

**North Carolina State University Phytotron
2019 Station Report for NCERA-101
Carole H. Saravitz, Joseph Chiera & Ricardo Hernandez**

New Facilities and Equipment

The ground breaking for a 200,000 sq. ft. Plant Science Research Complex will take place Fall of 2019. 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. The project is scheduled to be completed by Fall of 2021.

Accomplishment Summaries

The Phytotron Energy Conservation Project to upgrade Phytotron facilities was completed in 2014 and we have continued to work to improve our energy savings over the next four years. During the first two years, we did not reach our target savings, but through continued adjustments and improvements, we were able to exceed our target savings during the third and fourth years. Our surpluses now exceed the early deficits of the first two years and we are on target to pay off the loan early.

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 2018 was 99% of the recommended optimal occupancy, or 81% of maximal occupancy (Table 1). For 2018, total A-chamber (2.4 m width x 3.7 m depth x 2.1 m height) usage was 77% maximal occupancy. Usage of B-chambers (2.4 m width x 1.2 m depth x 2.1 m height) was at 98% and C-chambers (1.2 m width x 0.9 m depth x 1.2 m height), 82% for the year. Fifty-six different projects were conducted in the Phytotron during 2018 by faculty and students from 8 departments (Table 2). The Department using the largest amount of space in 2018 was Plant Pathology & Entomology (23%, for 19 different projects). The Crop Science Department used 15.8% of the space for 13 projects, Plant and Microbial Biology used 11.4% of the space for 9 projects, and Horticultural Science used 13.6% for 5 projects. During 2018, 29.4% of the growth space in the Phytotron was used to grow soybeans (Table 3). Research with other agronomic crops included cotton (5.7%), tomato, (6.3%) and corn (3.1%). Research on *Arabidopsis* used 2.4% of growth space, strawberries, 5.2%, and turfgrass, 5.9.

Selected Publications

Ekelöf, Måns, Kenneth P. Garrard, Rika Judd, Elias P. Rosen, De-Yu Xie, Angela D. M. Kashuba & David C. Muddiman. 2019. Evaluation of Digital Image Recognition Methods for Mass Spectrometry Imaging Data Analysis. *J. Am. Soc. Mass Spectrom.* (2018) 29:2467Y2470, DOI: 10.1007/s13361-018-2073-0

He, Yijian, Saet-Byul Kim & Peter Balint-Kurti. 2019. A maize cytochrome b–c1 complex subunit protein ZmQCR7 controls variation in the hypersensitive response, *Planta* 249:1477–1485, <https://doi.org/10.1007/s00425-019-03092-8>

Hutchens, W.J., T.W. Gannon, H.D. Shew, & J.P. Kerns. 2019. Effect of post-application irrigation on fungicide movement and efficacy against *Magnaportheopsis poae*. *Crop Protection* 122 (2019) 106–111. <https://doi.org/10.1016/j.cropro.2019.04.027>

Judd, Rika, M.Caleb Bagley, Mingzhuo Li, Yue Zhu, Caiyan Lei, Seyit Yuzuak, Måns Ekelöf, Gaobin Pu, Xiting Zhao, David C. Muddiman, De-Yu Xie. 2019. Artemisinin biosynthesis in non-glandular trichome cells of *Artemisia annua*. *Mol. Plant*. doi: <https://doi.org/10.1016/j.molp.2019.02.011>.

Kotilainen T, Robson TM, Hernández R. 2018. Light quality characterization under climate screens and shade nets for controlled-environment agriculture. *PLoS ONE* 13(6):e0199628. <https://doi.org/10.1371/journal.pone.0199628>

Li, Gui, Xiaoming Ji, Jing Xi, De-Yu Xie & Xiaohua Su. 2019. Creation of elite growth and development features in PAP1-programmed red *Nicotiana tabacum* Xanthi via overexpression. *Mol Breeding* 39:63. <https://doi.org/10.1007/s11032-019-0968-5>

Liu, Xiang, Jian Zhang, Deyu Xie, Robert G. Franks & Qiu-Yun (Jenny) Xiang. 2019. Functional characterization of *Terminal Flower1* homolog in *Cornus canadensis* by genetic transformation. *Plant Cell Reports* (2019) 38:333–343, <https://doi.org/10.1007/s00299-019-02369-2>

Ma, Dongming, Chong Xu, Fatima Alejos-Gonzalez, Hong Wang, Jinfen Yang, Rika Judd and De-Yu Xie. 2018. Overexpression of *Artemisia annua* Cinnamyl Alcohol Dehydrogenase Increases Lignin and Coumarin and Reduces Artemisinin and Other Sesquiterpenes. *Frontiers in Plant Science*. Volume 9, Article 828, pgs 1-12

Meineke, Emily K. & Steven D. Frank. 2018. Water availability drives urban tree growth responses to herbivory and warming. *J Appl Ecol.*, 55:1701–1713. DOI: 10.1111/1365-2664.13130.

Neill, Elena M., Michael C. R. Byrd, Thomas Billman, Federica Brandizzi, and Ann E. Stapleton. 2019. Plant growth regulators interact with elevated temperature to alter heat stress signaling via the Unfolded Protein Response in maize. bioRxiv. <http://dx.doi.org/10.1101/532796>

Xiaodong, Xie, Bode Olukolu, Qin Yang, Peter Balint-Kurti. 2018. Identification of a locus in maize controlling responseto a host-selective toxin derived from *Cochliobolus heterostrophus*, causal agent of southern leaf blight. 131:2601–2612
<https://doi.org/10.1007/s00122-018-3175-6>

Table 1. **CHAMBER USAGE SUMMARY, 2018**

Chamber		% Optimal	% Maximum
A-chambers	(21)	124	77
B-chambers	(10)	98	98
C-chambers	(14)	82	81
Glasshouses	(4)	73	60
BSL3 Glasshouse	(1)	87	70
HID Walk-in (H)	(2)	100	100
Arabidopsis Room (T)	(1)	81	81

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, 2018**

Department	% Total Use- Days	# Projects
Biochemistry	1.3	2
Bio & Ag Engineering	3.3	1
Plant & Microbial Biology	11.4	9
Crop & Soil Science	15.8	13
Horticultural Science	13.6	5
Plant Pathology& Entomology	23.0	19
Food Science	0.3	1
Electrical & Computer Engineering	0.1	1
Commercial	31.2	7
	100	56

Table 3. **CROP TYPE SUMMARY, 2018**

Crop	% Total Use-Days
ARABIDOPSIS	2.4%
ARTEMISIA	1.3%
BANANA	0.5%
CAMELINA	4.4%
CANTALOUPE	2.7%
CORN	3.1%
COTTON	5.7%
DOGWOOD	0.5%
GRAIN	7.8%
HEMP	0.5%
HOPS	0.9%
MELONS	1.3%
MIMULUS	2.2%
OTHER	4.7%
PALMS	0.1%
PEPPERS	0.1%
RICE	1.2%
SOYBEAN	29.4%
STEVIA	2.9%
STRAWBERRIES	5.2%
SWEET POTATO	1.7%
TOBACCO	1.4%
TOMATO	6.3%
TREES	0,1%
TURFGRASS	5.9%
VEGETABLES	3.7%
WATERMELON	0.1%
WEEDS	0.3%
WHEAT	3.4%
WILD FLOWERS	0.1%