Remote Sensing of Nitrogen and Water Status on Boston Lettuce Transplants in a Greenhouse Environment.

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Background:
Remote sensing is the stand-off collection through the use of a variety of devices for gathering information on a given object or area. Applied as a warning tool in plant stock production, it is expected to help in the achievement of better, more uniform and more productive organic cropping systems. Remote sensing of vegetation targets can be achieved from the reflectance or fluorescence properties of vegetation. Both approaches are based on indices that combine certain spectral bands known for the diagnostic information they provide on the condition of vegetation.

Project Overview:
In this study the spectroradiometer FieldSpec® Pro (350-2500 nm), the fluorescence sensor Multiplex®, and the multispectral Camera MiniMCA (450-850 nm) were used to analyze the nitrogen and water spatial variability on Boston lettuce transplants in a greenhouse environment. For each experiment, lettuce transplants were provided by the participating grower about 25 days after sowing and were treated with two nitrogen levels. Prior to remote sensing assessment, they were let to dry or differently watered in order to change their water status. Several vegetation indices were tested to assess nitrogen and water status. The Multiplex parameters FLAV (flavonols) and FRF-UV (Far Red Fluorescence under UV excitation) were found to be the best for discriminating N status while SFR-R (Simple Fluorescence Ratio under red excitation) was strongly significant for the water status. For nitrogen, the best FieldSpec Pro indices were: PSRI (Plant Senescence Reflectance index), DCNI (Double Peak Canopy Nitrogen index) ARI2 (Anthocyanin reflectance index 2), and NIR/R_{660}. For water status: NDWI (Normalized Difference Water index), NPCI (Normalized Pigments Chlorophyll Ratio index), and NDLI (Normalized Difference Lignin index). The camera MiniMCA was used to produce a map of N crop status within a greenhouse with the optimal vegetation index (VI_{opt}). None of the indices tested with the MiniMCA was able to assess water spatial variability.

Conclusions:
It is therefore possible to conceive an early warning system to sense the stress level of an organic transplant crop in the whole space of a greenhouse. The next step is the design of a handy imagery system that could speed-up data collection and processing.

Acknowledgments: This research was funded through Canada's Organic Science Cluster, which in turn was funded by the Canadian Agri-Science Clusters Initiative of Agriculture and Agri-Food Canada's Growing Forward Policy Framework and its industry partner, Les Serres Lefort, QC. We are grateful to Gilles Turcotte, Guillaume Proulx-Gobeil and Jean-Pierre Manceau who has supervised and conducted trials at the commercial experimental greenhouse facility.