

PENNSSTATE



College of Agricultural Sciences

L.W. SCHATZ CENTER FOR TREE MOLECULAR GENETICS
ANNUAL REPORT
July, 2016 – June, 2017

Prepared September 12, 2017, by
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L to R: Casey Weathers (PhD student), John Carlson, Nicole Zembower (Lab Manager), Maureen Mailander (undergrad' student), Lianna Johnson (undergrad' student), Nathaniel Cannon (PhD student), Colleen McMichael (visiting scholar), Krystle Swartz (undergrad' student), Wanyan Wang (PhD student). (not shown Di Wu, PhD student).

L.W. SCHATZ CENTER FOR TREE MOLECULAR GENETICS

ANNUAL REPORT, SEPTEMBER 12, 2017

The Louis W. Schatz Center for Tree Molecular Genetics at Penn State is a leader in research and training in modern tree genetics, thanks to the generosity and foresight of Dr. Schatz' gifts and the support and interest of the Schatz family. The endowed support for post-doctoral fellows, visiting scholars, undergraduate research, student field trips, faculty travel, and the colloquium makes it possible for the Schatz Center to play a prominent role nationally and internationally in forest genetics. We are pleased to provide this update on The Schatz Center for the past academic year, as we move forward briskly with our cutting-edge research.

UNIVERSITY PARK CAMPUS ENDOWMENTS

THE SCHATZ UNDERGRADUATE RESEARCH AWARD IN TREE GENETICS:

The Schatz Awards for Undergraduate Research provide students from various undergraduate programs across the university with opportunities to conduct research on molecular genetics with forest trees. In the 2016/17 academic year, three undergraduate students in Horticulture, Animal Science and Arboriculture programs participated in research projects in the Schatz Center. Animal Science student Krystle Swartz received an Undergraduate Research Grant from the College of Agricultural Sciences to further her research. She presented a poster on her project at the College's annual research day in March, as Alex Stanish in Horticulture had in the previous year. Recipients of Schatz Awards for Undergraduate Research this past academic year were:

Alex Stanish

Schatz Center period: August 2014 – August, 2016

Penn State Major: Horticulture

Graduated: May 2016

Projects: Assisted with field trial establishment and evaluation.

Plans: Graduate School; Currently lab technician, University of Colorado



Alex

Krystle Swartz

Schatz Center period: September 2016 – present

Penn State Major: Animal Science

Graduation: December 2017

Projects: Development and testing of DNA markers to assess buffalo nut genetic diversity.

Plans: Graduate School



Krystle

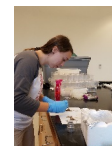
Maureen Mailander

Schatz Center period: March 2016 – present

Penn State Major: Arboriculture

Projects: 1) Assisted with establishment and data collection from green ash genetics trial; 2) Extraction and sequencing of soil DNAs from field trials to determine microbial community composition.

Maureen



THE SCHATZ VISITING SCHOLARS PROGRAM:

The Schatz Center continues to serve a very important role in hosting scholars and scientists from around the world who visit for training and collaborative research through the Schatz Visiting Scholars program. **In the first half of the 2016-17 academic year, The Schatz Center's Visiting Scholars program hosted Dr. Isacco Beritognolo**, Researcher in the Italian National Research Council in the Institute of Biology and Agro-Forestry, at Porano, Italy. Dr. Beritognolo works with Dr. Fiorella Villani in the Italian National Research Council and Dr. Rita Costa (Senior Researcher and Head of Molecular Biology Laboratory of Forest Research at the Instituto Nacional de Investigação Agrária e Veterinária) in Portugal on the genomics of European chestnut. His visit initiated a new research collaboration between The Schatz Center and the Italian National Research Council and the Portugal National Agriculture Research Institute which will advance the development of disease resistance in chestnuts internationally. Dr. Beritognolo studied "RNASeq" research methods with us and we conducted detailed comparisons of his gene expression results for European chestnut with our species.

In the second half of the 2016-17 academic year, the Schatz Visiting Scholar was Dr. Colleen McMichael from the bioenergy company LignoLink, Inc. Dr. McMichael is working with the Schatz Center director to establish a cooperative field trial of hybrid poplar plants expressing genes that enhance extraction of sugar from wood for more efficient production of lignocellulosic bioethanol. Dr. McMichael and the Schatz Center Director are also working together on the development of black walnut tissue cultures for use in development and propagation of walnut trees resistant to the devastating thousand cankers disease which affects all walnut and butternut species and spread from western to eastern states.

As stipulated in the Schatz Visiting Scholars guidelines, and endorsed by Gordon Schatz, the Schatz Visiting Scholars funds can also support Penn State staff to assist Scholars during their stay. In the 2016-17 year, the Visiting Scholars fund supported part-time hourly wages for The Schatz Center's lab manager Nicole Zembower, and partial support for the director's PhD students Di Wu and Nathaniel Cannon. Ms. Zembower provides both administrative and research support to the Center and the Visiting Scholar, making arrangements for travel, housing, university appointments, safety training, supplies, and research services. Ms. Zembower also managed the Schatz Center's summer planting work, including extensive greenhouse and field trials, transplanting seedlings, and a long summer of vegetation management (mowing).

The Schatz Visiting Scholar recruited for the 2017-18 year is Dr. Albert Abbott, co-Director of the Forest Health Research and Education Center at The University of Kentucky. Dr. Abbott previously held the prestigious Robert and Lois Coker Endowed Chair in Molecular Genetics at Clemson University for many years, as well as serving as department chair in Genetics. At The University of Kentucky he has helped to establish a strong group of 16 PhD-level scientists and professors in the Forest Health Research and Education Center with the shared mission of "developing research programs and facilitating discussions to fight forest health threats and ensure the resilience of eastern U.S. forest systems." Because this aligns so closely with the goals of The Schatz Center, Dr. Abbott and I plan to use his part-time Visiting Scholar appointment in The Schatz Center to form a strong collaboration between the two centers. Dr. Abbott's visit will lead to high visibility joint publications, expanded research collaborations, and a stronger working relationship between The Schatz Center and the Forest Health Research and Education Center at the University of Kentucky. In addition, Dr. Abbott will help Dr. Carlson direct an international hardwood genomics research project for which we applied for a grant to the National Science Foundation's Plant Genome Research Program. This major project will include 21 investigators and their research groups in 12 institutions, and will produce new genetic resources and technologies required to accelerate resistance breeding in forest trees.

SCHATZ POST-DOCTORAL FELLOWSHIP IN TREE GENETICS:

The recipient of the Schatz Post-Doctoral Fellowship was Dr. Teodora Orendovici Best, whose funding from The Schatz Center concluded shortly after start of the 2016-17 fiscal year. After departing the Schatz Center, Dr. Best obtained a permanent position with the Pennsylvania State University's Genomics Core Facility. The Schatz Post-Doctoral Fellowship was to be assigned for the 2016-17 fiscal year to PhD student Nathaniel Cannon after graduation, anticipated for Fall 2016. However, Cannon continued as a PhD student past the end of the fiscal year. So the fellowship fund was used to partially support Cannon's graduate stipend through to his graduation in Fall 2017. The fellowship will be advertised nationally for the 2017-2018 year. In the meantime, Nathaniel Cannon will continue to provide bioinformatics support and training for visitors and students, and serves as unix system manager, for the Schatz Center.

SCHATZ CENTER FACULTY TRAVEL FUND:

The Louis and Merry Schatz Faculty Travel Fund supported travel in the 2016-2017 fiscal year by Dr. Carlson to participate in two research meetings that were highly relevant to the Schatz Center goals. Attending such meetings is an important national and international outreach component of the Schatz Center, in which we inform the research community about results from the projects underway in the Schatz Center, and where we learn the latest research results and approaches from other forestry and molecular genetics groups.

For the 2016-17 fiscal year, Dr. Carlson will, as always, entertain requests for travel support from faculty in the ESM department. In the event of no such requests Dr. Carlson will use the funds to attend the international Plant and Animal Genome Conference in San Diego in January, 2018, or other relevant meetings such as The American Chestnut Foundation annual meeting and/or the USDA chestnut research project annual meeting.

THE SCHATZ STUDENT FIELD TRIP FUND:

Our biennial trip to visit Gordon and Karen Schatz and The L.W. Schatz Demonstration Tree Farm at Humboldt State University will occur again in 2018. App. 6 undergraduate students and 3-4 PSU faculty and graduate students will participate in the trip. We are planning this field trip to coincide with the 100th anniversary meeting of the Save The Redwoods League annual meeting in CA in 2018, which will be co-sponsored by the Schatz Tree Genetics Colloquium fund, which is an endowment at the Mont Alto campus of Penn State University.

SCHATZ CENTER RESEARCH UPDATE FOR 2016-2017

The Schatz Center endowments continue to support a wide variety of research projects ranging from preliminary projects that provide data for grant applications for external support to complete PhD thesis dissertations research projects. During the past year, The Schatz Center continued our research to complete the Chinese chestnut reference genome, and we began the process of integrating the genomic tools into The American Chestnut Fou

ndation/s blight resistance breeding program. A third major project in which the Schatz Center continued to participate is the “NEWBio” perennial biomass energy project (<http://www.newbio.psu.edu/>), which ends August, 2017. In this project we collaborate with researchers across the Northeast to identify the best willow and switchgrass cultivars for bioenergy production on poor, marginal non-food growing sites. For the NEWBio project we are also studying the role of soil microbial communities in promoting growth and environmental stress resistance in bioenergy tree crops.

During the 2016-17 academic year, Dr. Carlson and Schatz Center members published papers and presented invited talks and posters at conferences as follows:

Peer-reviewed publications:

1. Harmon M, Lane T, Staton M, Coggeshall MV, Best T, Chen CC, Liang H, Zembower N, Drautz-Moses DI, Hwee YZ, Schuster SC, Schlarbaum SE, Carlson JE, and Gailing O. 2017. Development of novel genic microsatellite markers from transcriptome sequencing in sugar maple (*Acer saccharum* Marsh.). *BMC Research Notes*, 10(1), p.369.
2. Čalić I, Koch J, Carey D, Addo-Quaye C, Carlson JE, Neale DB, 2017. Genome-wide association study identifies a major gene for beech bark disease resistance in American beech (*Fagus grandifolia* Ehrh.). *BMC genomics*, 18(1), p.547.
3. Wu, Y., Zhang, R., Staton, M., Schlarbaum, S., Coggeshall, M., Romero-Severson, J., Carlson, J., Liang, H., Xu, Y., Drautz-Moses, D., Schuster, S., Gailing, O. 2017. Development of genic and genomic microsatellites in *Gleditsia triacanthos* L. (Fabaceae) using Illumina sequencing. *Annals of Forest Research* 60(2): Online First: June 29, 2017.
4. Konar A, Choudury O, Bullis R, Fiedler L, Kruser J, Stephens M, Gailing O, Schlarbaum S, Coggeshall MV, Staton ME, Carlson JE, Emrich S, Romero-Severson J. 2017. High-quality genetic mapping with ddRADseq in the non-model tree *Quercus rubra*. *BMC Genomics*, 18(1):417, 12 pages.
5. Gailing O, Staton ME, Lane T, Schlarbaum SE, Nipper R, Owusu SA, and Carlson JE. 2017. Construction of a Framework Genetic Linkage Map in *Gleditsia triacanthos* L. *Plant Molecular Biology Reporter*, Volume 35(2): 177–187, (doi:10.1007/s11105-016-1012-0).
6. Lane T, Best T, Zembower N, Davitt J, Henry N, Xu Y, Koch J, Liang H, McGraw J, Schuster S, Shim D, Coggeshall M, Carlson JE, Staton ME. 2016. The green ash transcriptome and identification of genes responding to abiotic and biotic stresses. *BMC Genomics* 17:702, 16 pp.

7. Islam-Faridi N, Majid MA, Zhebentyayeva T, Georgi LL, Fan S, Hebard V, Sisco PH, Westbrook J, Carlson JE, Abbott AG, Nelson CD. 2016. FISH Confirmation of a Reciprocal Translocation in Chestnut. In Cytogenetic And Genome Research 2016 Jan 1, Vol. 148, No. 2-3, pp. 144-144, Allschwilerstrasse 10, Ch-4009 Basel, Switzerland: Karger.

Books, Book Chapters

1. Pereira-Lorenzo, S., Costa, R., Anagnostakis, S., Serdar, U., Yamamoto, T., Saito, T., Ramos-Cabrer, A.M., Ling, Q, Barreneche, T, Robin, C., Botta, R., Contessa, C., Conedera, M., Martín, L.M., Martín, A., Laranjo, J., Villani, F., Carlson, J.E. 2016. Chapter 15 - Interspecific hybridization of chestnut. In: Polyploidy and Hybridisation for Crop Improvement. Published May 15, 2016 by CRC Press, 440 Pages.

Conference Proceedings (25)

- Nelson, C., Powell, W., Merkle, S., Carlson, J., Staton, M., Nairn, C., Holliday, J., Westbrook, J., Georgi, L. and Hebard, F., 2016, Shovel-ready trees: Forest Health Initiative a model for rapid development and deployment of disease resistant trees. In *Phytopathology* Vol. 106, No. 12, page. 170. American Phytopathological Society, 3340 Pilot Knob Road, St Paul, Mn 55121 USA.

Abstracts for Presentations at Conferences

- Wanyan Wang, John E. Carlson, Lawrence B. Smart, and Craig H. Carlson, 2017, Transcriptome Analysis of Resistance of Shrub Willow to *Empoasca fabae*, Plant and Animal Genome XXV Conference, San Diego, CA, Jan. 14-18, 2017, poster abstract P0250.
- Di Wu, Thomas Lane, Teodora Orendovici-Best, Nicole Zembower, Margaret Staton, Jennifer Koch, John McGraw, Stephan C. Schuster, Kim C. Steiner and John E. Carlson, 2017, Genome Mapping, Tagging & Characterization: Forest Trees Intra - Species Variation in Green Ash Response to an Invasive Insect, Plant and Animal Genome XXV Conference, San Diego, CA, Jan. 14-18, 2017, poster abstract P0593.
- Nathaniel Cannon, Margaret E. Staton, Charles Addo-Quaye, Nurul Islam-Faridi, Lynn P. Tomsho, Stephen Ficklin, Chris Saski, Richard Burhans, Daniela Drautz, Nicole Zembower, Stephan C. Schuster, Albert G. Abbott, C. Dana Nelson, Frederick V. Hebard, John E. Carlson, 2017, The Physical And Genetic Structure Of The Chinese Chestnut (*Castanea Mollissima*) Genome, Plant and Animal Genome XXV Conference, San Diego, CA, Jan. 14-18, 2017, poster abstract.
- Irina Calic, Jennifer Koch, David Carey Charles Addo-Quaye, John E. Carlson, and David B. Neale, 2017, Genome Mapping, Tagging & Characterization: Forest Trees Genome -Wide Association Study Identifies a Major Gene for Beech Bark Disease Resistance in American Beech Tree (*Fagus grandifolia*Ehrh.), Plant and Animal Genome XXV Conference, San Diego, CA, Jan. 14-18, 2017, poster abstract P0592.
- C. Dana Nelson, William E. Powell, Scott A. Merkle, John E. Carlson, Margaret E. Staton, Campbell J. Nairn, Jason Holliday, Jared Westbrook, Laura L. Georgi, Frederick V. Hebard, Tatyana Zhebentyayeva, Steven N. Jeffers, Paul H. Sisco, Joseph B. James, Albert G. Abbott. 2016. Shovel-ready trees: Forest Health Initiative a model for rapid development and deployment of disease resistant trees. Annual meeting of the American Phytopathology Society, August 1, 2016, Tampa, Florida, USA.