Whole Plant Candidate Crop Characterization Using Advanced Growth Chamber Technology

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Updated chamber technology

- 7 original water cooled LEDs replaced with 9 new 9-channel (UV to far red) water cooled LED array’s
A collaboration between CESRF, CONVIRON, and Intravision Light Systems was established in order to develop the next generation high resolution sealed controlled environment system.
Sealed Controlled Environment System

A precision tool to better study plant physiological responses manipulation of multiple variables including:

- Temperature
- Humidity
- Carbon dioxide
- Oxygen
- Light (quantity, quality)
- Nutrients
- Plant water status
- Insect predation
- Pathogen application/response
- Chemical application (pesticide, biocontrol, fertilizer)

Using a sealed environment chamber, we can answer the question “what happens to photosynthesis when you change ________?”
Hardware

**Modified CONVIRON A1000 growth chamber**
- New door and frame with multipoint closure and hermetic seal
- Specular aluminium interior cladding
- Mettler Toledo 32 kg 0.1g balance for ET measurement

**HVAC**
- Custom design with chilled and hot water heat exchangers
- Variable speed air flow with bottom up distribution

**Control**
- ARGUS control system

**Lighting**
- 2200 Watt water cooled LEDs with seven independently controlled channels
- UV (368 & 380), blue (448), white (5650K), green (568), red (655), far red (735)
- Wavelength and intensity programming through Argus interface
Preliminary Testing

Preliminary testing with a variety of plant species including:

- **Solanum lycopersicum** CV Red Robin
- **Capsicum annuum** CV Mini Bell Red
- **Lactuca sativa** CV New Red Fire
• All plants were 4 weeks old at the time of analysis
• Plants were grown in 6” pots in Sunshine mix #1
• All data replicated a minimum of 3 times - most were 5 reps
• Plant nursery was walk-in growth chamber 27D
• Fluorescent lighting, 23C, ~65% RH, PPFD ~300
• Actual values are not important – the relative response to the tested variables is what we are looking at in these graphs
• This type of information is needed for modelling to be able to predict yield and atmospheric stability – especially if environment control fluctuates during production
• Potential use modelling data to predictively use the HPC as a throttle for atmosphere control (amount of CO2 removed or O2 produced or water produced)
• Other parameters to be tested are VPD response and temperature response
Phyto-pharmaceutical studies

One original ‘Guelph BlueBox’ chamber has been retrofitted with multi-channel, high-intensity water-cooled LEDs in compartments to study light responses related to the production of breast cancer drugs in tobacco.
Early evidence suggests vertical stratification of secondary metabolite production in cannabis flower buds in response to sub-canopy lighting.
Ongoing/Next Steps

- Examine relationships among environment variables in terms of plant responses
- Develop environment control recipes that reliably achieve predictable results in secondary metabolites such as taste and medicinal compounds
- Design more economic technical solutions for controlled environment systems