Tracking Easter lily height with graphs

Easter lily response to temperature during forcing

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Timing and height—how can you control these two vital elements in producing potted plants? At Michigan State, we've been researching the effects of light and temperature on lily, chrysanthemum and poinsettia timing and height. The result is a system called "graphical tracking" which shows you how to manipulate temperature to get your crops to bloom on time at the height you want.

The key to making this system work is knowing your crop's specific reactions to temperature. Lilies, for example, react differently depending on their stage of development. Before visible bud, their leaf unfolding is directly proportional to increases in average daily temperature. After visible bud, however, this is no longer true. Instead, the higher the initial average daily temperature, the less it helps to increase the temperature further.

While average daily temperature influences how fast lilies grow, the difference between day and night temperatures affects the way they look. Warm days with cool nights produce tall plants with upright leaves; cool days with warm nights produce short plants with horizontal or downward curling leaves.

What is an "isopleth plot"?

"Isopleth" means "equal quantity". An isopleth plot is a graph that shows how two variables relate to a constant quantity of another variable. A contour map which shows lines of equal elevation is an example of an isopleth plot. Our isopleth plots show which day and night temperatures result in the same rate of lily development.

Figures 1A and 1B show combinations of day and night temperature which result in the same rate of leaf unfolding (figure 1A for a 10-hour day and figure 1B for an 11-hour day). Figure 2 shows combinations of day and night temperature that result in the same number of days from visible bud to flower.

Some of these temperature combinations will produce tall plants (warm days/ cool nights) and other combinations will produce short plants (cool days/ warm nights).

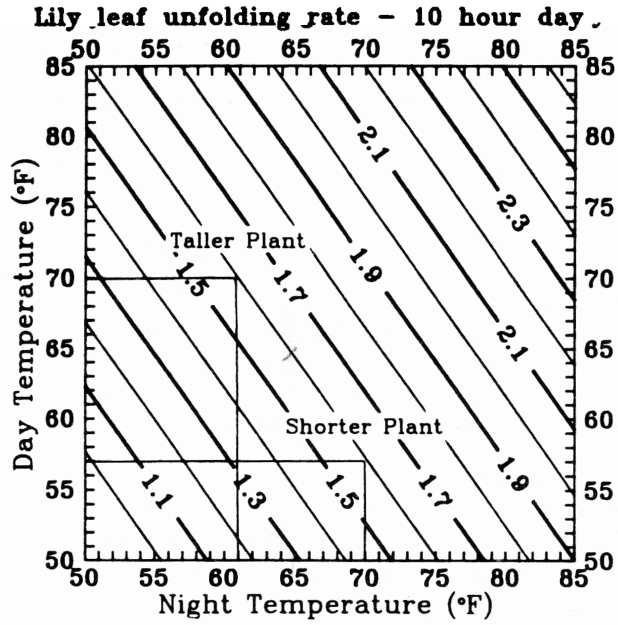

Figure 1A. Isopleth plots of lily leaf unfolding rates for a 10-hour day and 14-hour night.

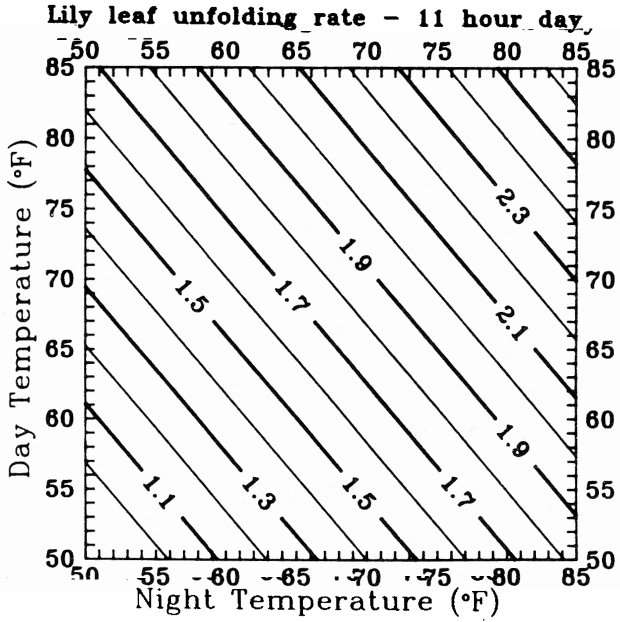

Figure 1B. Isopleth plots of lily leaf unfolding rates for an 11-hour day and 13-hour night.

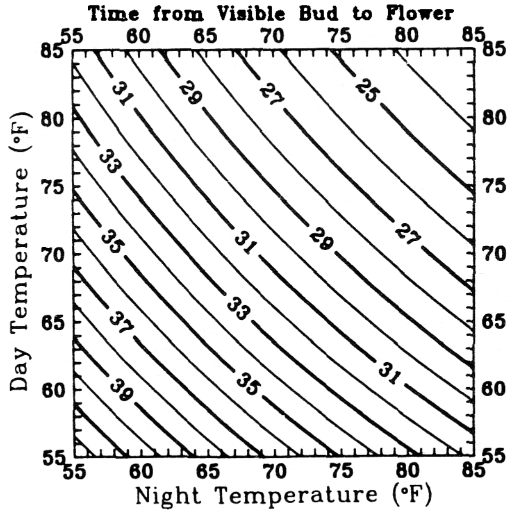

Figure 2. Isopleth plots of time from visible bud to flower for Easter lilies.

What can "graphical tracking" do for you?

Graphical tracking is a procedure used throughout development where actual plant height is plotted and compared with desired plant height.

This article will explain how to construct a graph like the one shown in Figure 3 showing the "tracking window". This "window" represents where your plants should be if they are to bloom on time at the desired height. If their actual measurements do not fall in the "tracking window", you can adjust their development by means of temperature changes—or growth regulator applications.

To construct the "tracking window" graph, draw a graph like the one shown in Figure 3, with height up the side and days to flower across the bottom. Let's assume that you need your lilies ready for shipment by April 1 and your final desired lily height is 22" to 24". (Subtract 6" for the pot, leaving 16" to 18" actual plant height.) We know from experience that a lily typically doubles in height from visible bud to flower, so visible bud height should be 50% of final height or 8" to 9" (14" to 15" including the pot). Connect your beginning height (0") with these desired minimum and maximum heights at visible bud and flower to form your "tracking window".

From emergence to flower initiation, we recommend growing lilies at 62° to 65° F (17° to 18° C) soil temperature, with constant air temperature a degree or two warmer. Keep day and night temperatures about the same.

Around the third week of January, you should be able to count the leaves and figure out how many are yet to unfurl.

Divide the number of leaves yet to unfurl into the number of days before your projected visible bud date to get the number of leaves that must unfurl each day to meet that deadline. Let's assume it's 1.6 leaves.

Check Figure 1A to find all the combinations of day and night temperatures which will unfold 1.6 leaves per day. Pick out a day temperature and draw a horizontal line to the 1.6 line; the night temperature directly below the point where those lines cross is the corresponding night temperature.

In January and early February, when days are short, use the 10-hour-day graph (Figure 1A); in mid-to-late February, when the days are longer, use the 11-hour-day graph (Figure 1B).

Measure the height of your plants every 4 to 5 days to see if they are within your "tracking window". Remember that warm days with cooler nights produce tall plants and cool days with warmer nights produce short plants. If your plants are too tall, choose a cooler day/warmer night combination of temperatures; if they're too short, choose a warmer-day-cooler-night combination.

The more extreme the differences in day and night temperatures, the more extreme the effect in stretching or slowing down the elongation of your plants. However, as long as you choose one of the combinations along that same 1.6-leaves-per-day line, your lilies will stay on your desired growing schedule.

After lilies reach visible bud, use the isopleth plot shown in Figure 2, showing number of days from visible bud to flower. Keep measuring your plants and adjust your temperatures as you did before, if your plants are too tall or too short for the "tracking window".

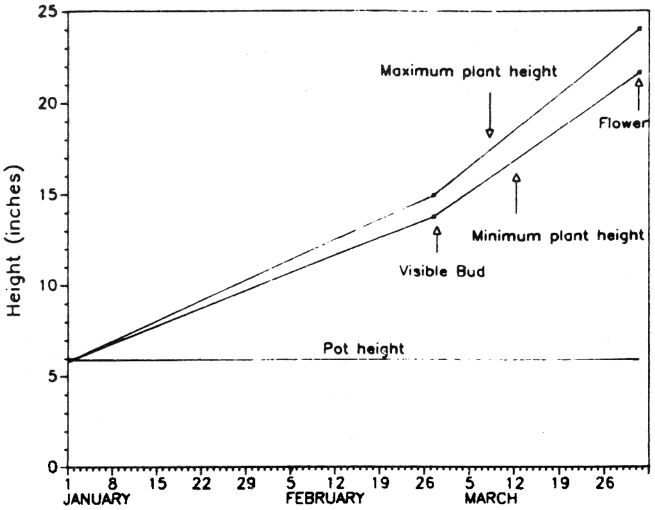

Figure 3. Graphical tracking plot showing the "tracking window" of desired plant height throughout Easter lily development.

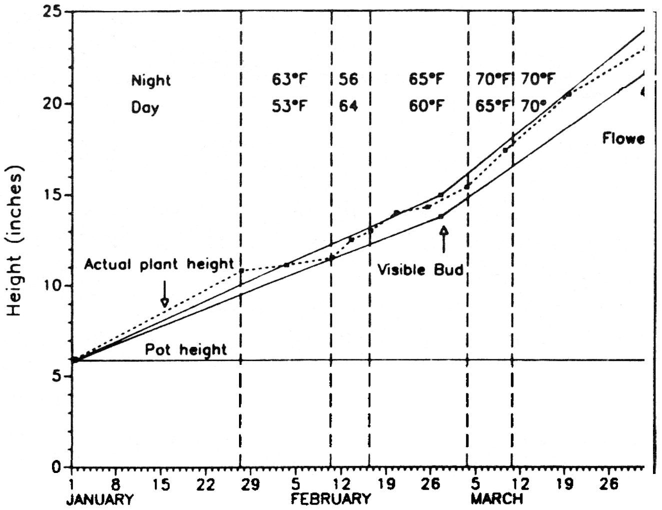

Figure 4. Example application of graphical tracking to a lily crop. Actual plant height is plotted and compared to the desired height shown in the "tracking window".

How does it work?

Figure 4 shows an actual example of graphical tracking in a commercial greenhouse. Before flower initiation, plants were grown at 62° F(16.5° C) both day and night. On January 27, the grower noticed that his plants were getting too tall for the "tracking window" and chose a warmer night/cooler day combination of temperatures (63° F night and 53° F day; 17° C night and 12° C day). Stem elongation decreased dramatically.

On February 10, the grower became concerned that the plants would soon drop below the "tracking window", so he adjusted the temperatures in the opposite direction, to 56° F night and 64° F day (13° C night and 18° C day). This increased the stem elongation while keeping the leaf unfolding rate at a constant 1.3 leaves per day.

On February 17, the grower chose to increase the leaf unfolding rate to 1.5 leaves per day, by adjusting the temperatures to 65° F night and 60° F day; (18°C night and 15.5°C day). He maintained this temperature past visible bud and then increased it twice more to hasten development.

Informed use of the "isopleth plots" and "graphical tracking" allowed this grower to produce his lilies on time, and at the desired height—without the use of growth regulators.

Growth regulators

Not all lily growers have light and outdoor temperature conditions that allow precise temperature control throughout lily development. If you can't keep your lilies in the "tracking window" by means of temperature control alone, growth retardants may be necessary.

When using the growth retardant A-Rest, keep in mind that its effectiveness decreases under cool day/warm night conditions and increases under warm day/cool night conditions. So if you are combining A-Rest with the shortening effect of cool-day-warm-night conditions, keep in mind that these temperature conditions reduce the effectiveness and benefit of A-Rest.

These are all tools

Any prcedure you apply to your plants—from basic watering on up to these more "scientific" procedures—is just another tool to help you control your crops. Once you understand how a tool works, it can make your work easier—and that goes for "isopleth plots" and "graphical tracking", too.