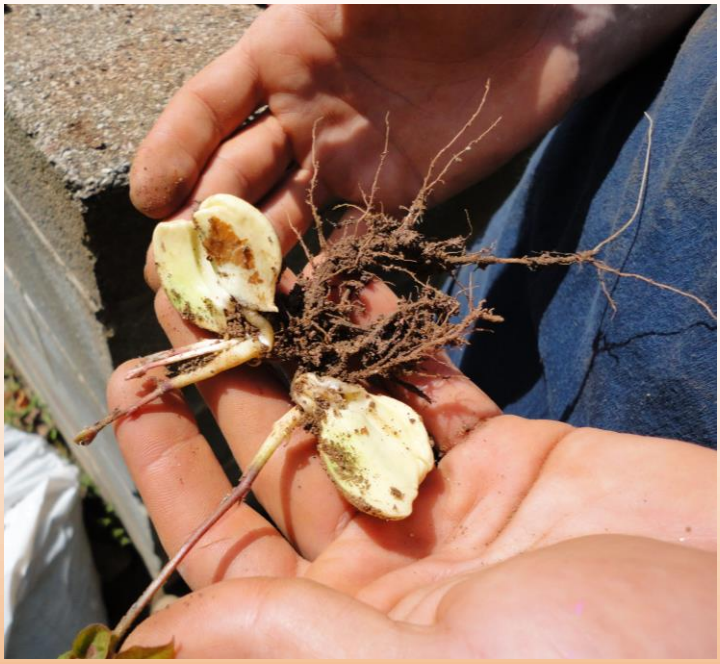
FY12 Annual TAES Workplan Report

UT Tree Improvement Program



East Tennessee Research and Education Center

UT Tree Improvement Program Workplans

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Annual Report for FY12

The following workplans will be continued in FY13. All at located at the Plant Sciences Farm.

TAES Workplan #129 Yellow-poplar (*Liriodendron tulipifera* L.) breeding orchard

FY12 Plans Mortality has been high in this breeding orchard, but certain clones are still valuable for molecular research and breeding. Clone 108 has been particularly important in molecular research on functional and evolutionary genomics conducted by cooperators at Penn State University and Clemson University. This year, crossing will be initiated with Clone 108 as the female parent in order to produce a full-sibling population that will become the molecular mapping population for the species.

Grafting of some clones will take place in 2011 on stock that was containerized in 2010 and in two raised nursery beds proximal to the large shadehouse. Additional seedlings will be containerized in 2011 for grafting in the future.

FY12 Accomplishments Samaras from controlled pollinations between Clone 108 and 23 (108 X 23) made in May, 2011 and open-pollinated samaras from Clone 108 were harvested in October, 2011. The resulting seed was stratified, germinated, and seedlings were placed into containers. The seedlings were transported to Clemson University, where they were sampled to determine pedigree through DNA analysis. The seedlings were returned to Knoxville, transplanted into larger pots, and placed in the large shadehouse at the Plant Sciences Farm (see Workplan #136) for further growth until outplanting.

Clone 108 and some other clones were successfully grafted and will be planted in 2013,

More bare root seedlings were containerized for grafting. Dead trees were cut and removed from the orchard, with the assistance of Tennessee Division of Forestry personnel.

Publications:

Liang, Haiying, Yi Xu, Yi; Abdelali Barakat, and **Scott E. Schlarbaum**. 2011. Investigation of genome structure of a cinnamyl alcohol dehydrogenase (CAD) locus in a basal angiosperm hardwood species, Liriodendron tulipifera L., reveals low synteny" Journal of Systematics and Evolution 49:396-405.

Liang, Haiying, Saravanaraj Ayyampalayam, Norman Wickett, Abdelali Barakat, Yi Xu, Lena Landherr, Paula E. Ralph, Yuannian Jiao, Tao Xu, **Scott E. Schlarbaum**, Hong Ma, James H. Leebens-Mack, Claude W. dePamphilis. 2011. Generation of a large-scale genomic resource for functional and comparative genomics in *Liriodendron tulipifera* L. Tree Genetics and Genome 7:941-954.

Jiao. Y., Norman Wickett, Saravanaraj Ayyampalayam, Andre Chanderbali, Lena Landherr, Paula E. Ralph, Lynn P Tomsho, Haiying Liang, Pamela S. Soltis, Douglas E. Soltis, Sandra E. Clifton, **Scott E. Schlarbaum**, Stephan C. Shuster, Hong Ma, Jim Leebens-Mack, and Claude W. dePamphilis. 2011. Ancestral polyploidy in seed plants and angiosperms. Nature 473: 97-100

Liang, Haiying, Abdelali Barakat, **Scott E. Schlarbaum**, John E. Carlson. 2011. Organization of the chromosome region containing a *FLORICAULA/LEAFY* gene in *Liriodendron*. Tree Genetics and Genome 7(2): 373-384.

TAES Workplan #130 Loblolly pine (*Pinus taeda* L.) breeding orchard

FY12 Plans This orchard is no longer used for breeding or seed collection, so no activities were planned.

FY12 Accomplishments No actions were taken in this orchard as planned.

TAES Workplan #131 White pine [*Pinus* L. subgenus *Strobus* (D. Don) Lemmon] breeding orchard

FY12 Plans No research activities are scheduled for this orchard. TIP personnel will containerize eastern white pine seedlings from the State Nursery for grafting. The seedlings will be used as rootstock for grafting in the futue.

FY12 Accomplishments TIP personnel containerized white pine seedlings for grafting. Some of the dead trees were cut in this orchard and hauled away by TIP and Tennessee Division of Forestry personnel.

TAES Workplan #132 Butternut (*Juglans cinerea* L.) stool bed

FY12 Plans Routine maintenance of grafts and root stock

FY12 Accomplishments Additional trees were cut back in order to induce new, lower branches, ideal for grafting. The clone bank was retagged. Grafts of black walnut were obtained from the University of Missouri and added to provide source material for Thousand Cankers Disease resistance testing. The stool bed was generally cleaned up to provide easy access to experimental materials.

TAES Workplan #136 Experimental seedling production in raised nursery beds and associated facilities

FY12 Plans

Raised Nursery Beds - The raised nursery beds contain a variety of materials that are not suitable for growing at the State Nursery or in containers. Currently, two beds (1&2) are empty and need to be replenished with a 1:1:1 mixture of loamy topsoil, sand and finely ground hardwood bark mulch. These beds will be planted with a molecular mapping population of northern red oak currently undergoing environmental stress tests at Clemson University. Part of the remaining two beds (3&4) contain yellow-poplar seedlings for bench grafting yellow-poplar clones from the breeding orchard. In part of bed 4, bladdernut seeds from Fontenelle Forest Nature Association were planted in 2009. These seeds are expected to germinate in 2011.

Large Shadehouse - The large shadehouse contains containerized seedlings of many species that will be grafted in 2011 and freshly containerized seedlings that will be used as root stock for grafting in 2012. The yard also contains containerized experimental materials belonging to the Tennessee Division of Forestry's (TDF) Tree Improvement Program. The gravel on the shadehouse floor is uneven and the weed barrier is torn.

Yard – The large yard next to the shadehouse is being used for UT and TDF containerized progeny tests and root stock for grafting in 2012. The yard is in poor condition with holes in the gravel, torn weed barrier, and a fence with only the poles remaining.

Butternut Clone Bank – No additions were made.

FY12 Accomplishments

Raised Nursery Beds – The soil was replaced in each bed and a drip irrigation system was professionally installed and tied to the timer that controls watering in the shadehouse and yard.

A large study of polyembryony (multiple seedlings from one acorn) in northern red oak open-pollinated progenies from the Watauga Seed Orchard (northeast TN) was planted. This research was based on studies in the 1990s, which detected polyembryony in some of the families from the Watauga Orchard, particularly families from Overton Co., TN. A total of 6132 acorns were planted. Upon germination, each acorn was examined for evidence of polyembryony. The seedlings from polyembryonic acorns were transplanted and placed in the shadehouse for eventual chromosome counting, as there can be chromosome number altercations in such seedlings. The data is presently being analyzed by Professor Saxton.

The polyembryonic study was terminated after the last polyembryonic seedlings were transplanted, and the beds were then planted with black walnut seedlings that were produced by Forrest Keeling Nursery (Elsberry, MO) under their RPM^{TM} protocols. These seedlings will be grafted in late winter 2013 and 2014 with timber and nut selections of black walnut and selected pure butternut and used in resistance testing for Thousand Cankers Disease. This activity will be covered in a new TAES Workplan.

Large Shadehouse – The large shadehouse was used for: 1) sheltering grafts of baldcypress selections from the Highland Rim REC (Workplan #98) and yellow-poplar grafts from the Plant Sciences Farm orchard (Workplan #129), which is being re-grafted due to age; 2) root stock of various species for grafting in 2013; 3) putative yellow-poplar molecular mapping population (waiting on DNA confirmation of parentage); 4) growing various pine genetic tests, lead by the Tennessee Division of Forestry, growing polyembryongenic northern red oak seedlings (see above); 5)housing northern red oak and black walnut molecular mapping population trees that were stress tested by Clemson University; and 6) growing seedlings from the General Jackson tree in Fayetteville to replace fallen historic trees.

Yard – Both the large shadehouse and the yard were re-graveled and had new weed barrier cloth installed. A professionally designed watering system was installed by RainScapes to eliminate the need for hand watering.

The yard is currently filled with seedlings of various species for grafting in 2013 and 2014.

Butternut Clone Bank – Some additional trees were hedged for grafting. The clone bank was re-monumented.

TAES Workplan #137 American chestnut [Castanea dentata (Marsh.) Borkh.] breeding orchard

FY12 Plans TIP personnel removed all unwanted trees and shrubs and retag the surviving chestnuts. They will also spray Round-Up on smaller grasses and weeds which have invaded the area and poison stumps of non-chestnut species.

FY12 Accomplishments The above maintenance was carried out and additional pure American chestnuts will be added to the orchard as available.

Workplan Termination

TAES Workplan #139 Physiological and develomental responses of containerized American chestnut and butternut to different shade regimes

FY12 Plans A light regime study on American chestnut hybrids was initiated in 2008, which contained eight small shadehouses (two light regimes) were erected, and four open areas set aside for controls. Containerized, pedigreed American chestnut hybrids were placed in the experimental plots. A sample of these seedlings was evaluated monthly using an IRGA instrument, which measures photosynthetic rate. The seedlings were also evaluated for height, diameter, and phyllotaxy. The selected seedlings were destructively sampled at the end of the growing season. Of the remaining seedlings, two from each genetic family were selected (four seedlings total) per light regime and returned to the shadehouse prior to budbreak in March, 2009 for a second year of evaluation.
Four open-pollinated families of butternuts from two different seed sources were planted incontainer in March, 2009 to conduct an identical shade regime experiment during the summer of 2009.

FY12 Accomplishments This study was terminated due to the lack of butternut materials to continue testing and limited resources to maintain this type of experiment. The shadehouse were removed and the area released back to the East TN REC for further use. A manuscript on the American chestnut research is in preparation (below).

Clark, Stacy L., Scott E. Schlarbaum, Ami M. Sharp and Callie J. Schweitzer. 2012. Effects of shade on growth and physiology of American chestnut [*Castanea dentata* (Marsh.) Borkh.]. (In prepartation).