breeding program to ensure new cultivars for the market.

All propagation begins with stock plants (elite plants) which are kept in a section of the nursery where only the propagator is allowed. These plants are tested regularly for diseases and uniformity. Cuttings taken from these elite plants are used to propagate mother stock plants from which cuttings are taken to produce plants for sale. Cuttings are stuck into the final selling pots and placed on transportable tables that are automatically moved into the propagating area. Depending on the time of year, mist propagation or enclosed plastic is used. We try to keep a relative humidity of 60% to 70%.

We have tested DIF (difference in day and night temperature) only on a few plants. In *Exacum* and *Gerbera* the use of a high night temperature caused plants to become more compact.

Biological treatments are used to keep the soil free of insects. We use 0.75 liters of Vectobac to 4 m^3 of soil, and all water in supplemented with nematodes (500 million per 700 m^2).

Temperature—DIF

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INTRODUCTION

Until a few years ago, standard practice in the greenhouse industry was to keep the night temperature for potted plants set lower than the day temperature. The reasoning was, that photosynthesis at day should be promoted by a high temperature and respiration at night should be limited by a lower temperature. In addition, the free heat from the sun during daylight should he utilized and the energy consumption at night should be limited to reduce production cost. Plant height and elongation growth was not considered—compact growth was obtained by the use of chemical growth retardants.

The use of chemicals, i.e., growth retardants, is now questioned and in society there is a general wish that chemicals should be used to a lesser extent. In Germany and Sweden, Alar is prohibited and this may also happen in Denmark for this and other chemicals. For these reasons growers and researchers are looking for other means to control plant height.

Therefore, much interest was generated by experiments in the United States of America which showed that a higher night than day temperature reduced internode length and plant height when compared to the normal temperature programme (higher day than night temperature) (Erwin et al., 1988; Erwin et al., 1989). It was shown that the diurnal average temperature was not the decisive factor controlling elongation, but the difference between day and night temperature was important. This difference in day and night temperature was abbreviated to DIF, and the concept of DIF was defined as day temperature (DT) minus night temperature (NT) (DIF = *DT minus NT*). From this three terms arose:

- Positive DIF—where the night temperature is lower than the day temperature.
- Negative DIF—where the night temperature is higher than the day temperature.
- Neutral DIF—where the night temperature is the same as the day temperature.

Negative DIP is the interesting combination of day and night temperatures, since this may produce plants with short internodes and hence compact growth.

EXPERIMENTS

The first experiments in the U.S.A. were carried out with *Lilium longiflorum* Thunb., which is not grown in Denmark. A later review of the literature shows that the effect of negative DIF varies among plant species, and some plant species do not respond to DIF (Jensen, 1991).

In our own experiments we have investigated the effect of raising the temperature for a part of the night as opposed to all night. Rooted cuttings of *Pelargonium* × *hortorum* 'Pink Cloud' [syn. *P.* × *zonale* 'Pink Cloud'] and *Dendranthema* × *grandiflora* Tzvelev 'Choral Charm' were subjected to 0, 2, 6, or 10 h of 6C higher night temperature than day temperature after sunset, around midnight, or before sunrise. The diurnal average temperature was 18.5C for all treatments.

The results with *Pelargonium* showed that -6 DIF reduced internode length by 11% and plant height by 8%. Interestingly, the effect of negative DIF treatment was equally good whether given for 2, 6, or 10 h and whether the high temperature period was placed after sunset, around midnight, or before sunrise. There was no influence on the number of nodes (Jensen, 1993a).

The results for *Dendranthema* were different. Two hours of high temperature after sunset gave 11% shorter internodes and 13% lower plant height than neutral DIF, and there was no influence on the number of nodes. On the other hand, 6- and 10-h of high night temperature after sunset showed no effect on plant height because 8% to 15% more nodes counteracted the 17% shorter internode development. When the high night temperature was placed around midnight, plants became 22% higher at a 2-h duration because there was no effect on internode length and a greater number of nodes indicating delayed flower formation. A 6 or 10 h duration around midnight produced shorter internodes, but the number of nodes was greater and the final result was unchanged plant height compared to neutral DIF. When the high night temperature was given for 2 h before sunrise, the internodes became shorter than at neutral DIF, but the effect was too small to compensate for more nodes. At 6 and 10 h of high night temperature before sunrise, plant height was reduced by 12% to 17%, the internodes were 17% shorter, and there was no effect on the number of nodes compared to neutral DIF. Thus, for *Dendranthema* the best retardation of plant height was obtained by placing the high night temperature period 2 h after sunset or 6 or 10 h before sunrise. The number of days to visible flower bud increased with the duration of the high night temperature period, and the delay of flower formation was greatest when the high night temperature period was placed around midnight (Jensen, 1993b).

In another experiment the aim was to see how poinsettia, *Euphorbia pulcherrima* Willd. 'Lilo', responded to negative DIF before sunrise. The treatments were +4, 0,

-4, and -8C DIF placed before sunrise for 2, 6, or 10 h. Day and night temperatures were set to give a diurnal average temperature of 20C for all treatments. During the first 43 days no differences were observed. From then on the plants grew taller at negative DIF than at neutral and positive DIF. The explanation for this unexpected result was delayed time to visible flower bud appearance and the formation of more leaves at negative DIF compared to neutral and positive DIF. The best plants were produced at a constant temperature of 20C (Jensen, 1994).

CONCLUSION

At present, the main conclusion from the work on DIF is that the plant height retarding effect of negative DIF is in the order of 10% to 15% compared to neutral DIF. For some plant species, e.g., poinsettia, the best result may be achieved by choosing neutral DIF, i.e., the same temperature day and night. The best temperature will then be the one which favours flower formation.

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