By Erik Runkle

The Fundamentals of Temperature

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Floriculture crops are grown under a wide variety of environmental conditions. One principle that applies to all crops is that their developmental rate (such as the rate of leaf unfolding or rate of flowering) decreases as temperature decreases. As temperature decreases, plants develop progressively slower and, at some point, they stop growing. The cool temperature at which plant development stops is referred to as the base temperature. The base temperature varies among species, although for most floriculture crops, estimated values range from 32° to 50° F.

As temperature increases above the base temperature, the rate of development increases in essentially a linear manner, until a specific temperature is reached at which the plant develops as fast as it can. The temperature at which development is maximal can be called the optimum temperature. Again, the optimum temperature varies from one crop to the next. Generally, plants with a high base temperature have a higher optimum temperature than plants with a low base temperature.

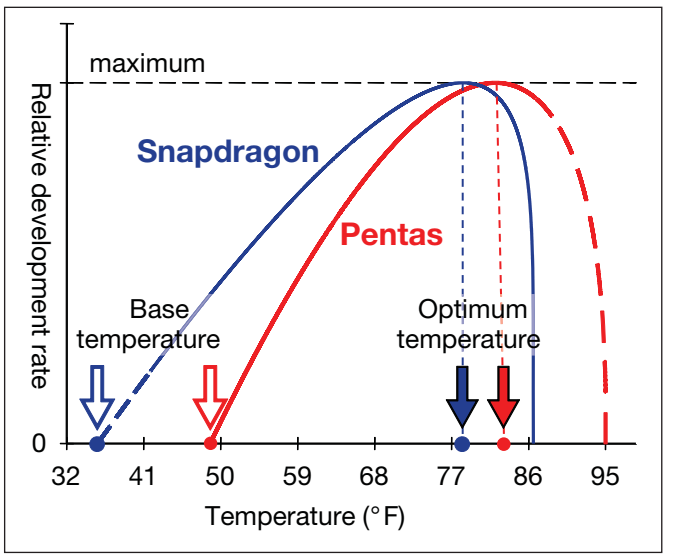

Figure 1. *The effect of temperature on relative developmental rate of snapdragon ('Montego Orange Bicolor') and pentas ('Graffiti Lavender'). The base temperature is the cool temperature where the rate of plant developmental is zero. The optimum temperature is that where plants are developing as rapidly as possible.*

The optimum temperature is not necessarily the best temperature to grow a crop; under light-limiting conditions, plants can be of moderate or even poor quality if grown at a crop's optimum temperature. Therefore, as a general rule, high-light crops should only be grown at near-optimal temperatures when the average daily light integral (DLI) at plant level is high (for example, greater than 15 mol·m-2·d-1). When the DLI is very low (less than 8 mol·m-2·d-1), high-quality crops can only be grown at relatively cool temperatures (such as a temperature where the relative growth rate is around the 50 to 75 percent of the maximum value).

Two relative plant development curves, one for snapdragon and the other for pentas, are shown in Figure 1. This graph was generated based on research by Matthew Blanchard at Michigan State University, who grew plants in growth chambers with temperatures that ranged from 41° to 86° F. The open arrows in Figure 1 refer to the plant's base temperature, where rate of development is zero. The estimated base temperature for snapdragon is 36° F, while that for pentas is 49° F. The filled arrows refer to the optimum temperature for the two crops, where plant development is most rapid. These estimates assume that plants are provided with adequate water, nutrition, light, carbon dioxide, etc.

Plants develop in response to the average daily temperature. In other words, if the day and night are each 12 hours long, plants grown at a day/night of 75/65° F would flower at the same time as plants grown at a constant 70° F. However, if periods during the day or night are below the base temperature (or above the optimum temperature), then plant development will be delayed. For example, pentas would not develop during the time it was exposed to temperatures below 49° F.

Finally, plant development rate decreases as temperature increases beyond the optimum temperature. The maximal temperature is the temperature at which development stops due to plant stress and it varies among crops; it is 87° F for snapdragon and 95° F for pentas. When possible, avoid exposing plants to temperatures above the optimum temperature, and especially temperatures above the maximal temperature.

Erik Runkle is associate professor and floriculture extension specialist in Michigan State University's department of horticulture. He can be reached at runkleer@msu.edu or 517.355.5191 ext. 1350.