SPLIT-NITE TEMPERATURES SAVE ENERGY

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The use of split-nite temperatures, where plants are grown colder for a portion of the night, is a most interesting new concept in greenhouse management. It may reduce energy consumption by one sixth.

CONCEPT

During the summer, plants in this latitude have light and carry on photosynthesis for 15 hours a day. During the nine hours or so of darkness they accomplish the "dark reactions" that are essential to their physiology.

Nine hours is enough. During the winter they have 15 hours of darkness. Why do they have to be kept warm for all of those hours? Why not cool them off for six or more of the fifteen hours and save energy?

Mr. William Loefstedt (1977) was the first to propose this "split-nite" temperature pattern and test it in the greenhouse. He found that it did work. But in addition to dropping the temperature 15° from 2300 to 0500 hours, he arose each morning and watered them with warm water.

PLANT RESPONSE

For the third year, plants have been grown under split-nite temperatures (SNT) at the University of Connecticut. There appear to be three (or more) groupings of plants according to their response:

1. Crops that grow well under SNT

2. Crops that require vernalization. During the growth period following cold treatment they do not grow as fast under SNT. After the vernalization response has passed, they may grow normally under SNT.

3. Tropical plants that appear to grow more slowly with a temperature of 50° or below.

1a. Chrysanthemum

Pot mums flower at the same time under SNT. Only one (of six) crops indicated a delay of a day or two. Parups (1978) reported that plants were taller and delayed by about three days under SNT but that there was no noticeable change in growth and quality of a large selection of cultivars.

1b. Rieger Begonia

This plant would seem to belong in group 3 but two crops grown under SNT appear to show no pronounced delay. Results are not conclusive. A current experiment will provide more data.

1c. Carnation

This crop should be a natural for SNT. An extensive experiment is currently being conducted at UConn. Results so far are not encouraging.

1d. Snapdragon

The fall crop harvested in November showed no delay. But night temperatures were not low enough to provide a true differential. We will have to wait for the next experiment to draw any conclusions.

1c. Seedings

Thorne and Jaynes (1977) report no delay for marigold and petunia.

2a. Easter Lily

During early growth following vernalization, they respond to temperature and are delayed by SNT. Once buds are well formed, SNT do not appear to delay them. The current experiment is designed to ascertain how much bud development is necessary before SNT may be started.

2b. Azalea

The delay appears to be proportionate to all temperatures during forcing.

3a. Poinsettia

Growth appears to be proportionate to temperature. However, early cultivars complete most of their development before night temperatures are low enough to affect their growth. Very little heat is saved until late in their development when temperatures are normally reduced. After bracts are well developed a temperature regime of 55/35°F using the 2300-0500 time period should not harm them. Unfortunately, this fall was too warm to establish these temperatures regularly and confirm this in the experiment just completed.

3b. Gloxinia

Current growth (mid-December) does not indicate the delay expected. Judgment will be withheld until we complete the experiments through the winter.

3c. Kalanchoe

SNT delayed the crop materially.

COMMENTS

Current experiments are being grown under five temperature regimes. These are 60°F control, 60/50° and 60/40° for poinsettia (completed), gloxinia, pot mum, Rieger begonia, hydrangea and Easter Lily; 50° control and 50/40° for carnation, snapdragon, cineraria, and calceolaria.

The temperatures are controlled by two thermostats which are switched from one to the other to change from high to low temperatures at 2300 and back to high temperatures at 0500 by a double pole double throw time clock. The cost of this installation is about $60 plus labor.

Concern has been voiced regarding the cooling of soil during the six hour low temperature period. Mr. Loefstedt (1977) dropped the temperature to 45°, then watered his plants at 0600 each morning with warm water. This is impractical commercially. To find out if warming the soil is beneficial, benches were constructed of plywood with holes to accept the pots and a skirt around the bench with bottom heat to keep the pots warm. Results to date (mid-January) indicate no advantage.

THEORETICAL SAVINGS

Calculations were made based on fuel usage at 60° versus 50°F. Assuming the 50° usage for 40% (six hours out of 15) of the time in a 60° house, the savings were calculated at 15% for a year. Gent, Thorne and Aylor (1980) in their forthcoming bulletin used a much more sophisticated approach based on heating degree days hour by hour and calculated fuel savings at 18% for an eight hour period of 15° temperature reduction.

When the low temperature period begins, the temperature falls relatively slowly on many nights. The heat loss is greater than theoretical during this time lag. Then, when the temperature is raised, some heat is required to overcome the latent heat deficit and there is usually some temperature override. This was included in the calculations by Gent, Thorne and Ayler (1980). It would seem that actual energy savings would more likely be around 15% for a six hour temperature drop of 10°F.

To illustrate this savings, a double poly greenhouse 26 x 96' should require about 3000 gallons of oil to maintain 60° for a year. A 15% reduction is 450 gallons, a significant savings.

Split-nite temperatures will not be applicable for all stages of growth for every greenhouse crop. But it will work for some.

<u>*LITERATURE CITED*</u>

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