

Tissue Culture, Vegetative Propagation, and Genetic Modification Technologies of Hardwood Tree Species

Paula M. Pijut, Ph.D., Principal Investigator

Cooperators:

L.S. Bauer, Ph.D., USFS
A. Brunner, Ph.D., Virginia Tech
L. Farlee, M.S., Purdue, FNR
D.J. Gray, Ph.D., Univ. of FL
B. Hawkins, Indiana DNR
M. Jenks, Ph.D., Purdue, HLA
J. Karstens, Indiana DNR
J.J. King, Eli Lilly & Co.
J. Libs, Ph.D., Phyllom LLC
G.P. Mayora, M.S., ArborAmerica
J. McKenna, M.S., HTIRC, USFS
R. Meilan, Ph.D., Purdue, FNR
C.H. Michler, Ph.D., HTIRC, USFS
M.E. Ostry, Ph.D., USFS
M. Schott, B.S., ArborAmerica
J. Seifert, Indiana DNR
K.E. Woeste, Ph.D., HTIRC, USFS
J.R. Xu, Ph.D., Purdue, Botany & Plant Path.

Graduate Students and Post-docs:

Current:

X. Liu, Ph.D. Candidate
N. Du, Ph.D. Candidate, van Eck Scholar

Previous:

A.C. Espinosa, M.S., 2004
G. Smagh, M.S., 2005
C. Roschke, M.S.-non-thesis, 2007
G. Vengadesan, Post-doc, 2007

Laboratory Technician:

Currently vacant

Goals:

1. Tissue Culture: Develop in vitro selection, somatic embryogenesis, micropropagation, organogenesis, rooting, and clonal propagation technologies for fine hardwood tree species.
2. Vegetative Propagation: Develop rooted cutting propagation technologies for fine hardwood tree species.
3. Genetic Modification: Develop effective gene transfer and efficient regeneration systems for fine hardwood tree species that can be

Statement of Problem:

Clonal reproduction of commercially important hardwood tree species is necessary, in a tree improvement program, in order to provide improved planting stock for use in progeny testing and for production forestry. In vitro and vegetative propagation methods will be required to produce clones of elite genotypes or genetically improved genotypes. Many ecologically and economically important hardwood tree species have a low genetic or physiological capacity for adventitious root formation, and are considered recalcitrant to routine, commercial-scale propagation. Genetic modification of hardwood tree species to produce trees with herbicide tolerance, disease and pest resistance, improved wood quality, and reproductive manipulations for commercial plantations is also a major aspect of a tree improvement program. Development of an effective gene transfer and efficient in vitro regeneration system for each hardwood species, that can be easily adapted for many genotypes, will be required to produce genetically improved hardwood trees.

Current Activities:

Research is underway to develop new protocols and improve existing ones for in vitro selection, somatic embryogenesis, micropropagation, adventitious regeneration, rooting, genetic transformation, and clonal propagation of several hardwood tree species. Species of interest include black walnut (*Juglans nigra*), northern red oak (*Quercus rubra*), black cherry (*Prunus serotina*), butternut (*Juglans cinerea*), white oak (*Quercus alba*), green ash (*Fraxinus pennsylvanica*), and white ash (*Fraxinus americana*).

Current Projects: Adventitious shoot regeneration, clonal propagation, rooting, and genetic modification of *Fraxinus* sp. for resistance to the emerald ash borer; Adventitious shoot regeneration, clonal propagation, rooting, and genetic modification of *Prunus serotina* for reproductive sterility; Adventitious shoot regeneration, clonal propagation, rooting, and genetic modification of *Juglans nigra*; Clonal propagation, rooting, somatic embryogenesis, and development of genetic transformation of *Quercus rubra*; Adventitious shoot regeneration, clonal propagation, rooting, and development of genetic transformation of *Juglans cinerea* for resistance to the butternut canker pathogen. This research will allow germ plasm improvement, which in turn will lead to improved hardwood tree production and deployment.

easily adapted for many genotypes.

Recent Publications:

Morse, A.M., Tschaplinski, T.J., Dervinis, C., Pijut, P.M., Schmelz, E.A., Day, W., and Davis, J.M. 2007. Salicylate and catechol levels are maintained in *nahG* transgenic poplar. *Phytochemistry* 68: 2043-2052.

Pijut, P.M., Woeste, K.E., Vengadesan, G., and Michler, C.H. 2007. Technological advances in temperate hardwood tree improvement including breeding and molecular marker applications. *In Vitro Cellular and Developmental Biology-Plant* 43: 283-303.

Espinosa, A.C., Pijut, P.M., and Michler, C.H. 2006. Adventitious shoot regeneration and rooting of *Prunus serotina* in vitro cultures. *HortScience* 41(1): 193-201.

Michler, C.H., Pijut, P.M., Jacobs, D.F., Meilan, R., Woeste, K.E., and Ostry, M.E. 2005. Improving disease resistance of butternut (*Juglans cinerea*), a threatened fine hardwood: a case for single-tree selection through genetic improvement and deployment. *Tree Physiology* 26: 121-128.

Pijut, P.M. 2004. Vegetative propagation of butternut (*Juglans cinerea*) – field results. IN: Michler, C.H., Pijut, P.M., Van Sambeek, J., Coggeshall, M., Seifert, J., Woeste, K., Overton, R. (eds.). Black walnut in a new century. *Proc. of the 6th Walnut Council research symposium*. Gen. Tech. Rep. NC-243. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 188 p.