1. New Facilities and Equipment

In 2019, Heliospectra continued to develop helioCORE™ and new features for the light control system software. We also improved vertical farming system in a research facility in headquarter in Göteborg, Sweden.

2019 also brought new construction of the unique EDEN ISS growth facility on Antarctica as an active partner on the EDEN ISS European project team. The structure is equipped with custom, water-cooled Heliospectra lighting system was opened in summer 2019 and welcomes interested researchers. More information: https://eden-iss.net/

Heliospectra introduced the MITRA series of LED fixtures to the research and commercial food production markets. This new generation of highly efficient dimmable 600Watt or 300Watt top lights was designed for crops with high light and intensity requirements including vine crops and medicinal plants. Commercial trials with Neame Lea Nursery in United Kingdom demonstrated advantages in greenhouse herbs production.

2. Unique Plant Responses

Heliospectra research team continues to work on application of Far Red enriched spectrum on increased productivity of greenhouse crops – herbs, lettuces and other leafy greens together with commercial partners. Presence of FR in growth spectrum has a significant effect on plant productivity even in a greenhouse environment with a presence of sunlight.

Pulsed light (PVM) was shown to have both positive and negative effect on basil development; therefore, PWM dimming must be used with caution in research facilities and when planning light settings. Increasing DC from 50 to 80%, DC has a positive effect on basil growth.

Green light percentage has a significant influence on morphology and light availability inside the canopy and consequently affects quality of tomatoes grown under a LED sole source light. Heliospectra's research team collaborated on earlier greenhouse studies (Kaiser et al. 2019) showing a positive effect of growth spectrum with a high green light proportion on tomato. ***The results will be presented during IX International Symposium on Light in Horticulture in June 2020.***

3. Accomplishment Statements

Heliospectra hosted Plant and Light Workshops in Europe and United States to foster community and share of knowledge with commercial growers. Discussions focused on photobiology, validation of light spectra for transplant, rooting and produce finish and appearance, and resource efficiencies achieved with LED technology and controls for medicinal plants, tomatoes, leafy greens and herbs.

We continue R&I work related to bio sensors, light control systems and biofeedback control, initiating a new research project with academic partners to evaluate biotic stress detection with optical sensing.

4. Impact Statements

Heliospectra continues work with Dr. Brande Wulff at John Innes Research Centre, Dr. Lee Hickey at University of Queensland, and Amir Sharon of ICCI at University of Tel Aviv to support technology transfer of speed breeding research protocols and rapid seed to seed generation of cereals and grains. University of Queensland recently extended their program focus with a trial installation in Ethiopia with the aim to improve seed applications and secure future food supply in arid climates.

Heliospectra is participating as industrial partner in the *LEDs make it resilient project* at Wageningen University, which started in 2019. To support technology advancement, the project team and three PhD candidates are investigating the effects of different light quality and temperature conditions on crop production and resilience with findings to be published over upcoming years.

5. Published Works

Chiang C., J. E. Olsen, D. Basler, D. Bånkestad and G. Hoch (2019) Latitude and Weather Influences on Sun Light Quality and the Relationship to Tree Growth Forests 10(8):610 DOI: 10.3390/f10080610

Chiang C., D. Bånkestad, G. Hoch (2020) Reaching natural growth: Light quality effects on plant performance in indoor growth facilities. Submitted for Plant Sciences Journal

Chiang C., D. Bånkestad and G. Hoch (2020) Reaching natural growth: The significance of light and temperature fluctuations on plant performance in indoor growth facilities. Submitted for Acta Horticulurae

Tran Nguyen J. and S Wiede (2019) Detect plant stress by measuring chlorophyll fluorescence gain from lamp PWM signal. Chalmers University of Technology, Gothenburg. Master thesis.

Poster and Session Presentations:

Bochenek G.M., C. Chiang, D. Bånkestad (2019) Effects of pulsed LED light on plant productivity in a controlled environment. GreenSys 2019. (Poster)

Bochenek G.M. The lighting system of EDEN ISS growth facility in Antarctica (2019) International workshop GREENHOUSES IN SPACE: DOWN TO EARTH. Bleiswijk. The Netherlands. (session presentation)

Jia, Fei. (2019) Lighting Applications in Controlled Environment Agriculture. Association for the Advancement of Industrial Crops. (session presentation)

Jia, Fei. (2019) LED Lighting for Horticulture Environments. University of Arizona, Controlled Environments and Agriculture Center Commercial Crop Production and Greenhouse Engineering Short Course 2019. (session presentation)