



Controlling Height with Temperature Drops

By Erik Runkle



Scheduling a temperature drop before sunrise might enhance stem extension with minimal impact on heating costs.

About 20 years ago, researchers at Michigan State University (MSU) discovered that, in many plants, stem extension is influenced by the way temperature is delivered in each 24-hour period. In particular, plants are often shorter when the day is cooler than the night. A cooler day than night is commonly referred to as a negative DIF (DIF = difference). The opposite is true with a positive DIF: Stem elongation increases when the day temperature is warmer than the night.

But providing a warm night (negative DIF) can be expensive because most of the energy consumed to heat a greenhouse occurs at night (see www.tinyurl.com/gpn-dif for more information on that topic). Fortunately, dropping the temperature at the beginning of the morning, which is referred to as a temperature drop or dip, can provide at least a partial negative DIF response. Using a temperature drop also has little impact on heating costs.

Temperature drop is the practice of lowering the temperature, typically by 5-15° F, before sunrise for a two- to three-hour period. Generally, the greater the magnitude of the temperature drop, the stronger its effect on plant height. For the best and most consistent results, the temperature drop must be achieved before plants perceive the start of the day. Therefore, a common goal is to attain the desired temperature-drop setpoint 30 minutes before sunrise. Temperature drops are generally not effective when delivered at other times of the day or night.

Some growers will let temperature naturally ramp down near the end of the night by turning off heaters for a short time. If the greenhouse does not cool rapidly enough, venting may be necessary to achieve the desired low-temperature setpoint. Growers using energy curtains at night may need to slowly open the curtains before sunrise to allow the cool air above to reach plants below.

With the addition of a morning temperature drop, the average daily temperature decreases. Therefore, the remaining hours of the day and night need to be increased slightly so that the average daily temperature remains the same as before (Figure 1). In this example, the three-hour drop, from around 5:30 a.m. (here, 30 minutes before sunrise) to 8:30 a.m., plunges to 58° F. To achieve an average daily temperature of 68° F, the remaining period of the day and night is increased to 69.5° F.

We don't have a clear understanding of how DIF and drop mediate stem extension of plants. Some scientific evidence indicates that temperature influences the biosynthesis of gibberellic acid (GA). GA is a natural plant hormone that regulates stem extension. So, in some way, a negative DIF and a temperature drop inhibit the biosynthesis of GA. There is also likely some interaction with phytochrome, the pigment in plants that perceives whether light is present. 

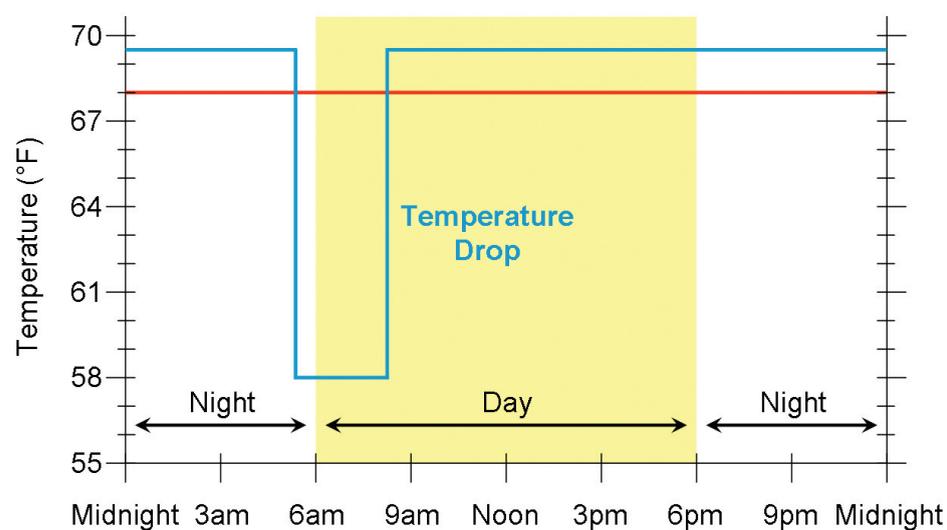


Figure 1. An example of an idealized temperature drop (blue line) compared to the same average daily temperature of a constant 68° F (red line). In reality, the temperature drop and rise take time to achieve the desired greenhouse setpoints. Note that temperature before and after the drop is increased slightly so that the 24-hour average temperature is the same.

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