edu.

