SPACE EXPLORATION

A Source of Technology Transfer in the Terrestrial Agri-Food Sector

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The Challenge of Space……..

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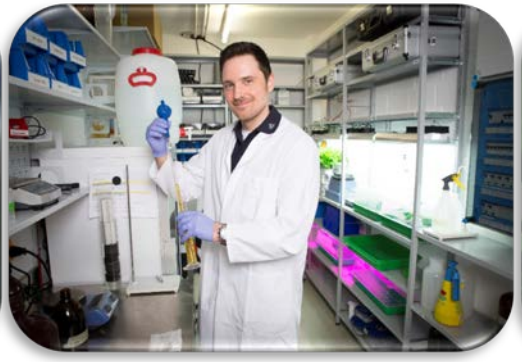
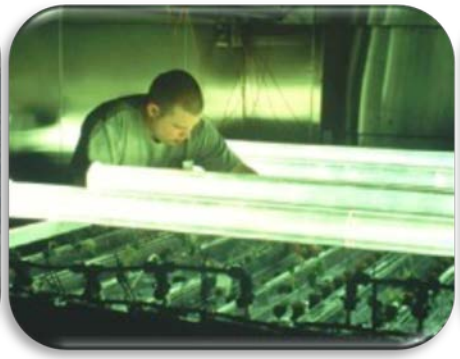
Technology Transfer

The "pull" of technology requirements for human space exploration yields significant benefits to terrestrial industry

Investigating contributions of plants to human life support in space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The Roles of Plants

- Food production
- Oxygen evolution
- Carbon Dioxide uptake
- Fresh water recycling
- Psychological benefits

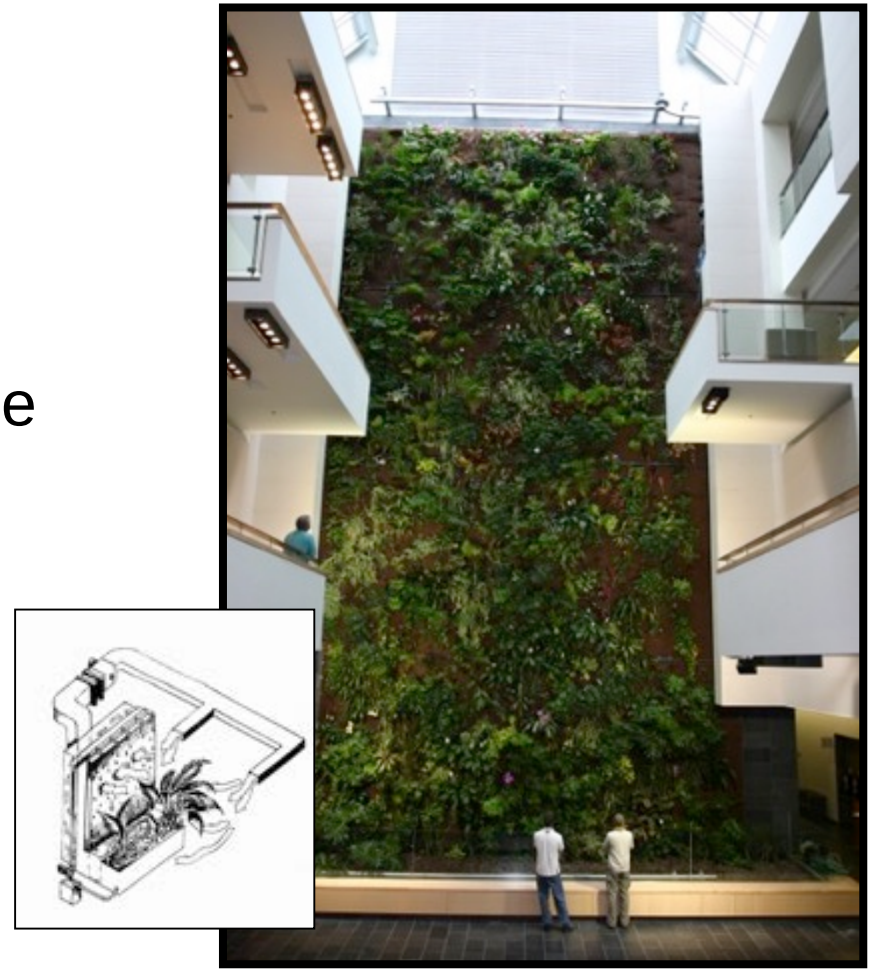
Areas of Research

Atmosphere Management
Biodegradable/recyclable Growth Media
Attributes of Candidate Crops
Non-toxic Residue Disinfection (O_3)
Root Zone Oxygen Control
Recycling Nutrient Solution
Environment Sensor Requirements
Artificial Lighting Systems (LEDs)
Hypobaric Plant Growth Chambers
Mars Analog Studies (Devon Island)
Sensors for Irrigation Management
High Density Modular/Vertical Farming
Phyto-pharmaceuticals

Biological Air Filtration Technologies

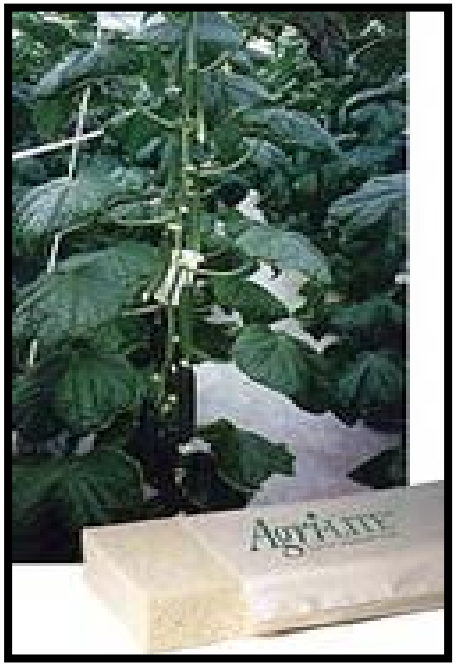
Air treatment in sealed occupied spaces including:

- Home or office
- Mine shafts
- Submarines
- Passenger aircraft
- Part of an ALS system in space



Recyclable plant growth media

- Adaptable to conventional recycling protocols
- Modified irrigation management strategies
- Comparable production performance
- Licensing opportunities



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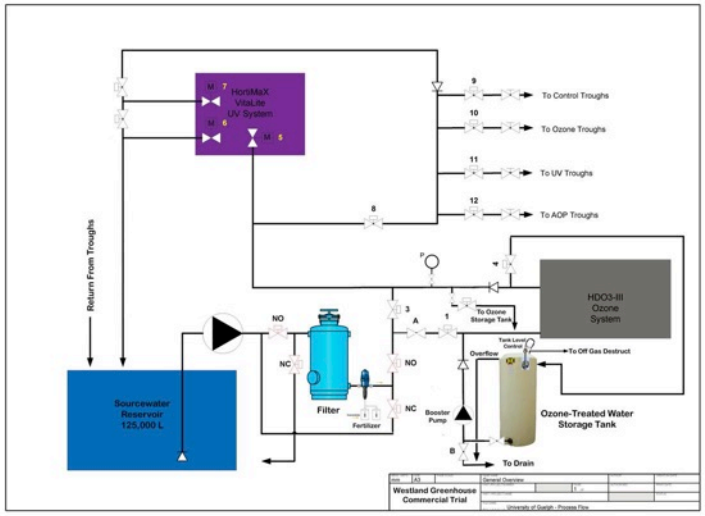
Applications of Aqueous Ozone

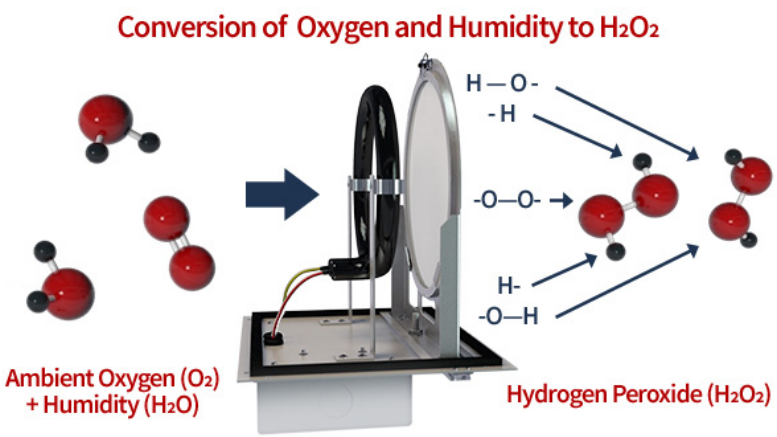
- **Food safety**
- **Greenhouse disinfection**
- **Tissue culture**
- **Extended shelf life**

Next Gen Disinfection Technologies

AOP ~ UV/O_3



E-AOP ~ UV/O_3/Electrochemical



Dry H_2O_2

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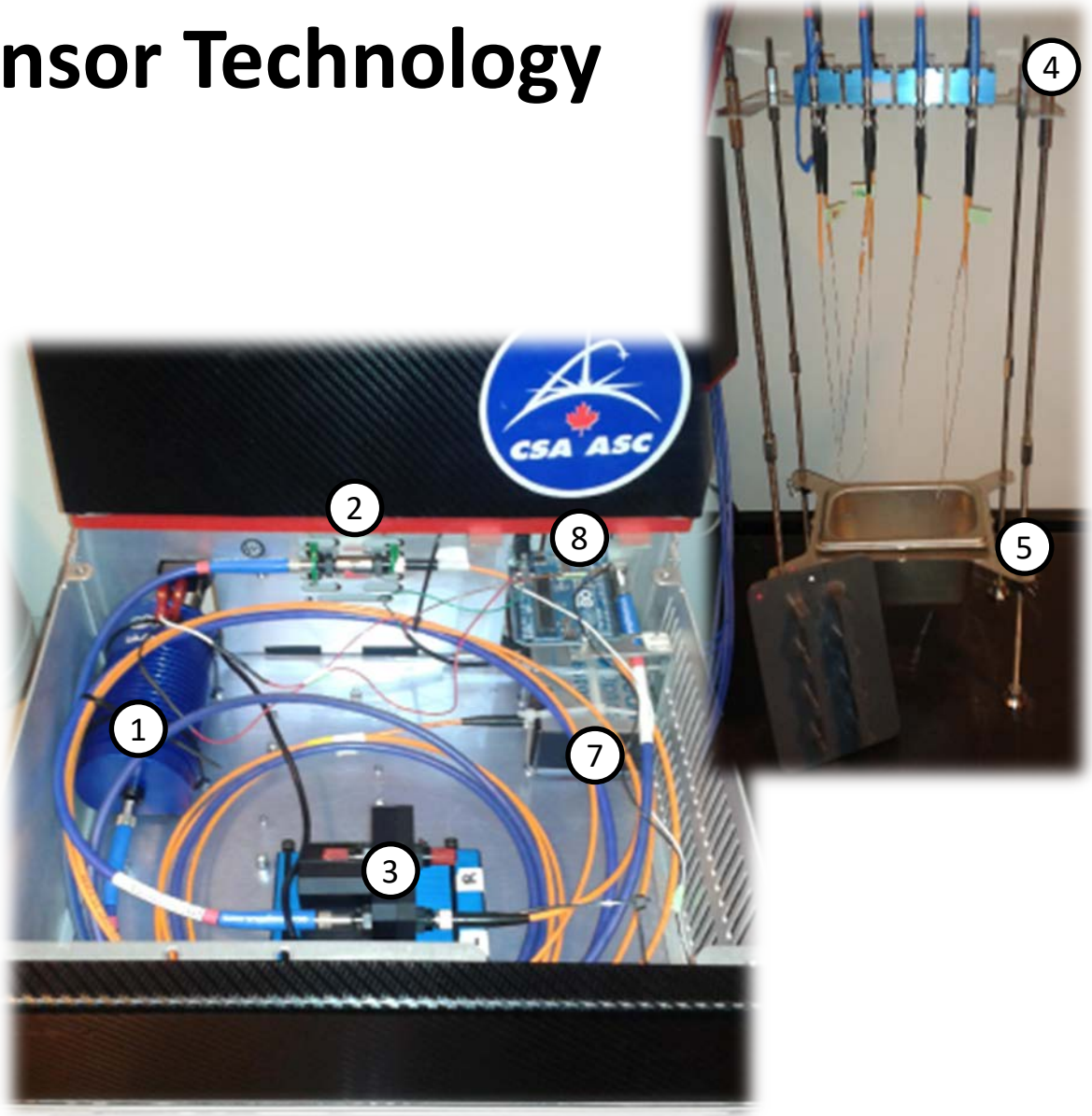
Ion Selective Sensor Technology

Using optrodes and light to identify individual ions in a hydroponic nutrient solution



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Stem Psychrometer - measures plant water stress

1. Make sure sensor is clean & thermocouples are intact.

2. Expose plant sapwood tissue.

3. Use deionized water to wash away residual plant tissue.

4. Secure sensor flush against plant using clamp.

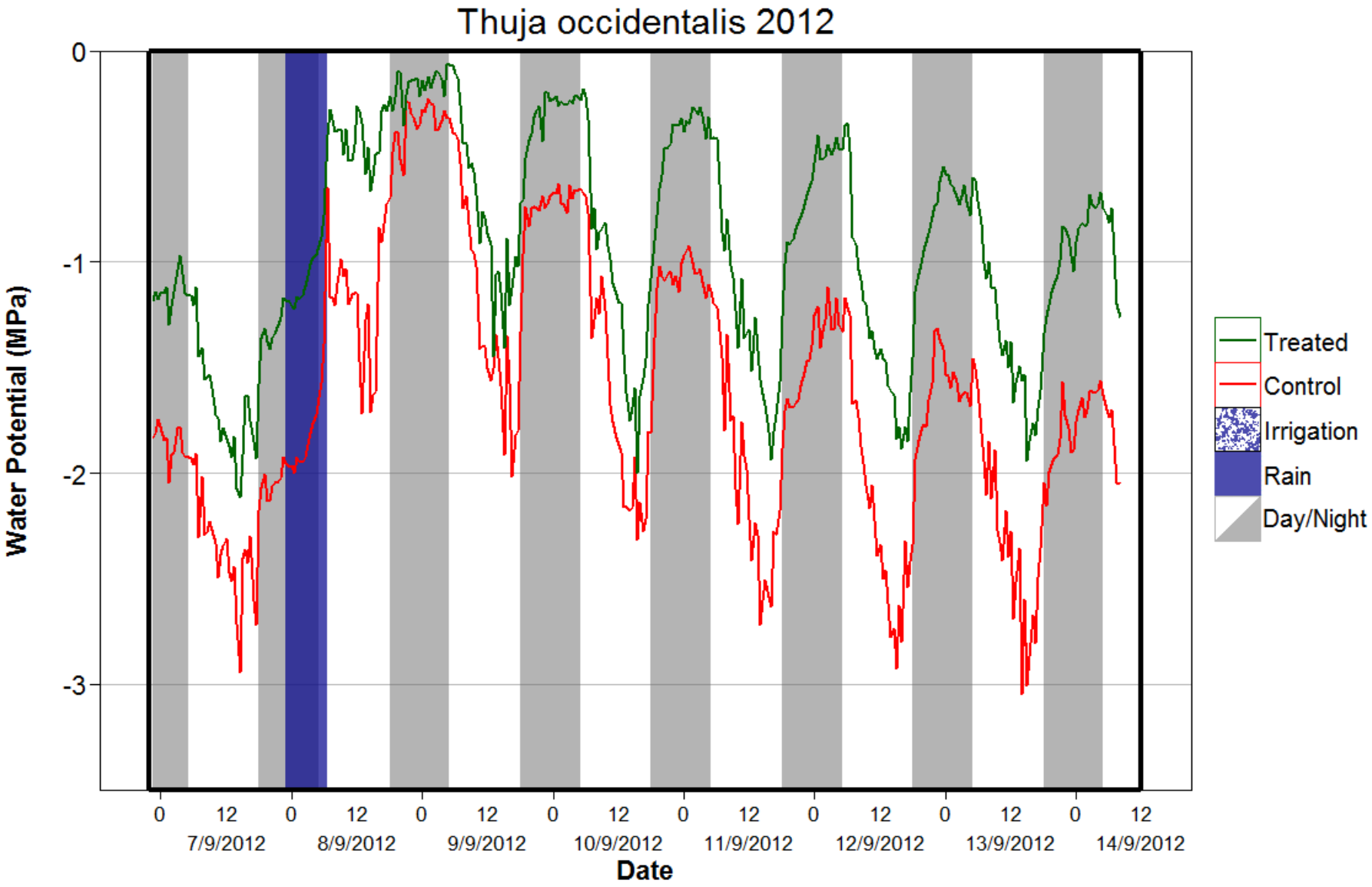
5. Apply silicone grease for a gas-tight seal around instrument.

6. Attach automated PSY data logger to plant.

7. Insulate instrument.

8. Wrap installation in aluminum foil.

Nursery - efficacy of water stress management



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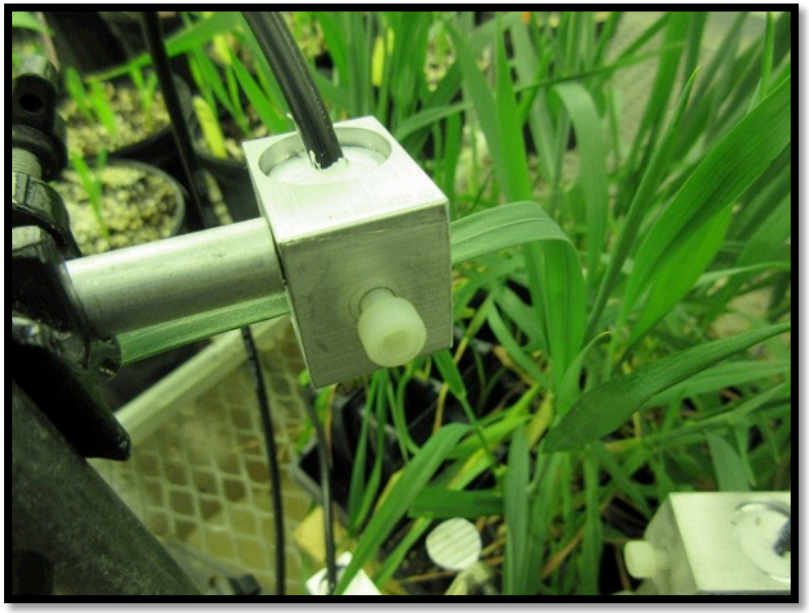
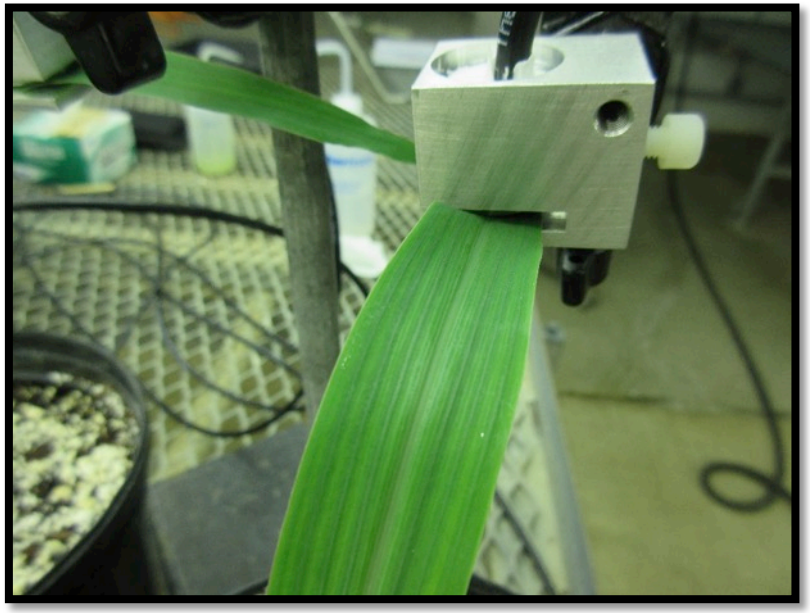
Psychrometer Technology Advancement

- *in situ* leaf psychrometer
  - New sensor for measuring plant water status licenced to ICT International Pty. In Australia
  - 10 minute resolution and remote data collection





Hypobaric Chamber Technology

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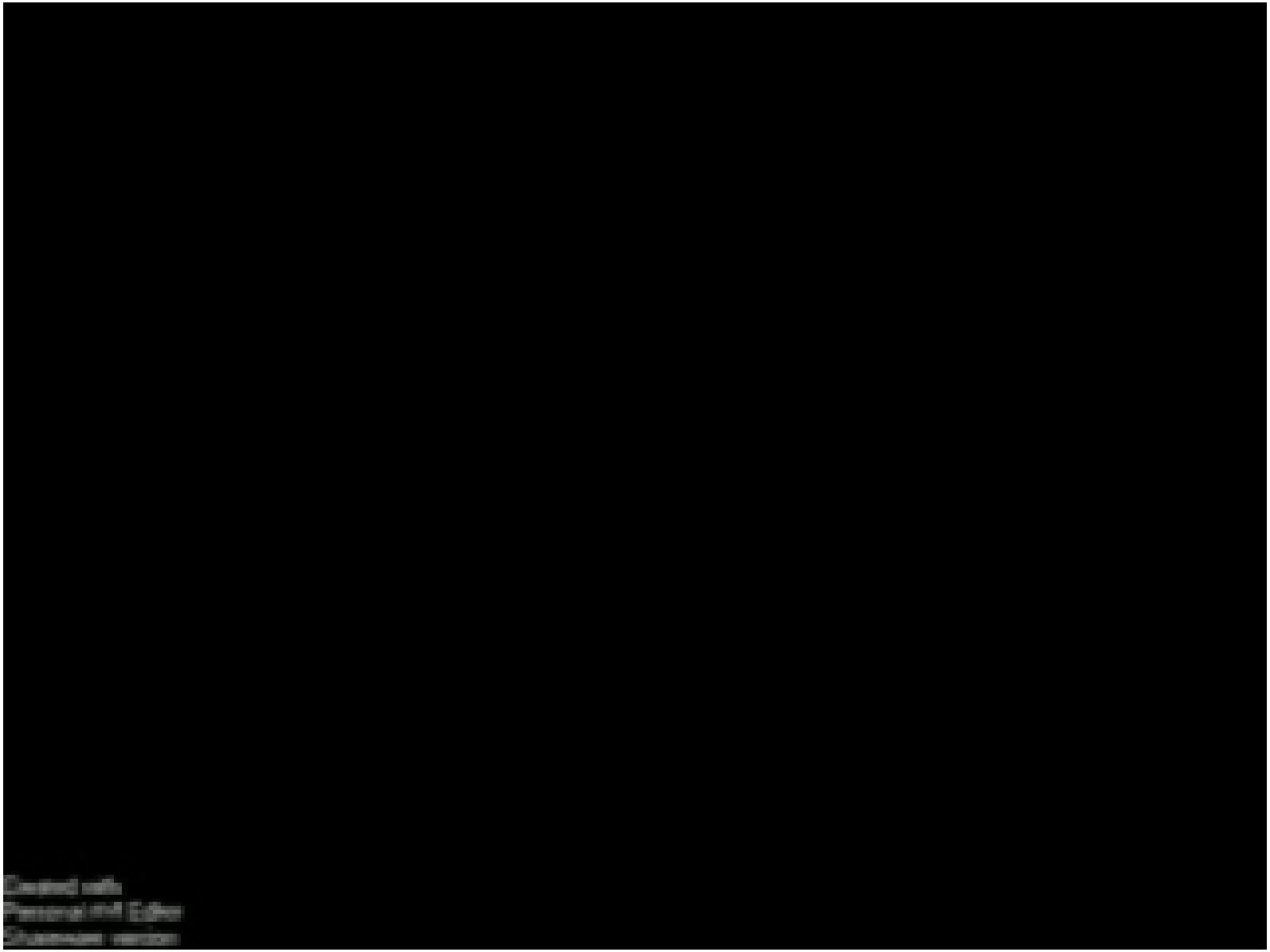
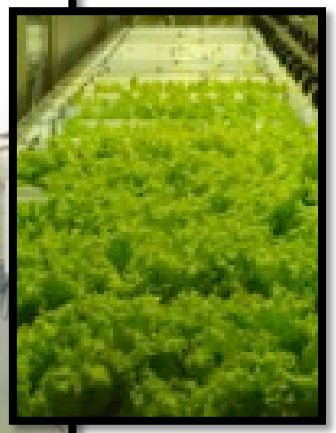
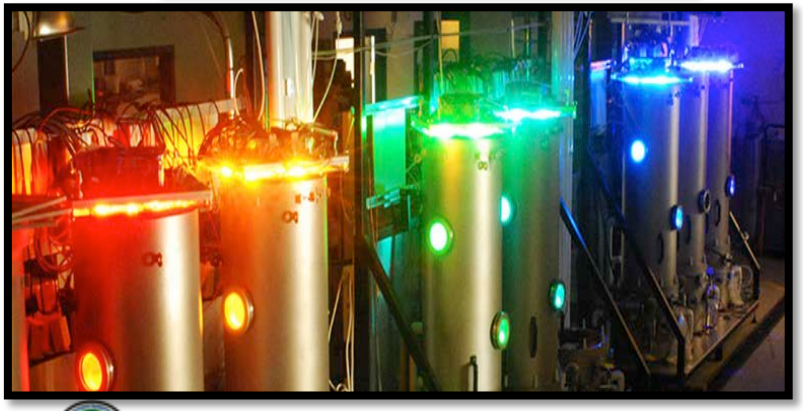


CES Chamber Technology Advancement





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“Guelph BlueBox Chamber”
Latest Technology Advancement

“Phridge” model PS1000

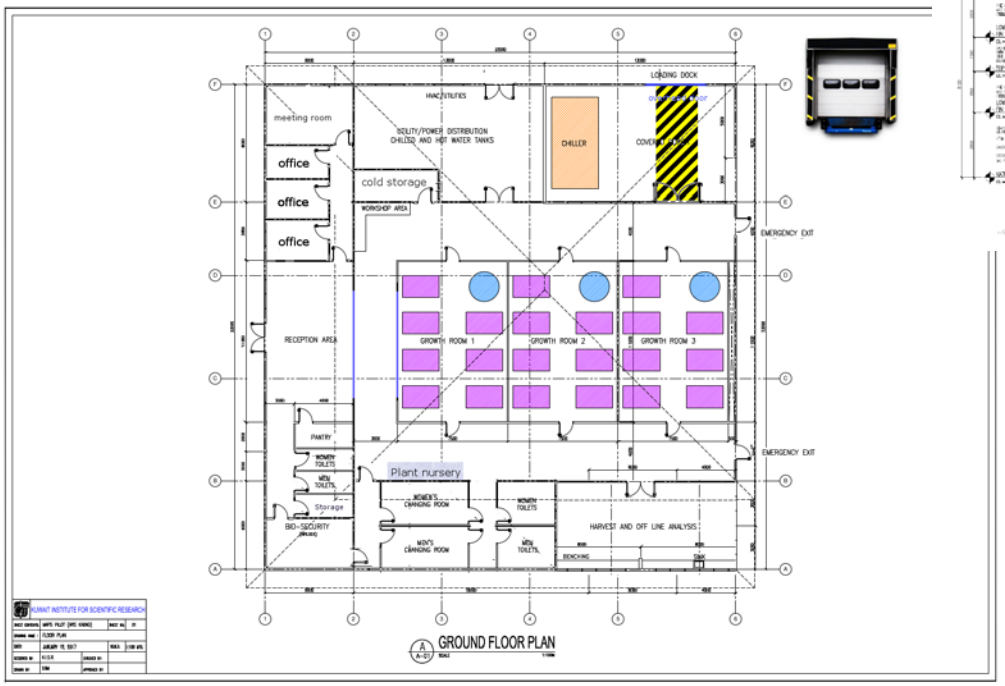
- Photosynthesis and ET whole plant growth chamber
- Developed with CONVIRON and Intravision
  - Temperature
  - Humidity
  - Carbon dioxide
  - Light (quantity, quality)
  - Air speed

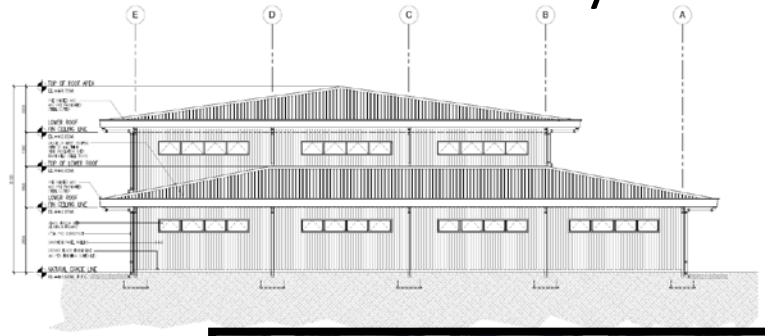
Technology Transfer

Kuwait Institute for Scientific Research

Construction of a pilot facility in the Kuwait desert

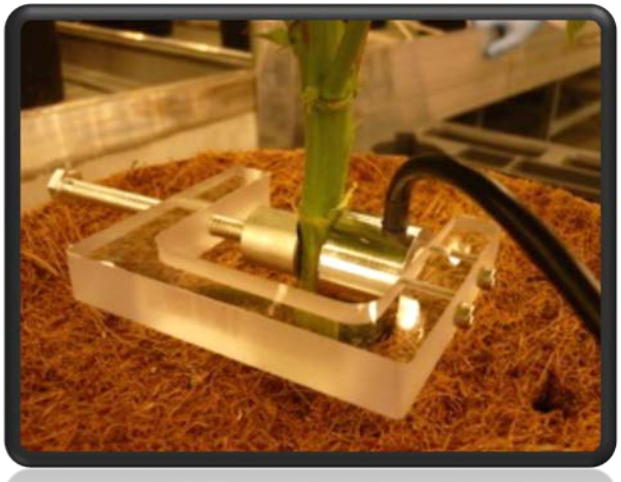
Three growth chambers with 21 three level LED NFT systems





High Density Modular Food Production Systems with LEDs

Phyto-pharmaceutical Research Investigations


ABcann ABSOLUTE BALANCE

Environment control strategies for standardized production of medicinal compounds



Plant Form

Enhanced production of cancer drugs in tobacco plants

Terrestrial Benefits

- Improvements in greenhouse labour and energy efficiency
- Environmental legislation compliance
- Plant production systems for northern/remote communities
- Green buildings
- Alternative pest/pathogen control
- Efficient use of water resources
- Education & Outreach

TOMATOSPHERE™

CESRF Technology Transfer

Is built on…..

- ✓ 5 International MOU's
- ✓ 30+ international collaborations (current)
- ✓ 15+ industry partners (current)
- ✓ 7+ patents
- ✓ Multiple licensing opportunities
- ✓ **>100 HQP trained**