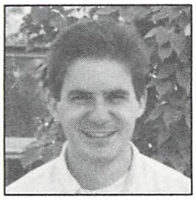
New Concepts on How Day and Night Temperatures Affect Plant Growth

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Temperature is a critical environmental factor for plant growth. Yet, despite its importance to our industry, it's amazing how little we know about how temperature influences plant growth. During the past 5 years, we have been involved with experiments designed to determine exactly how day and night temperatures influence the growth of Easter Lily, poinsettia and chrysanthemum. Here are some of the interesting results, along with highlights of a new technique for monitoring stem elongation called 'graphical tracking.'

Stem Elongation

Day and night temperatures have a great impact on stem elongation. Plant height increases as day temperature increases. In contrast, plant height decreases as night temperature increases, unless flower initiation is delayed which results in an increase in node number and, ultimately, plant height.

Close analysis of the data showed that it was the difference (DIF) between day and night temperature (day temperature minus night temperature) which ultimately determines internode length at flower. The effect of DIF on stem elongation is true regardless of the absolute temperatures a plant is grown under between 50°F (10°C) and 90°F (32°C). Stem elongation increases as DIF increases.

Leaf Orientation

Leaf orientation, i.e. whether the leaf is raised upward or drooping downward, is influenced in a similar manner by DIF as stem elongation. Leaf orientation increases as DIF increases. In general, a negative DIF (higher night temperature than day temperature) results in leaves oriented downward. In contrast, whenever DIF is positive, leaves are oriented upward. It is important to note at this point that whenever the night temperature is greater than the day temperature, foliar chlorosis occurs in the upper leaves.

Rapidity of Response to DIF

The response to DIF is rapid. Often a definite response can be seen as soon as 24 to 48 hours after making a change in the day/night temperature relationship.

Rate of Plant Development

The rate of plant development can often be measured by determining the leaf unfolding rate of the plant. The most common example of this is the practice of 'leaf counting' used to properly time Easter lilies. In general, the rate of leaf unfolding is a linear function of the average temperature under which a plant is grown.

An exception to this rule occurs when night temperatures exceed 72°F (22°C) with short day plants, i.e. chrysanthemum and poinsettia. With these plants, average temperatures above 72°F (22°C) often result in a delay in flower initiation (heat delay) which results in an increase in the node number and the time to flower.

Flower Initiation and Development

As mentioned above, night temperatures above 72°F can result in a delay in flower initiation on short day plants which ultimately increases the time to flower and plant height due to an increase in node number.

Flower development is controlled by average temperature in poinsettia and Easter lily. As average temperature increases, the time from visible bud to flower decreases. The reduction in the time to flower for each degree increase in average temperature, decreases as the average temperature increases from 50°- 90°F.

Flower development in the chrysanthemum differs from the poinsettia and the Easter lily in that 65°F (18°C) is the optimal temperature for flower development. As the average temperature at which a chrysanthemum is grown increases or decreases above 65°F, the time to flower increases.

Flower Size

In general, as the average temperature at which a plant is grown increases from 55°F (13°C) to 75°F (24°C), flower and/or bract size increases. Increasing temperatures above 75°F, results in a decrease in flower size.

Graphical Tracking

The basic concept behind graphical tracking is the use of a tracing line to monitor crop growth with respect to stem elongation and the rate of plant development. The initial plant height and desired final height are plotted on a graph, and a line is used to connect them. There is normally an acceptable range of plant heights when a plant is marketed, not a specific plant height, e.g. 21 to 23 inches for a lily. Therefore, we may have a window of acceptable heights during the development of a crop.

Plant height is measured at regular intervals and the actual height is plotted on the graph. Actual height should be within the window connecting the original point and the final minimum and maximum acceptable plant height. If actual height does not fall within the window, corrective actions must be taken to alter the rate of stem elongation.

The advantage of graphical tracking is that corrective action can be taken early in the development when adequate time is available to make adjustments to the stem elongation rate. The closer the plant gets to the market date, the less time and opportunity there is to make a correction.

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