Why grow plants with warmer nights

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At first, it may seem illogical to grow plants with warmer night temperatures than day temperatures—but there are at least two reasons why this method can make sense. First, it limits plant height while still allowing control of plant development. Second, it can save money in two ways: by reducing or eliminating the need for growth retardants and by reducing heating costs provided that you have a thermal blanket system.

To understand the benefits of reversing day and night temperatures, let's review the ways temperature affects stem elongation and plant development.

How temperature affects height

Day temperature influences plant height in a different way than night temperature. Plant height increases as day temperature increases. This height increase can be substantial in lilies, poinsettias and chrysanthemums (Figure 1). Conversely, plant height decreases as night temperature increases (Figure 2).

It is the combined effect—that is, the degree of difference between day and night temperature—that ultimately controls the height of the plant at flower. The warmer the day, relative to the night, the taller the plant will be at flower. The warmer the night, relative to the day, the shorter the plant will be at flower.

In other words, as the difference (DIF) between day and night temperatures (day temperature minus night temperature) becomes more positive, plant height increases; as it becomes more negative, plant height decreases (Figures 3 and 4). For example, a crop grown at 70° F days and 60° F nights (+10° DIF) will be taller at flower than another crop grown at 65° F days and 65° F nights (0° DIF).

This 0° F DIF crop will still be taller than another crop grown at 60° F days

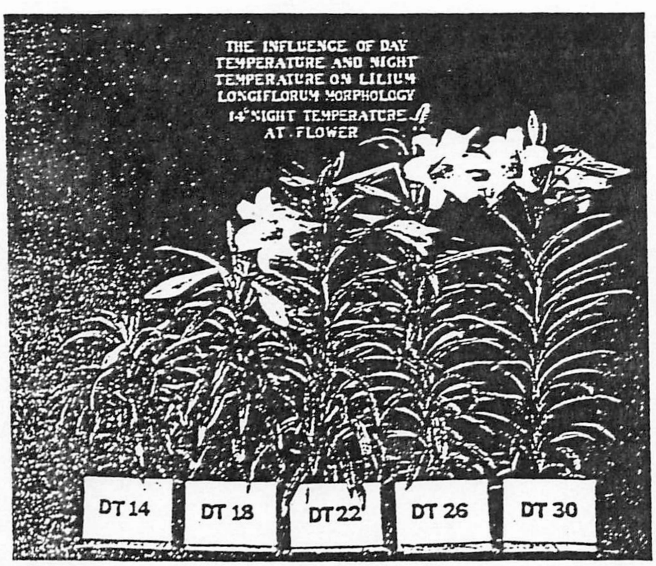

Figure 1 (left). The effect of increasing day temperature on Easter lily plant height at flower when grown at day temperatures from 14° C (57° F) to 30° C (86° F) while holding night temperature constant at 14° C.

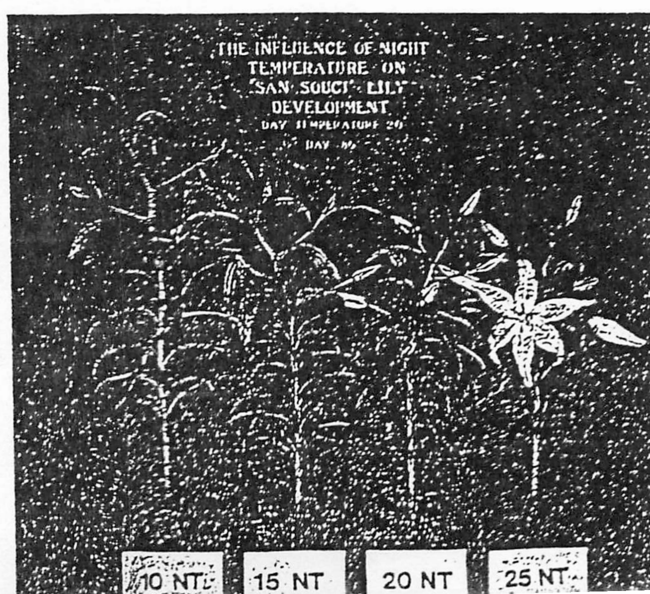

Figure 2 (right). The effect of increasing night temperature on San Souci lily plant height at flower when grown at night temperatures from 10° C (50° F) to 25° C (77° F) while holding day temperature constant at 20° C (68° F).

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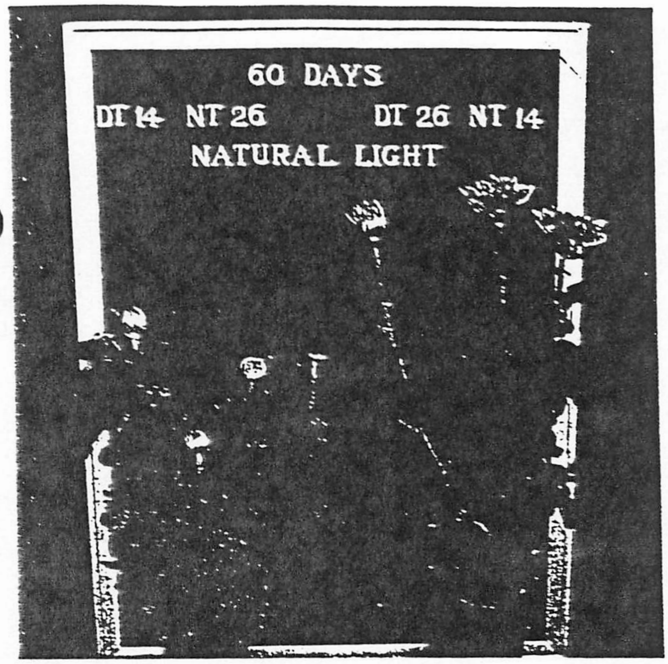

Figure 3 (below). Comparison of poinsettia Annette Hegg Dark Red grown with a −10° F difference (left) or a −10° F difference (right) between day and night temperature.

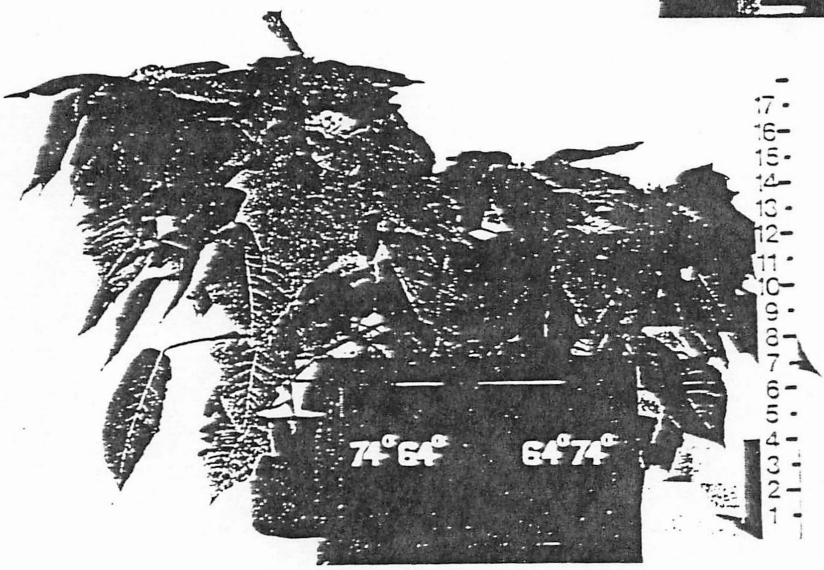

Figure 4 (above). Comparison of chrysanthemum Bright Golden Anne 60 days after the start of short days when grown with a −8° C (−21° F) difference or a +8° C (−21° F) difference between day and night temperature.

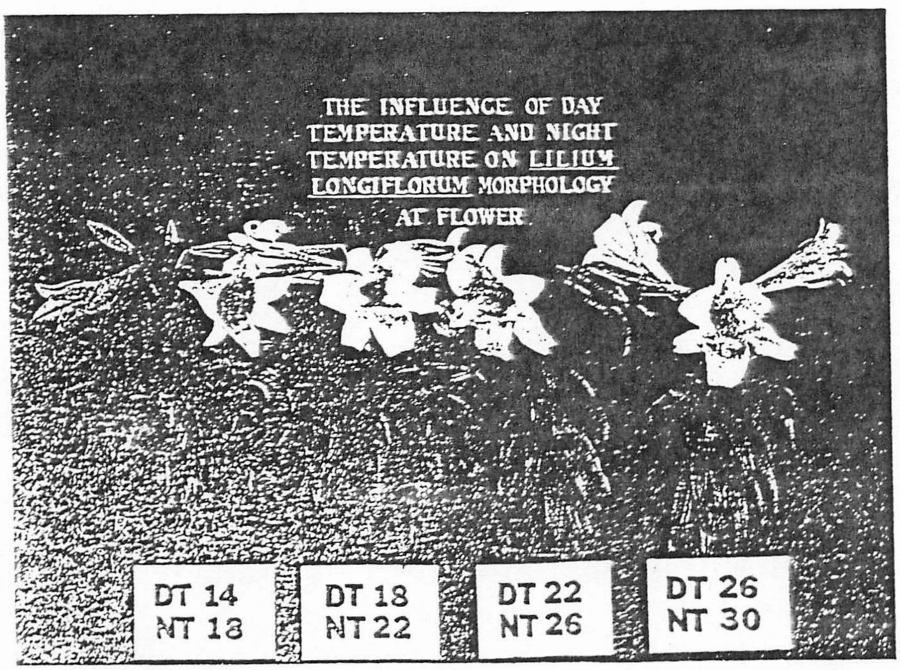

Figure 5. Appearance of Easter lily plants at flower when grown with a constant difference between day and night temperature (4° C) but with different average daily temperatures.

and 70° F nights (−10° DIF). With plants grown between 50° and 85° F, the degree of difference between day and night temperature influences plant height regardless of the absolute temperature. Although each of the four lilies in Figure 5 was grown with a different average temperature, the difference between day and night temperature was the same—therefore, plant height at flower was the same.

An exception to this degree-of-difference effect occurs with certain short-day plants, such as chrysanthemums. Very warm night temperatures (over 72° to 75° F) can cause "heat delay," a condition where plants form a larger number of nodes (leaves) before flower initiation. This can result in an increase in plant height at flower.

How temperature affects plant development

Unlike stem elongation, the rate of plant development is not affected by the difference between day and night temperature, but rather by the 24-hour average temperature. Rate of plant development increases as the 24-hour average temperature increases; it doesn't matter whether these are day or night temperatures or how much difference there is between day and night temperatures. However, "heat delay" is an exception to this rule.

Using these principles to control plant growth

You can use these principles of growth as tools to "fine tune" the height and timing of your crop. Remember that height is controlled by the *difference* (DIF) in day and night temperatures, and rate of development by the 24-hour *average* temperature.

These responses to temperature are immediate. You can almost bring stem elongation to a complete halt, within one to two days, by decreasing DIF. And you can speed up or slow down rate of development by raising or lowering the average temperature.

A number of growers have used these principles on mums, lilies and poinsettias with great success. They adjusted the difference between day and night temperatures once or twice a week to maintain the proper rate of development while keeping stem elongation under control.

Not only did these growers have greater control over their crops, but they also saved money through reduced growth retardant applications and lower energy costs.

How can increasing night temperature save money?

At first, it may seem as if increasing night temperatures during the winter months would be an added expense—and it is. But the combination of thermal blankets and cloudy conditions can reduce the overall expense of producing the crop, even with increased night temperatures.

Let's consider a practical example: growing Easter lilies during January, February and March. We simulated heating costs associated with growing Easter lilies with a traditional 68° F days/65° F nights regime compared with a reversed 65° F days/68° F nights regime—with and without thermal blankets. The simulation was based on average weather conditions for mid-Michigan.

When a thermal blanket was not used, heating costs with the reversed day/night temperatures were 5% greater than heating costs with the traditional temperatures. However, when a thermal blanket was used, heating costs were 2.5% *lower* with reversed temperatures.

Climate is a significant factor here. Under Michigan's cold, cloudy conditions, it costs more to heat a greenhouse during the day than it does during the night if a thermal blanket is pulled at night to conserve heat. The opposite is true on sunny days when a majority of daytime heat can come from the sun. In a sunny climate, reversed day/night temperatures would not reduce heating costs.

Eliminating growth retardant costs

The possible increase in heating costs of reversed day/night temperatures must be weighed against reduced growth regulator costs and increased control of plant height and development that can be achieved with this growing method.

Consider the growth regulator costs associated with growing Easter lilies. A typical A-Rest (ancymidol) application is .25 milligrams of active ingredient per plant if drenched, or .5 milligrams per plant if sprayed.

A-Rest costs approximately $48 per quart. One quart of A-Rest will treat about 1,000 plants as a drench or 500 plants as a spray.

The chemical cost would be 4.8¢ per plant as a drench and 9.6¢ per plant as a spray. Eliminating A-Rest applications on lilies by using reversed day/night temperatures could save a grower 12¢ to 24¢ per square foot depending on plant spacing and application method.

Growth retardant savings are even greater than the possible energy savings mentioned before.

So even if you do not have thermal blankets and cloudy conditions, eliminating growth-retardant costs alone can save enough money to justify this reversed day/night growing method.

How do poinsettias respond?

Controlling height with reversed day/night temperatures is possible with poinsettias, but it is not as easy or economically attractive as it is with Easter lilies. A reason for this is that total growth regulator costs per square foot of bench space are considerably lower with poinsettias than with lilies.

One effective way to use the day/night temperature relationships to control poinsettia height is to minimize day temperature as much as possible—avoid a positive DIF as much as possible. Reducing day temperature from late September through October will reduce the "stretch" seen during this time of year.

October 15 is commonly the last date recommended to apply growth regulators in the northern states; a somewhat later date is recommended in the South. Applying growth regulators after this date will reduce bract size. So what's to be done if poinsettias are getting too tall after this date? Growers historically have had to choose between plants with smaller bracts and plants that are too tall.

Reversed day/night temperature strategy offers another option. Height can still be controlled after October 15 without reducing bract size by growing with days cooler than nights.

Since bract size is controlled by average 24-hour temperature, optimum bract size can still be achieved if this 24-hour average temperature is above 65° F. At the same time, height can be controlled if the day temperature is cooler than the night (for example, 70° F nights and 65° F days).

If you use such a temperature regime, remember to lower both the day and night temperatures the last two weeks of the crop. This will improve bract coloration and prevent cyathia drop (center drop).

Flexibility and control

With any crop, the benefits of a reversed day/night temperature regime go beyond cost reduction. The greatest benefit is the flexibility this method offers growers in controlling stem elongation rate on a day-to-day basis. Growth retardant applications do not allow such flexibility. The reversed day/night temperature regime is a precision tool growers can use to produce crops that flower at the right time and the right height.

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