Cost-efficient light control for production of two campanula species

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Introduction

A cost-efficient light control system based on weather forecasts, electricity prices and daily photosynthesis integral (DPI) was evaluated for commercial production of the long-day (LD) plant Campanula portenschlagiana ‘Blue Get Me’ and C. cochlearifolia ‘Blue Wonder’. Experiments included a traditional LD treatment of 19 h day and a range of treatments controlled by the software system DynaLight which automatically defines the most cost-efficient use of supplemental light based on a predefined set point of DPI, forecasted solar irradiance and the market price on electricity. The set points of DPI in the treatments were 300, 450 and 600 mmol m⁻² leaf⁻¹.

DynaLight

DynaLight consists of five different entities: An electricity price web server, a weather forecast web server, an environmental climate computer (ECC), a PC running DynaLight Desktop and the greenhouse. The desktop computer is connected to the two web servers over the Internet while the connections between the desktop computer, the ECC and all the way down to the greenhouse are proprietary. An energy and cost-efficient light plan is created for each of the forthcoming days on the basis of daily weather forecasts and hourly electricity prices. The algorithm is illustrated in Figure 1.

Materials and methods

Campanula plantlets were received from a commercial grower and grown to maturity in an LD-treatment of 19 h day and in DynaLight treatments with different set points of DPI and light intensity of supplemental light. Dry matter production was determined at each harvest during the experiment and the number of flowers and buds were counted at the end of the experimental period.

Results

The two campanula species responded similarly to the regular light conditions. Plant growth and flowering was maintained in the DynaLight treatments with a relative saving in energy use and cost of 25% in comparison to a 19-h LD treatment. Plant dry matter accumulation was linearly correlated to cumulative light integral (CLI) irrespective of differences in light intensity.

Table 1: Show average DPI, and the sum of electricity use and cost for 19 h-LD treatment and three DynaLight treatments. The two campanula species were subjected to supplemental light provided by irregular light breaks during the experiment running from January to March 2010. The DPI set points in the treatments were 300, 450 and 600 mmol m⁻² leaf⁻¹.

References