

**North Carolina State University Phytotron  
2025 Station Report for NCERA-101  
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1. New Facilities and Equipment

- New Percival Controllers were retrofitted onto the original walk-in growth chambers in the Main Campus Phytotron.
- 4 double door LT-105 Percival growth chambers & 5 LT-41VL Percival Incubators were added in the Centennial Campus Phytotron

2. Unique Plant Responses

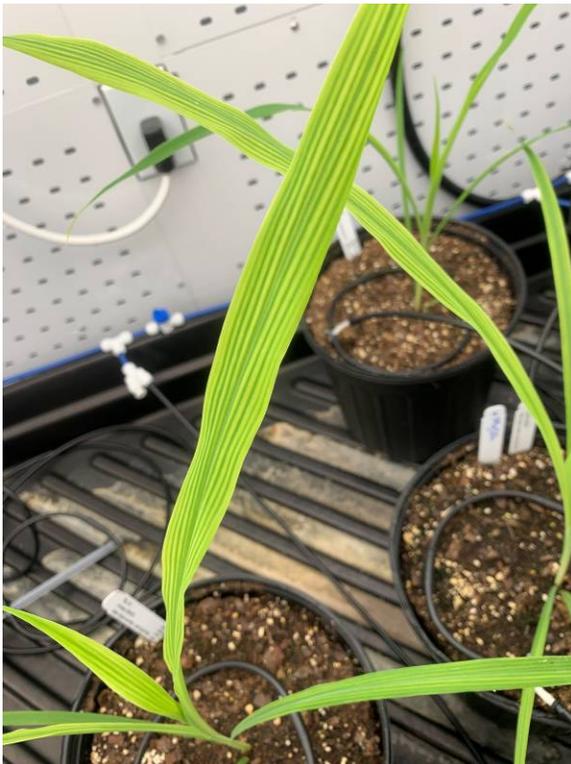
**Holey cotton leaves.** Multiple lines/cultivars displayed what looked like herbivorous holes in the leaves, but no pests were found. Others thought possible Mn toxicity. Initially blamed on uneven watering within a pot. Although uniformity helped some lines, there were still some showing the symptom with even watering.

We reduced our standard fertilizer rates by 0.5X (1:200 dilution; 50PPM N) and saw even more improvement. We will analyze the flow through using HPIC for cation analysis.





**Corn striping.** Some lines were very sensitive to amount of water and fertilizer given. As we supplied less water, the symptoms improved. We are training our users not to over water and/or over fertilize their corn plants.





**Powdery mildew in strawberry** We have integrated UV-C light treatments with a regular spray routine to control powdery mildew for strawberry plants grown in our greenhouse and we have seen a dramatic reduction in outbreaks and much less spraying is required for control. The UV\_C treatment has worked well over the past year in our greenhouses. The greenhouses are sealed and air is continuously filtered, but even so, the previous year saw significant outbreaks without UV-C treatments.



Strawberries that have been UV-C treated- no powdery mildew

### 3. Accomplishments

#### 3a. **Short-term outcomes**

- We updated RO filter system for irrigation with sensors to monitor and log filtered water production in Centennial Campus Phytotron facilities.

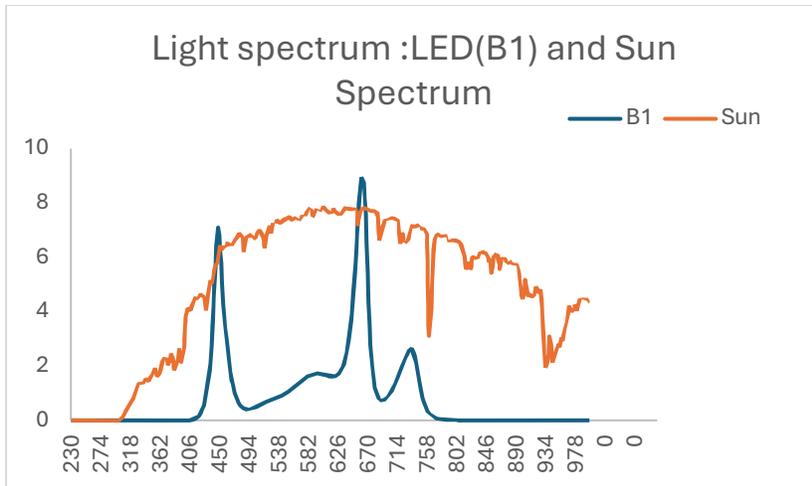
- We had many issues with the Heliospectra LED lights that was initially installed during building construction in Centennial Campus greenhouses and we are now replacing them with a Venntis system with wireless dimming control integrated into Argus.

### 3c. Activities

- We evaluated Jack's Pure Water fertilizer for fertilizing plants in Centennial Campus greenhouses and found we needed to supplement with MgSO<sub>4</sub>.
- We evaluated substrates with a focus on Arabidopsis growth but also found the mix is useful as general seed starter mix. Sunshine 360 mix replacements (Jolly C/B) didn't work very well (not quite dense enough) and a pure propagation mix too dense. We found Sunshine propagation mix and Turface MVP at a 2:1 ratio works very well and is now our standard for Arabidopsis and general starter mix.

For Main Campus Phytotron growth chambers, different LED light settings are being tested in comparison to the traditional fluorescent and incandescent lighting that are currently used in most chambers. Ongoing studies on soybean, maize, cotton, tomato, and sunflower plants are evaluating growth, morphology, and physiology to determine the optimal light intensity for successful growth under LED lighting.





**Compared to fluorescent and incandescent lighting, LED lights have shown a more positive impact on the growth of the plants mentioned above.**

The morphological differences observed in various crops, are shown below.



Tomatoes



Maize



Soybean



The conclusion from the initial phase of the LED experiments indicates that both LED and fluorescent lighting offer distinct advantages for plant growth. The choice between the two often depends on specific factors such as crop type, growth stage, and resource availability. While no significant statistical difference in plant growth was observed under LED lighting overall, LEDs fixtures with a combination of red, blue, white and far-red diodes demonstrated clear advantages over both other LED setups and fluorescent lights. Ongoing studies aim to standardize the use of LED lighting across different crops for optimal performance.

### 3b. Milestones

- Centennial Campus Phytotron growth facilities are open & operating successfully with about 90% occupancy in the greenhouses at this time and is currently servicing ~30 research projects, both academic and commercial.

## 4. Impact Statements.

Our goals are to continue modernizing the main campus Phytotron by extending controller upgrades to all reach-in chambers and installing CO<sub>2</sub> regulation systems across all main campus Phytotron greenhouses. We also aim to enhance the capabilities of the Centennial Campus growth facilities by remodeling the four Blue Box chambers with LED lighting. The Phytotron remains a critical resource, supporting both the NC State University community and a diverse range of companies, from large

corporations to small startups, throughout the North Carolina Research Triangle Park region.

## 5. Published Written Works

K Lindelof, A Krings, N Giertych. 2025. Scientific Note: the Role of Pre-stratification Dry Storage Time in Germination Success of an Imperiled, Southern Appalachian Endemic, *Houstonia montana*, *Castanea*, 89(2):196-208. <https://doi.org/10.2179/0008-7475.89.2.196>

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Jean Hansel, Amanda C. Saville, and Jean Beagle Ristaino. 2024. Evaluation of a Formulation of *Bacillus subtilis* for Control of *Phytophthora* Blight of Bell Pepper, *Plant Disease* 108:1014-1024 <https://doi.org/10.1094/PDIS-04-23-0807-RE>

Jonathan E. Oliver, Dorith Rotenberg, Karolyn Agosto-Shaw, Holly A. McInnes, Kirsten A. Lahre, Michaël Mulo, Sott Adkins, and Anna E. Whitfield. 2024. Multigenic Hairpin Transgenes in Tomato Confer Resistance to Multiple Orthospoviruses Including Sw-5 Resistance-Breaking Tomato Spotted Wilt Virus, *Phytopathology*® 114:1137-1149 <https://doi.org/10.1094/PHYTO-07-23-0256-KC>

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Muhammad Irfan Siddique, Emily Silverman, Frank Louws and Dilip R. Panthee. 2024. Quantitative Trait Loci Mapping for Bacterial Wilt Resistance and Plant Height in Tomatoes. *Plants*, 13, 876. <https://doi.org/10.3390/plants13060876>  
<https://www.mdpi.com/journal/plants>

Eli D. Hornstein, Melodi Charles, Megan Franklin, Brianne Edwards, Simina Vintila, Manuel Kleiner, Heike Sederoff. 2024. IPD3, a master regulator of arbuscular mycorrhizal symbiosis, affects genes for immunity and metabolism of non-host *Arabidopsis* when restored long after its evolutionary loss. 2024. *Plant Molecular Biology* (2024) 114:21 <https://doi.org/10.1007/s11103-024-01422-3>

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