Ecosystem services of rotation-age hybrid poplars used for phytoremediation

*Ronald S. Zalesny Jr.[1], USDA Forest Service Northern Research Station
William L. Headlee[2], Arkansas Forest Resources Center
Edmund O. Bauer[1], USDA Forest Service Northern Research Station
Bruce A. Birr[1], USDA Forest Service Northern Research Station
Amanda M. Foust[1], USDA Forest Service Northern Research Station
Adam H. Wiese[1], USDA Forest Service Northern Research Station
JY Zhu[3], USDA Forest Service Forest Products Laboratory

Poplars and their hybrids are among the most commonly-used trees for phytoremediation and associated phytotechnologies. However, the majority of data about ecosystem services these purpose-grown trees provide are from the first few years of plantation development, thereby resulting in a lack of data from crown closure through the end of their biological and/or economic rotation. To address the need for this information, we harvested rotation-age hybrid poplars of two clones (*Populus deltoides* Bartr. ex Marsh × *P. nigra* L. 'DN34'; *P. nigra* × *P. suaveolens* Fischer subsp. *maximowiczii* A. Henry 'NM6') used for phytoremediation of nitrates at a landfill in Rhinelander, Wisconsin, USA (45.6 °N, 89.4 °W) and are assessing the ecosystem services of biomass productivity and aboveground carbon storage potential. In addition, we are evaluating tree height and diameter growth, as well as physiological traits such as specific gravity, fiber composition (i.e., percentages of cellulose, hemicellulose, and lignin), water use efficiency (via $\delta^{13}C$ stable isotope ratios), biofuels recalcitrance (via testing of ethanol production through enzymatic saccharification and fermentation by dilute acid and SPORL pretreatments), and concentrations of carbon, nitrogen, and inorganic pollutants (i.e., salts and heavy metals) in leaves and wood. Soil chemistries are also being tested (as with the trees), along with physical edaphic properties such as texture, pH, and percent organic matter. Analytical analyses and data summaries will be completed for the conference, where we will compare both clones at this site for the characteristics listed, along with contrasting genotypic performance of these landfill-grown trees with those from non-contamined bioenergy systems. Additionally, we will discuss the implications of using hybrid poplars for phytoremediation at similar landfills and other liability sites, especially in the context of integrating the allometric and physiological traits with potential long-term ecosystem services the trees provide.

Keywords: carbon storage, biomass productivity, phytotechnologies, *Populus*

[1] USDA Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, Rhinelander, WI 54501, USA rzalesny@fs.fed.us , +1 715-362-1132

[2] UA Division of Agriculture, Arkansas Forest Resources Center, Monticello, AR 71656, USA headlee@uamont.edu , +1 870-460-1642

[3] USDA Forest Service, Forest Products Laboratory, Madison, WI 53706, USA jzhu@fs.fed.us , +1 608-231-9520

Biography for Ron Zalesny

Ron Zalesny is Team Leader and Research Plant Geneticist with the U.S. Forest Service, Northern Research Station. He earned his Ph.D. in forest genetics from Iowa State University, and currently develops short rotation woody crops for fiber, energy, and phytotechnologies. Relevant professional affiliations include serving as: 1) coordinator of IUFRO Working Party 2.08.04 (Poplar and Willow Physiology/Genetics), 2) delegate of the IPC-FAO Environmental Applications of Poplar and Willow Working Party, and 3) steering committee member of the SRWCOWG. He also serves on the editorial boards of the International Journal of Phytoremediation and BioEnergy Research.