# *Genetic Improvement of Landscape Trees for Disease and Pest Tolerance, Non-Invasiveness, and Ornamental Traits*

**PRINCIPAL INVESTIGATOR:**
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**PROJECT OBJECTIVES:**
The U.S. National Arboretum urban tree breeding program's primary objective is the development of disease, pest, and stress-tolerant, non-invasive cultivars of common and underutilized landscape trees. A number of genera are being investigated for potential improvement, with primary focus on *Catalpa*, *Chionanthus*, *Nyssa*, *Tsuga*, and *Ulmus*.

**ACCOMPLISHMENTS:**
Established a long-term *Catalpa* breeding program to develop powdery mildew resistant, cold-hardy *Catalpa* and ×*Chitalpa* cultivars. Conducted crosses to elucidate self-compatibility, and determine interspecific and intergeneric compatibilities and interploid crosses. In *Nyssa* breeding, a series of controlled pollinations were made between select F1 parents to generate large F2 populations segregating for improved plant habit, fall color, and leaf spot tolerance. Molecular identification and characterization of the leaf spot organism affecting *Nyssa*. Molecular markers were developed to analyze genetic diversity among cultivated and non-cultivated *Chionanthus* taxa, as well as to clarify pollination and reproductive biology in the genus and related genera. Finished a 2-year study screening field-grown hybrid hemlocks, *Tsuga*, for resistance to hemlock woolly adelgid.

**TECHNOLOGY TRANSFER/IMPACT:**
In order to maintain and enhance genetic diversity in urban forests, new tree species adapted to urban conditions and superior cultivars of established tree species must be evaluated and bred for tolerance to existing abiotic and biotic stresses as well as introduced pathogens and pests. Since 2006, the urban tree program has reengaged the nursery industry and redirected efforts to broaden its scope, including making over 20 presentations to industry groups and conferences on the goals and objectives of the USNA program. Molecular markers developed from *Chionanthus retusus* are being used to analyze existing diversity in cultivated *Chionanthus*, to determine provenance effects on adaptability and invasive properties. A vigorous, upright, male selection with good fall color has been identified for propagation and further evaluation. Cross-amplification of *Chionanthus*-derived markers will be tested in *Fraxinus* to assist efforts in combating emerald ash borer. Molecular identification of the leaf spot organism in *Nyssa*, which limits use of the genus in southeastern landscapes, has facilitated breeding leaf-spot tolerant cultivars from existing germplasm. Superior *Tsuga* hybrid selections have been identified and are being propagated for further evaluation. Several selections of *Nyssa* and *Catalpa* have been sent to cooperators for preliminary evaluation and propagation. Several newly imported European selections of important urban trees have also been shared with cooperators.

**ADDITIONAL FUNDING/EXTERNAL SUPPORT:**

- J. Frank Schmidt Family Charitable Foundation, $5,200 for "Genetic improvement of *Catalpa* and ×*Chitalpa* for urban landscapes" (2006-2008).
- Western Maryland Resource Conservation & Development Council, $75,000 for "Breeding urban-tolerant trees for utility line plantings" (2006-2009).
- USDA-Forest Service, Northern Research Station, $65,000 for "Developing advanced *Tsuga* hybrids: incompatibilities, hybrid fertility, and screening container-grown plants for HWA resistance" (2007-2009).
- Friends of the National Arboretum, $17,000 for "Germplasm collection of Chinese catalpas and fringe trees" (2009-2010).

**COLLABORATORS:**

Renée S. Arias, USDA-ARS Genomics and Bioinformatics Research Unit, Stoneville, Mississippi (*Chionanthus* molecular-marker development); Drew Minnis, USDA-ARS Systematic Mycology and Microbiology Laboratory, Beltsville, Maryland (*Nyssa* leaf spot identification and characterization); Michael E. Montgomery, USDA-Forest Service, Center for Forest Health Research, Hamden, Connecticut (hemlock woolly adelgid resistance screening); Tom Ranney, NCSU-MHCREC, Fletcher, North Carolina (*Catalpa* and ×*Chitalpa* breeding) Tim Rinehart, USDA-ARS-MSA Southern Horticultural Laboratory, Poplarville, Mississippi (*Chionanthus* and molecular markers); and Amy Rossman, USDA-ARS Systematic Mycology and Microbiology Laboratory, Beltsville, Maryland (*Nyssa* leaf spot identification and characterization).