North Carolina State University Phytotron
2017 Station Report for NCERA-101
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New Facilities and Equipment

North Carolina State University is building a 200,000 sq. ft. Plant Science Research Complex that will be completed by 2021. The facility will have 30,000 sq. ft. of controlled environment rooftop greenhouses with 10,000 sq. ft. being biosafety level 3 compliant as well as multi-user area with growth chambers. Faculty labs and offices will be located throughout the facility and there will be leasable corporate lab and startup suites available for corporations. An atrium collaborative space and multi-user labs will also be included.

Accomplishment Summaries

NCSU Phytotron staff has completed an Energy Conservation project renovating the facility/growth chamber/greenhouse cooling system, facility electrical system and growth chambers. We have also added a full-service Plant Transformation Laboratory (PTL) to our facility on the third floor. The PTL was constructed using 2 lab spaces: one that was formerly used as a Plant Pathology lab & the other was a Phytotron staff research lab. We relocated the Phytotron research lab by renovating a room used for miscellaneous incubators. A new incubator room was constructed on the first floor using part of the newly renovated mechanical room to create the extra space.

Impact Statements

Tables summarizing the use of the NCSU Phytotron by growth chamber type, department and crop are listed at the end of the report. Usage for all growth chambers in 2016 was 91% of the recommended optimal occupancy, or 73% of maximal occupancy (Table 1). For 2016, total A-chamber (2.4 m width x 3.7 m depth x 2.1 m height) usage was 82% maximal occupancy. Usage of B-chambers (2.4 m width x 1.2 m depth x 2.1 m height) was at 82% and C-chambers (1.2 m width x 0.9 m depth x 1.2 m height), 69% for the year. Lower usage of C-chamber was due to on going renovations of the chambers. Fifty-seven different projects were conducted in the Phytotron during 2016 by faculty and students from 11 departments (Table 2). The Crop Science Department used the largest amount of space in 2016 (more than 23%, for 12 different projects). The Plant Pathology Department used 9.1% of the space for 7 projects, Plant and Microbial Biology used 8.8% of the space for 8 projects, and Horticultural Science used over 5% for 6 projects. During 2016, 37% of the growth space in the Phytotron was used to grow soybeans (Table 3). Research with other agronomic crops included cotton (9%), tobacco, (3.6%) and corn (5%). Research on Arabidopsis used 7% of growth space, ornamentals, 6%, turfgrass, 4.5% and the 'Demonstration' category (1%) included space for plants grown for display during tours of the facility.

Selected Publications

Geng, Xing-Min, Xiang Liu, Mikyoung Ji, William A. Hoffmann, Amy Grunden and Qiu-Yun J. Xiang. 2016. Enhancing Heat Tolerance of the Little Dogwood *Cornus canadensis L.f.* with Introduction of a Superoxide Reductase Gene from the Hyperthermophilic Archaeon *Pyrococcus furiosus*. Frontiers in Plant Science. doi: 10.3389/fpls.2016.00026

Liu, Xiang, Jian Zhang, Ahmad Abuahmad, Robert G. Franks, De-Yu Xie, Qiu-Yun Xiang. 2016. Analysis of two TFL1 homologs of dogwood species (Cornus L.) indicates functional conservation in control of transition to flowering, Planta 243:1129–1141, DOI 10.1007/s00425-016-2466-x

Lu, Jianli, Leichen Zhang, Ramsey S. Lewis, Lucien Bovet, Simon Goepfert, Anne M. Jack, James D. Crutchfield. 2016. Expression of a constitutively active nitrate reductase variant in tobacco reduces tobacco-specific nitrosamine accumulation in cured leaves and cigarette smoke, Plant Biotechnology Journal (2016) 14: 1500–1510, doi: 10.1111/pbi.12510.

Ma, Qing, Xiang Liu, Robert G. Franks and Qiu-Yun (Jenny) Xiang. 2016. Alterations of *CorTFL1* and *CorAP1* expression correlate with major evolutionary shifts of inflorescence architecture in Cornus (Cornaceae) – a proposed model for variation of closed inflorescence forms, New Phytotolgist. doi: 10.1111/nph.14197

Reynolds, William Casey, Grady L. Miller, David P. Livingston III, and Thomas W. Rufty. 2016**.** Athletic Field Paint Color Impacts Transpiration and Canopy Temperature in Bermudagrass. Crop Sci. 56:1–10 (2016). doi:10.2135/cropsci2016.01.0028

Riar, Mandeep K. Danesha S. Carley, Chenxi Zhang, Michelle S. Schroeder-Moreno, David L. Jordan, Theodore M. Webster, and Thomas W. Rufty. 2016. Environmental Influences on Growth and Reproduction of Invasive *Commelina benghalensis*. International Journal of Agronomy, Article ID 5679249, 9 pages http://dx.doi.org/10.1155/2016/5679249

Saville, Amanda C., Michael D. Martin, Jean B. Ristaino. 2016. Historic Late Blight Outbreaks Caused by a Widespread Dominant Lineage of *Phytophthora infestans* (Mont.) de Bary. PLOS ONE, DOI:10.1371/journal.pone.0168381

Stiff, Michael R. & Candace H. Haigler .2016. Cotton fiber tips have diverse morphologies and show evidence of apical cell wall synthesis. www.nature.com/scientificreports . 6:27883, DOI: 10.1038/srep27883

Xi, Jing, Lorenzo Rossi, Xiuli Lin, De-Yu Xie. 2016. Overexpression of a synthetic insect–plant geranyl pyrophosphate synthase gene in Camelina sativa alters plant growth and terpene biosynthesis. Planta (2016) 244:215–230, DOI 10.1007/s00425-016-2504-8

Zhou, Binbin, Hong Luo, Rongda Qu. 2016. Expression of the shrimp antimicrobial peptide penaeidin 4-1 confers resistance against brown patch disease in tall fescue. Plant Cell Tissue Organ Cult, DOI 10.1007/s11240-016-0963-z

Table 1. **CHAMBER USAGE SUMMARY, 2016**

Chamber		% Optimal	% Maximum
A-chambers	(20 individual)	131	82
A-chambers	(2 standard)	110	69
A-chambers	(22)	133	83
B-chambers	(10)	82	82
C-chambers	(14)	69	69
Glasshouses	(4)	52	41
BSL3 Glasshouse	(1)	60	48
HID Walk-in	(2)	82	82

Dimensions of Chambers are:
A = 8' x 12' x 7'h
B = 8' x 4' x 7'h
C = 4' x 3' x 4'h
H = 10' x 6' x 8'h
T = 16' x 12' x 7'-15'h

Table 2. **DEPARTMENT USAGE SUMMARY, 2016**

Department	% Total Use-Days	# Projects
Phytotron	4.2	1
Bio & Ag Engineering	2.7	1
Plant & Microbial Biology	15.8	13
Crop Science	23.4	12
Entomology	2.8	2
Horticultural Science	8.8	8
Plant Pathology	9.1	7
Food Science	2.7	1
Applied Ecology	0.4	1
Biochemistry	1.3	1
Soil Science	0.3	1
Academic	0.1	1
Commercial	28.4	7
Other Universities	0.1	1
	100	57

Table 3. **CROP TYPE SUMMARY, 2016**

Crop	% Total Use-Days
ARABIDOPSIS	6.9%
BIOFUELS	0.4%
CAMELINA	3.0%
CORN	5.0%
COTTON	9.2%
CUCUMBER	1.3%
DEMO	0.8%
FRUIT	2.8%
GRAIN	0.6%
HOPS	1.3%
INSECT	2.1%
MANGROVE	0.4%
MELONS	1.1%
ORNAMENTALS	5.9%
OTHER	2.4%
SOYBEAN	37.4%
STEVIA	0.8%
STRAWBERRIES	0.7%
SWEET POTATO	1.9%
TOBACCO	3.6%
TOMATO	0.8%
TURFGRASS	4.5%
VEGETABLES	5.3%
WEEDS	0.9%
WHEAT	1.1%