# LI-COR, Inc. – NCERA101 Station Report 2020

## About

LI-COR scientists and engineers are closely involved in the scientific community through extensive internal R&D; global collaborations with leading scientists; presentations at scientific conferences, workshops, and seminars; and publishing in leading scientific journals. By maintaining close relationships with academic, governmental, and industrial research institutions, LI-COR develops products that are at the forefront of modern technology for research in the biological and environmental sciences. LI-COR customers are committed to conducting excellent research, and the company's mission is to facilitate this research by providing high-quality system solutions and superior, personalized customer support.

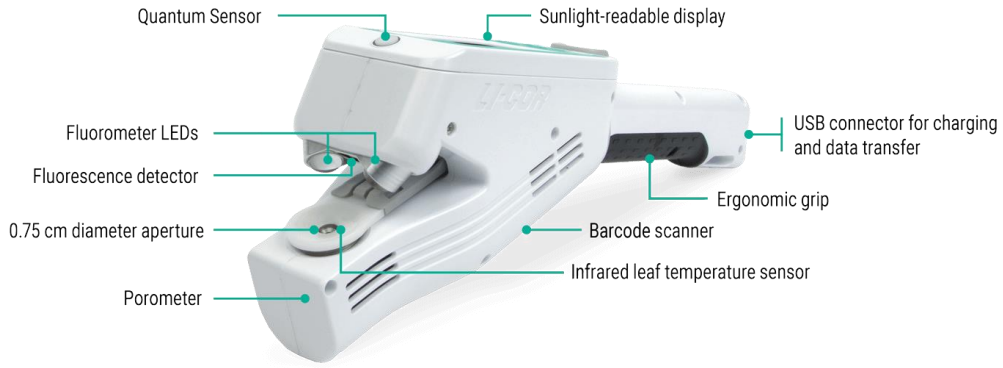
## New Facilities and Equipment

***New*** *LI-180 Firmware (new features and benefits)*

For measuring the spectral quality of the light in your greenhouse, the portable LI-180 Spectrometer captures intensity and composition of the five major wavebands at the single-nanometer level. With this information, supplemental lighting can be optimized through the different stages of growth. Matching light sources (and wavelengths of light) to one of twelve pigmentations in the leaves (pre-programmed into the device and plotted against light source) can identify peaks where growers can adjust light recipes for more desirable outcomes.

***New*** *LI-600 Porometer/Fluorometer*

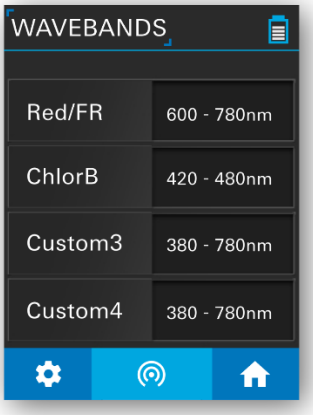
The new LI-600 Porometer/Fluorometer is a lightweight, handheld porometer and optional fluorometer that simultaneously measures stomatal conductance and chlorophyll fluorescence of leaves while they are connected to the plant. Stomatal conductance to water ($g_{sw}$), which responds to light, $CO_2$, temperature, and humidity, amongst others, is a measure of the degree of stomatal openness and the number of stomata. It is an indicator of a plant's genetic makeup and physiological response to environmental conditions. Measurements of chlorophyll *a* fluorescence can provide information about the leaf's quantum efficiency, electron transport rate (ETR), non-photochemical quenching (NPQ), as well as an assortment of reactions that collectively protect a leaf when it absorbs excessive light energy. This hand-held device can be carried throughout the greenhouse, making multiple measurement per plant, as well as multiple plants throughout the greenhouse.

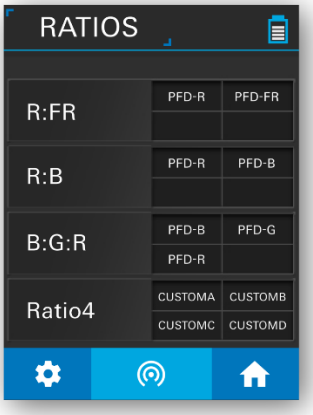


## Accomplishment Summaries

*New LI-180 Firmware*

With the LI-180 Spectrometer, you can now configure custom wavebands to measure only the light intensity for the wavebands in which you have an interest. Similarly, you can set up your own custom ratios to compare fractions of light between various wavebands.




*New LI-600 Porometer/Fluorometer*

The LI-600 makes its measurements in 5-15 seconds, allowing you to sweep through your entire greenhouse to make measurements in a very short time period. A barcode reader is also built into the device to allow you to scan plants and/or tables that might be coded for quick documentation and metadata of your measurements. The LI-600 also includes computer software for flexible configuration set-up and data streaming.

## Impact Statements

*What you can do with new LI-180 software*

For light quality, knowing and controlling the spectrum of the light source can have significant effects on your plant. For example, you can affect the following: morphology with blue light, growth and yield with red light, plant heath and chemical content with UV light, and transition from vegetative to flowering with FR light. In addition, you can apply different light spectrums at different growth stages. Light source selection should be dependent on the stage of growth and the goal during that stage. Knowing the light source's spectrum, or using an LED 'recipe,' equips growers with the ability to make confident decisions on which light sources to use and when to use them.

*What you can do with new LI-600 Porometer/Fluorometer*

Controlling the inputs/drivers described above can have significant affects, positive or negative, on plant growth. Measuring the plant's response to these influences is key.

Besides plant disease, one of the other indicators of health is plant stress, typically from lack of water or overheating. To help identify plant stress, measurements can be made on leaves to measure transpiration rates in the form of stomatal conductance. When these measurements are out of range, this can be used as an early indicator of plant stress, even before visible signs are present. This also plays a role in affecting leaf temperature, water requirements, and the greenhouse microclimate, including water loss from the soil or substrates and plant surfaces. A good value of stomatal conductance can inform you that your plant is growing as expected and is reacting to the source of light being applied and the VPD/RH levels in the greenhouse.

## Published Written Works

*Recent Publications utilizing the LI-180 Spectrometer:*

Bartucca, Maria Luce and Del Buono, Daniele and Ballerini, Eleonora and Benincasa, Paolo and Falcinelli, Beatrice and Guiducci, Marcello (2020), Effect of Light Spectrum on Gas Exchange, Growth and Biochemical Characteristics of Einkorn Seedlings. Agronomy, 10(7), 1042. https://doi.org/10.3390/agronomy10071042

Bayley, Daniel (2020), Controlled Environment Production of Romaine Lettuce (Lactuca sativa). Thesis; School of Environmental Sciences, The University of Guelph, Ontario, Canada. uri: https://hdl.handle.net/10214/21293

Callaghan, Joshua (2020), Development of Rapid Propagation Systems for Hemerocallis sp. (Daylilies). Thesis; Department of Plant Agriculture, The University of Guelph, Ontario, Canada. uri: http://hdl.handle.net/10214/17751

Hasenleitner, M.; Plaetzer, K. In the Right Light: Photodynamic Inactivation of Microorganisms Using a LED-Based Illumination Device Tailored for the Antimicrobial Application. *Antibiotics* 2020, *9*, 13. https://doi.org/10.3390/antibiotics9010013

Qiuhua Duan, Yanxiao Feng, Enhe Zhang, Yuhui Song, Julian Wang, Shengnan Niu (2020), Solar Infrared Radiation towards Building Energy Efficiency: Measurement, Data, and Modeling. Environmental Reviews. https://doi.org/10.1139/er-2019-0067

McClain, A.M. and Sharkey, T.D. (2020), Building a better equation for electron transport estimated from Chl fluorescence: accounting for nonphotosynthetic light absorption. New Phytol, 225: 604-608. doi:10.1111/nph.16255

Y. Bouzembrak, A. Chauhan, F. Daniels, A. Gavai, J. Gonzalez Rojas, C. Kamphuis, H. Marvin, L. Meesters, P. Mishra, J. Mueller-Maatsch, W. Ouweltjes, M. Paillert, R. Petie, A. Petropoulou, F. Plantenga, H. Rijgersberg, J. Top, I. Tsafaras, M. Ummels, A. van Breukelen and Y. Weesepoel (2020), KB DDHT project 8: Non-destructive and non-invasive sensor technologies in food supply chains (Project deliverables 1.1-1.4). Wageningen Food & Biobased Research commissioned by the Dutch Ministry of Agriculture, Nature and Food Quality, Wageningen, The Netherlands. DOI: https://doi.org/10.18174/513795

*Recent Publications utilizing the LI-600 Porometer/Fluorometer:*

Due to the recent introduction of this instrument to the scientific community in August 2020, there has not been a sufficient period of time to collect data, analyze results, and produce published peer-reviewed works.