A Novel APAP1 Glycoconjugate Indicates a New Role for Pectin in Plant Cell Walls

Li Tan[1,3]* (tan@ccrc.uga.edu), Melani Atamodjo,[1,3] Stefan Eberhard,[1,3] Sivakumar Pattathil,[1,3] Xiang Zhu,[1,3] Michael G. Hahn,[1,3] Alan Darvill,[1,3] Marcia Kieliszewski,[2] **Debra Mohnen**,[1,3] and **Paul Gilna (BESC PI)**[3]

[1]The University of Georgia, Athens, Georgia; [2]Ohio University, Athens, Ohio ; [3]BioEnergy Science Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee

http://bioenergycenter.org

Project Goals: The BioEnergy Science Center (BESC) is focused on the fundamental understanding and elimination of biomass recalcitrance. BESC's approach to improve accessibility to the sugars within biomass involves 1) designing plant cell walls for rapid deconstruction and 2) developing multitalented microbes for converting plant biomass into biofuels in a single step (consolidated bioprocessing). BESC biomass formation and modification research involves working directly with two potential bioenergy crops (switchgrass and *Populus*) to develop varieties that are easier to break down into fermentable sugars. We are using both testing and generation of large numbers of natural and modified plant samples as well as developing genomic tools for detailed studies into poorly understood cell wall biosynthesis pathways.

Plant cell walls are a renewable resource that consists of roughly 10% protein and 90% of an interacting carbohydrate network of cellulose, hemicellulose, and pectin. We report the detailed structural characterization of an Arabidopsis glycoconjugate, purified from Arabidopsis cell culture medium and presented in plant cell walls. N-terminal sequencing, chemical, enzymatic and glycome profiling analyses revealed that the glycoconjugate contains covalently-attached protein and glycan domains previously attributed to independent wall components. Multiple *apap1* T-DNA insertion mutants exhibit modified cell wall and growth properties. This glycoconjugate structure, named APAP1, has broad implications for the synthesis, structure and function of wall components, especially for roles of pectins in plant walls. APAP1 structure supports *gaut* mutant studies which showed that insertion mutation of 13 of the 15 Arabidopsis *GAUT* genes caused significant changes of major wall monosaccharides such as xylose, glucose, mannose, fucose, arabinose, galactose, and rhamnose. Recent results showing that pectins are synthesized in both primary and secondary walls indicate a role for pectins in both herbaceous and woody plant biomass species. The combined results suggest that pectins not only serve as a negatively charged matrix in the wall, but also function as a cross-linker that holds different polysaccharides, especially hemicelluloses, in the wall. The ramification of the results for reducing plant biomass recalcitrance will also be discussed.

Funding from National Science Foundation NSF-MCB 0646109, DOE center grant DOE DE-FG02-09ER20097 and BioEnergy Science Center grant DE-PS02-06ER64304.

[The BioEnergy Science Center is a U.S. Department of Energy Bioenergy Research Center supported by the Office of Biological and Environmental Research in the DOE Office of Science.]