

Cooperative Tree Improvement Program

61 Years of Living Our Land Grant Mission

NC STATE
UNIVERSITY

College of
Natural Resources

Department of Forestry & Environmental Resources

Impact of the Cooperative

- We develop the genetic material that is planted on almost one million acres per year in the southern US. Almost 75% of the trees planted in the region come from the breeding programs of the members of the NC State University Cooperative Tree Improvement Program.
- The present value of continued genetic gains from tree improvement is estimated to be **\$1.9 billion** to landowners and citizens in the southern US. In North Carolina alone, the value of continued genetic improvement is **\$220 million**.
- In-kind support from Cooperative members for our research programs via field trials and access to germplasm is estimated to be **\$190 million*** over the past 61 years.
- **16,239 control crosses** among loblolly pine selections have been established in replicated field trials throughout the region.
- **7511 selections** established in Genetic Diversity Archives to ensure the conservation of the precious loblolly pine genetic resource for future generations.
- **2300 acres of advanced-generation seed orchards** are intensively managed to produce genetically improved seeds that will assure a reliable, affordable, and ecologically sustainable supply of wood for decades to come.



Academic Achievements

Direct contributions to NC State from our Cooperative members have enabled these education, research, and outreach accomplishments:

- **228 graduate students** have received advanced degrees with Cooperative faculty. Many are employed in high-level academic and business careers around the world.
- Undergraduates are provided with opportunities to apply classroom training to research in the lab and field.
- **68 post-docs** and visiting scientists representing 34 countries over 5 continents have studied and conducted research with Cooperative staff.
- **356 scientific papers** published in refereed journals, signify the intellectual contribution of Cooperative students, scientists, and staff.
- Cooperative and University funds have been leveraged to attract over **\$7.6 million** in competitive grants over the last 10 years.



*The NCSU Cooperative Tree Improvement Program was founded in 1956. These financial estimates are in 2017 US dollars.



Recent Selected Publications by NC State University Cooperative Tree Improvement Program Scientists, Students & Associates

2017

- Farjat, A.E., A.K. Chamblee, F. Isik, R.W. Whetten, and S.E. McKeand. 2017. Variation among loblolly pine seed sources across diverse environments in the southeastern United States. *For. Sci.* 63(1): 39-48.
- Farjat, A.E., B.J. Reich, J. Guinness, R.W. Whetten, S.E. McKeand, and F. Isik 2017. Optimal seed deployment under climate change using spatial models: application to loblolly pine in the southeastern US. *Journal of the American Statistical Association* (In press) <http://dx.doi.org/10.1080/01621459.2017.1292179>
- Holliday, J.A, S.N. Aitken, J.E.K. Cooke, B. Fady, S.C. Gonzalez-Martinez, M. Heuertz, J.P. Jaramillo-Correa, C. Lexer, M. Staton, R.W. Whetten, C. Plomion. 2017. Advances in ecological genomics in forest trees and applications to genetic resources conservation and breeding. *Molecular Ecology* 26(3):706-717.
- Isik, F., C. Maltecca, and J. Holland. 2017. Genetic data analysis for plant and animal breeding. Springer International. ISBN 978-3-319-55177-7 (in press).
- Kohlway, W.H., R.W. Whetten, D.M. Benson & J. Frampton. 2017. Response of Turkish and Trojan fir to *Phytophthora cinnamomi* and *P. cryptogea*, *Scandinavian Journal of Forest Research*, DOI: 10.1080/02827581.2017.1280076
- Pais, A.L., R.W. Whetten, Q-Y. Xiang. 2017. Ecological genomics of local adaptation in *Cornus florida* L. by genotyping by sequencing. *Ecology and Evolution* 7(1):441-465.
- Spitzer, J.E., F. Isik, R.W. Whetten, A.E. Farjat, and S.E. McKeand. 2017. Correspondence of loblolly pine response for fusiform rust disease from local and wide-ranging tests in the southern United States. *For. Sci.* (In press).

2016

- Bartholomé J, Bink MC, van Heerwaarden J, Chancerel E, Boury C, Lesur I, Isik F, Bouffier L, Plomion C. 2016. Linkage and association mapping for two major traits used in the maritime pine breeding program: height growth and stem straightness. *PLoS One*. Nov 2;11(11):e0165323.
- Čepl J., D. Holá, J. Stejskal, J. Korecký, M. Kočová, Z. Lhotáková, I. Tomášková, M. Palovská, O. Rothová, R.W. Whetten, J. Kaňák, J. Albrechtová, and M. Lstibůrek. 2016. Genetic variability and heritability of chlorophyll *a* fluorescence parameters in Scots pine (*Pinus sylvestris* L.). *Tree Physiology* (in press).
- Gräns, D., F. Isik, R.C. Purnell, and S. McKeand. 2016. Genetic variation in response to herbicide and fertilization treatments for growth and form traits in loblolly pine. *For. Sci.* (In press).
- Isik, F., J. Bartholomé, A. Farjat, E. Chancerel, A. Raffin, L. Sanchez, C. Plomion, L. Bouffier. 2016. Genomic selection in maritime pine. *Plant Science* 242:108-119 doi:10.1016/j.plantsci.2015.08.006.
- Kurt, Y., J. Frampton, F. Isik, C. Landgren, and G. Chastagner. 2016. Variation in needle and cone characteristics and seed germination ability of *Abies bornuelleriana* and *Abies equi-trojani* populations from Turkey. *Turkish Journal of Agriculture and Forestry* 40:169-176.
- Plomion, C., J. Bartholomé, I. Lesur, C. Boury, I. Rodríguez-Quilón, H. Lagrault, F. Ehrenmann et al. 2016. High-density SNP assay development for genetic analysis in maritime pine (*Pinus pinaster*). *Molecular Ecology Resources* 16 (2): 574-587.
- Xiong, J., S.E. McKeand, F.T. Isik, Jill Wegrzyn, D.B. Neale, Z-B Zeng, L. da Costa e Silva, and R.W. Whetten. 2016. Quantitative trait loci influencing stem defects in an outbred pedigree of loblolly pine. *BMC Genetics* 17:138. DOI 10.1186/s12863-016-0446-6