Operational Evaluation of the Root Modules of the Advanced Plant Habitat.

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Operational Evaluation

• Photosynthetic and growth data were collected on APH Root Module

• Stand pipe system for active moisture control

• Tested germination in wicks

• Evaluated EC-5 moisture sensors

• Demonstrated that Wheat plants can grow in the APH Root Module
Controlled Growth Environment System

I. Homogenous Lighting System
II. Root Zone Moisture Control
   I. 3D Printed Root Module/Manifold
   II. Water Manifold with Porous Tubes
   III. Passive Suction Control (Stand Pipe)
   IV. EC-5 Moisture Sensor
III. Atmospheric Monitoring and Control
Cultural activities

- EC-5 Moisture sensor calibration (Volumetric Moisture Content)
  - Glass beads and Turface 1-2mm
  - Mix media with water to known VMC and insert sensor, record mV

- Moisture sensor placement
  - Stand pipe system to control moisture in root module
  - Bottom of tray is flooded
  - Top of tray determines VMC for germination

- High fidelity germination studies
  - Root module with manifold
  - Used old BPS Mott porous tubes
  - Primed tubes and they remained primed for 10+ days
  - Turface with Nutricote 18-6-8 at 20 g/ml
  - High CO2 and PPF
  - Wick trade studies – Nytex, Crew wipes (BPS), Cap Mat2 (Veggie)
  - Planted 10 seeds per row – 660 plants/m2
Decagon EC-5 Calibration

EC-5 Calibration

[Graph showing the relationship between Volumetric Moisture Content and Millivolts, with curves for 1-2 mm Surface and Glass Beads.]
Germination/Early Growth Studies

I. Four separate trials of thirty *Triticum aestivum* L. cv. Apogee plants
   I. Wicks: Nitex, Cap Mat II, Crew Wiper
   II. Foams: Pyrell, Melamine
Plant Stand Photosynthesis

**Conditions**
- **Media:** 1-2 mm Turface w/ 20 g/L of 18-6-8 Nutricote
- **Light:** 600 PAR 20/4 photoperiod
- **CO2:** ~1500 PPM
- **VMC:** 0.55 top / 0.7 bottom (-2 suction)
- **Relative Humidity:** uncontrolled

**Graph:**
- Pnet
- Units: μmol m⁻² s⁻¹ CO2
- Days

**Images:**
- Plant stand photosynthesis
- Light on and suction lowered
Plant Growth

Plant heights were measured live, every day after the first day of witnessed growth. Additional growth rates are still being characterized by selectively harvesting batches of plants from each wick every 5 days to record biomasses.

![Graph showing plant growth (Average Plant Heights)]
Wheat Growth – 45 Days After Planting

Germination 4 DAP

10 DAP

Harvest 45 DAP