

New Facilities and Equipment.

- A second PS-1000 whole plant photosynthesis system was acquired from CONVIRON.
- Both of the original BlueBox walk-in photosynthesis growth chambers are now equipped with Intravision LED systems, replacing the previous 7,800 Watts of HPS and MH lamps that were on each box.
- Three CONVIRON PGC-Flex growth chambers equipped with seven channel Intravision multispectral LED arrays were installed in our satellite laboratory in Napanee, Ontario. This laboratory is located within a secure licenced cannabis production facility. The new chambers will soon be employed in the investigation on the environmental effects on cannabis growth, development and biochemistry.
- A 'new to us' HPLC was acquired and will be used for the measurement of vitamins in plant tissue related to vertical farming initiatives.
- A new controlled environment building dedicated to the study of medicinal plants (cannabis) is in the design phase. The building will house over 30 controlled environment spaces consisting of both walk-in and reach-in growth chambers and a roof-top greenhouse.



Unique Plant Responses.

- The addition of sub-canopy lighting in cannabis improved yield and normalized the THC and CBD profiles in the plant canopy.
- *Nicotiana benthamiana* plants grown under low light conditions showed an increased target protein response in transgenic biosimilar drug production trials.

Accomplishment Summaries.

Technology transfer:

- EDEN ISS, an EU 2020 Antarctic 'greenhouse' project coordinated by the German Space Agency and involving a large consortium of European, Canadian and American partners completed its first mission. CESRF provided the hydroponics and control systems. The system produced 77 kilograms of fresh lettuce, 51 kilograms of cucumbers and 29 kilograms of tomatoes, along with a number of other herbs and leafy greens, the majority of which were fed to the overwintering crew at Germany's Neumayer III Station.
- CESRF BlueBox technology has been licenced to Intravision Group AS who are building our next generation whole plant photosynthesis chamber, the PS2000.

Technology advancement:

- Patent submission for Regenerative in situ Electrochemical Hypochlorination process in support of a commercialization plan.
- Developing an electrochemical advanced oxidation system for in situ processing of 'organic' fertilizers to improve nutrient availability.

Communication:

- Tomatosphere, a free science outreach program available throughout North America, is now in its 20th year

Published Written Works

Caplan, D., J. Stemeroff, M. Dixon, Y. Zheng. 2018. Vegetative propagation of cannabis by stem cuttings: effects of leaf number, cutting position, rooting hormone, and leaf tip removal. *Canadian Journal of Plant Science* 98 (5), 1126-1132

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Hawley, D., Graham, T., Stasiak, M., and Dixon, M.A. (2018) Improving cannabis bud quality and yield with sub-canopy lighting. *HortScience* (53):1593-1599. doi:10.21273/HORTSCI13173-18

Hao, X., Guo, X., Lanoue, J., Zhang, Y., Cao, R., Zheng, J., Little, C., Leonardos, D., Khosla, S., Grodzinski, B., Yelton, M. 2018. A Review on Smart Application of Supplemental Lighting in Greenhouse Fruiting Vegetable Production. *Acta Horticulturae*. doi: 10.7660/ActaHortic.2018.1227.63.

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Lanoue, J., Leonardos, E.D., Khosla, S., Hao, X., Grodzinski, B. 2018. Effect of Elevated CO₂ and Spectral Quality on Whole Plant Gas Exchange Patterns in Tomatoes. *PLoS ONE*. 13(10): e0205861. Doi: 10.1371/journal.pone.0205861.

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Mah, J.J., D. Llewellyn, Y. Zheng. 2018. Morphology and flowering responses of four bedding plant species to a range of red to far red ratios. *HortScience* 53 (4), 472-478

Zheng, Y. 2018. Current nutrient management practices and technologies used in North American greenhouse and nursery industries. *Acta Horticulturae* 1227, 435-442