Daily light integral: a better way to measure greenhouse light

Do you measure the light in your greenhouse to ensure your plants are receiving an adequate amount of light? If you are using a footcandle meter to measure the light intensity you are not getting a true measurement of the amount of light received by the plants. Measuring the light in footcandles or micromoles per square meter per second (µmol/m2/s) is a measurement of instantaneous light, that is, the amount of light at the time the measurement is made. An instantaneous measurement made under sunny or cloudy conditions may not provide an accurate evaluation of the total amount of light perceived by the plants over the course of a day.

"When you think about light over the course of a day, light is extremely dynamic," said assistant horticulture professor Chris Currey at Iowa State University. "From sunrise to sundown, there are variations in light. If growers take a single light measurement early in the day, they may be underestimating the amount of light. Alternatively, if the light measurement is made later in the day, growers may be overestimating the light level. Instantaneous light levels change over the course of a day."

Visible light vs. photosynthetic light

Currey said another issue with measuring light with a footcandle meter is that it measures the light that is visible to the human eye. "The sun produces a broad spectrum of light," he said. "Photosynthetic light, which is the light plants can use for photosynthesis and is defined as photosynthetically active radiation (PAR), is the light that occurs between 400 and 700 nanometers. So if a footcandle meter measures light that is visible to the human eye, this includes wavelengths outside of PAR. Consequently, footcandle measurements tend to overestimate the amount of light for plant growth."

More accurate measurement

Currey said it is the total amount of photosynthetic light that is going to impact how a greenhouse crop is going to grow. "Daily light integral (DLI) is the sum of photosynthetic light over the course of a day," he said. "In production situations where there is a static light source it is relatively easy to determine the DLI. Examples of a grower producing a crop under a static source of light include growing plants under high pressure sodium lamps in a warehouse or tissue culture plantlets grown under LED lights in a laboratory. In these situations the light levels are not going to change throughout the day.

"In most greenhouse environments light levels change throughout the day. So to take one instantaneous measurement to indicate the light level isn't the best way to describe the total amount of PAR light available. It's better to look at the total amount, which is the DLI."

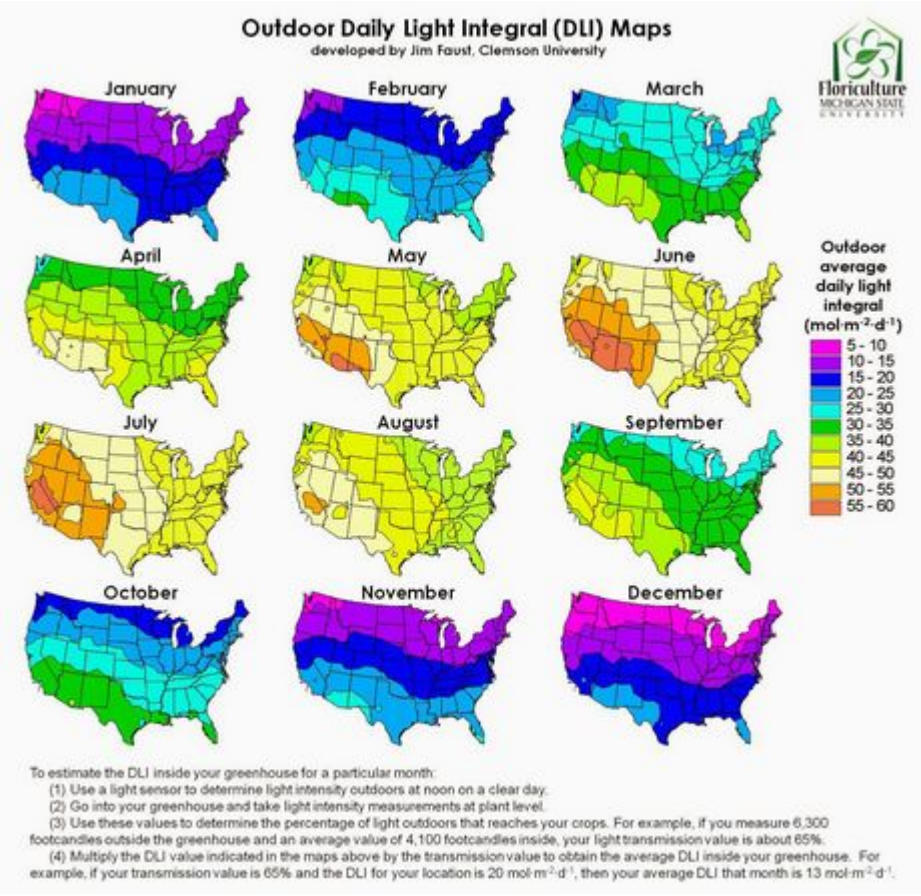
Currey said a grower could estimate the DLI by using hourly measurements. "A grower could go out into the greenhouse every hour and measure the light intensity," he said. The grower would then use these measurements in some calculations that would give the DLI. Realistically, very few growers are going to determine DLI this way."

There are a number of instruments available for measuring DLI. Currey said one of the best ways to determine DLI is to use a quantum sensor that measures PAR. The unit of measurement for DLI is moles per square meter per day (mol/m2/day).

"In many cases the quantum sensor is connected to a data logger that records the light measurements," he said. "The quantum sensor can be attached to a data logger that can record frequent instantaneous light measurements which can then be integrated into a cumulative total for the day. The quantum sensor can also be hooked up to a greenhouse environmental control computer, such as an Argus or Priva, which can calculate the DLI."

Expanding use of DLI

Researchers at Clemson University used light measurements collected by the National Oceanic Atmospheric Administration to developed monthly DLI maps for the United States.



Monthly daily light integral maps for the United States

Currey said the maps are based on historical averages. “The DLI maps give you a good average,” he said. “Poinsettia growers will tell you each growing season is different. Sometimes they will have bright, sunny Novembers and other years, it’s dark and cloudy. These maps provide a good indication of light levels, but there are going to be variations between years. That’s why it is important for growers to measure DLI so they know what is happening in their greenhouses and be able to react, including using supplemental lighting to increase DLI.”

Currey said that research has been done to quantify the DLI necessary for specific crops. “The optimum DLI is going to vary for different crops,” he said. “For African violets, a DLI of 6 mol/m2/day is enough to produce a good crop. For poinsettias, 10-12 mol/m2/day are needed to grow an acceptable quality crop. For cut roses, the DLI needs to be above 20 mol/m2/day to produce a good crop.”

Growers are using daily light integral with their environmental controls and supplemental lighting to provide their plants with optimum photosynthetically active radiation levels.

Currey said some growers are using DLI, their environmental controls and supplemental lighting to provide their plants with optimum PAR levels. “It is kind of like predictive lighting,” he said. “Growers have their lights turn on when the light intensity is below a certain level and turn off when the light goes above a certain level. This way a grower is not adding light during the brightest time of the day when the light level is at or above the light saturation point for photosynthesis. Growers can use lighting set points so that if they are not achieving the target DLI for a crop, they can have the lights turn on sooner or turn off later to ensure plants receive enough PAR. As a crop goes later into the spring, a grower is likely going to lower that trigger light intensity because there is going to be more natural sunlight so less supplement light is needed.”

For more information:
Iowa State University
Christopher Currey, Department of Horticulture
(515) 294-1917
ccurrey@iastate.edu

Hort Americas, LLC
Chris Higgins
Skype: chigginsconsultant
T: +1 469 532 2261
chiggins@hortamericas.com
www.hortamericas.com

Publication date: 2/26/2014