

Science News

from research organizations

Print Email Share

Biofeedback system designed to control photosynthetic lighting
System helps lights adapt to plants' needs in controlled environment agriculture

Date: May 9, 2016
Source: American Society for Horticultural Science
Summary: A chlorophyll fluorescence-based biofeedback system was used to maintain the electron transport rate (a proxy for photosynthesis) of lettuce, sweetpotato, and pothos at target rates altered over 15 hours. The biofeedback system can maintain a wide range of ETRs by automatically adjusting light output from LEDs. It can also distinguish between standard plant mechanisms to dissipate excess light energy and damage to the photosynthetic apparatus as causes for decreases in light use efficiency of plants.
Share: Facebook Twitter Google+ LinkedIn + Email

RELATED TOPICS

- Plants & Animals
- Endangered Plants
 - Botany
 - Nature
 - Agriculture and Food
 - Food and Agriculture
 - Pests and Parasites

RELATED TERMS

- Chlorophyll
- Photosynthesis
- Leaf
- Color vision
- Chloroplast
- Algae

See Also

- Top 10 Brain Supplements
- How to Burn Belly Fat
- Immune System Vitamins
- Schizophrenia Therapy Techniques
- Best Brain Supplements
- Top 10 Brain Supplements
- Immune System Vitamins
- Best Treatments For Sciatica
- Astronomy Courses Online
- Best Vitamin D Supplement
- Common Cancer Symptoms
- Treatment for Alzheimer's



A sweetpotato crop is shown in the biofeedback system. Chlorophyll fluorescence measurements are taken on the plant on the right side to determine how efficiently the plant uses the light provided by LEDs. LED light levels are automatically adjusted to maintain specific levels of physiological activity.

Credit: Photo courtesy Michael T. Martin

Controlled environment agriculture is rapidly becoming an important part of the global food system. For example, there has been much interest in the potential of large-scale, indoor agricultural production - often referred to as vertical farming - as a means to produce high quantities of produce. These "plant factories" are expensive to operate, however, in part because of the large power requirements of electric lamps that provide the type and amount of light necessary for photosynthesis in plants.

To find new methods of adapting lighting to plants' requirements in controlled environments such as vertical farms, the researchers developed and tested a biofeedback system that allows for the control of light levels based on the physiological performance of the plants. "Controlling the intensity of light based on plants' ability to use it efficiently may substantially reduce the energy cost of LED lighting, and contribute to making large-scale controlled environment agriculture more profitable," van Iersel said.

The researchers used lettuce, pothos, and sweetpotato plants in experiments with photosynthetic light provided by a 400-Watt LED. Using chlorophyll fluorescence measurements, a datalogger determined how efficiently the plants used the light they received. This data was used to calculate the electron transport rate (ETR), which is an indicator of photosynthesis. The datalogger then altered the duty cycle (the proportion of time that the LEDs are energized during each short on/off cycle) of the LEDs to provide more or less light.

The target ETR was altered in a stepwise pattern over a 15-h period. The biofeedback system was capable of automatically adjusting the light levels to assure that the desired ETR was reached. As the target ETR was increased, light levels increased as well. In addition, conversion of light energy into heat (a common way for plants to deal with excess light) was upregulated, while the light use efficiency decreased. As the target ETR was decreased during the last 7 hours, conversion of light into heat decreased greatly in lettuce and pothos, with only a small increase in light use efficiency. "This suggests that the light use efficiency of lettuce and pothos was limited by a process other than conversion into heat, likely light-induced damage to the photosynthetic machinery in the leaves," the authors noted.

"The biofeedback system successfully maintained a wide range of ETR values in different species, while it also is capable of distinguishing between conversion of light into heat and damage to the photosynthetic machinery as causes for decreases in light use efficiency," the authors said. They said the biofeedback system has potential applications in controlled environment agriculture, as well as basic plant physiology studies, where the system can be used to maintain specific levels of physiological activity.

Story Source:

The above post is reprinted from materials provided by **American Society for Horticultural Science**. *Note: Materials may be edited for content and length.*

Journal Reference:

- Marc W. van Iersel, Geoffrey Weaver, Michael T. Martin, Rhuanito S. Ferrarezi, Erico Mattos, and Mark Haidekker. **A Chlorophyll Fluorescence-based Biofeedback System to Control Photosynthetic Lighting in Controlled Environment Agriculture**. *J. Amer. Soc. Hort. Sci.*, 141:169-176

Cite This Page:

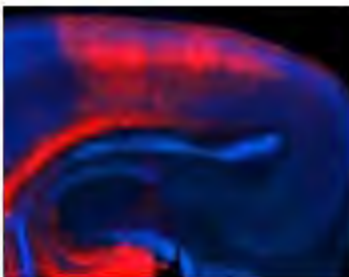
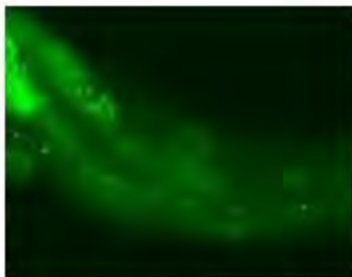
MLA APA Chicago

American Society for Horticultural Science. "Biofeedback system designed to control photosynthetic lighting: System helps lights adapt to plants' needs in controlled environment agriculture." ScienceDaily. ScienceDaily, 9 May 2016. <www.sciencedaily.com/releases/2016/05/160509145527.htm>.

See Also

- | | | | |
|---|--------------------------|---|------------------------------|
| 1 | Best Brain Supplements | 4 | Best Treatments For Sciatica |
| 2 | Top 10 Brain Supplements | 5 | Astronomy Courses Online |
| 3 | Immune System Vitamins | 6 | Best Vitamin D Supplement |

Powered by Google

 PROMOTED ON gardeningenthusi... Plant	 sciencedaily.com How stress influences disease: Study reveals in...	 PROMOTED ON tckw.com.tw TCKW- Global Metal Industry	 sciencedaily.com Stress changes how people make decisions	 sciencedaily.com Using fungi to decrease need for chemical ferti...	 sciencedaily.com From lighting screens to lighting homes	 sc M fr fl
--	---	---	---	--	--	--

NEXT >

Recommended Articles

Targeted LEDs could provide efficient lighting for plants grown in space
Purdue University, ScienceDaily, 2015

Effects of LEDs on leaf lettuce: Mixture of blue and red lights recommended to enhance lettuce quality, yield
American Society for Horticultural Science, ScienceDaily, 2013

LED lights used in plant growth experiments for deep space missions
NASA, ScienceDaily, 2012

Switching on a dime: How plants function in shade, light
Carnegie Institution, ScienceDaily, 2014

'Safety valve' protects photosynthesis from too much light
Carnegie Institution, ScienceDaily, 2009

Evaluation of Different Light Conditions in the Working Environment for Handling Photosensitive and Thermolabile Compounds
Pendela, Murali et al., J AOAC Int, 2015

Wheat yield improvement in eroded semi-arid areas of China
Deng Xi-Ping et al., Outlook on Agriculture via Outlook on Agriculture, 2003

Tropical vegetables and spices: potential value and contributions to sustainable agriculture in Nigeria
F.O. Olaniran, Outlook on Agriculture via Outlook on Agriculture, 2001

Development of a Novel Dimensional Cultivation System for Balcony Agriculture
Bin Li et al., Sensor Letters via Sensor Letters, 2014

Heat illness and heat stroke.
David S Jardine, Pediatr Rev, 2007

Powered by Trend MD

Free Subscriptions

Get the latest science news with ScienceDaily's free email newsletters, updated daily and weekly. Or view hourly updated newsfeeds in your RSS reader:

- Email Newsletters
- RSS Feeds

Follow Us

Keep up to date with the latest news from ScienceDaily via social networks:

- Facebook
- Twitter
- Google+
- LinkedIn

Mobile Apps

Get the latest news from ScienceDaily via our free mobile apps, available for download on the following platforms:

- iPhone/iPad
- Android

Have Feedback?

Tell us what you think of ScienceDaily -- we welcome both positive and negative comments. Have any problems using the site? Questions?

- Leave Feedback
- Contact Us