Carbon sequestration potential of poplar energy crops in the midwest, USA

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Energy use and climate change mitigation are closely linked via ecological, social, and economic factors, including carbon management. Energy supply is a key 21st century National security issue for the United States; identifying and developing woody feedstocks for transportation fuels and combined heat and power operations are a crucial component of the future National energy strategy of this country. When strategically placed in the landscape,purpose-grown trees such as short rotation woody crops (e.g., poplars) exhibit high productivity levels and ecosystem services such as soil and water conservation, nutrient recycling, and carbon sequestration. Given the demand for carbon estimation methods and tools, we are using a combination of expert knowledge, literature review and database enhancements, and field testing to assess the carbon sequestration potential of poplar feedstock production systems in the Midwest, USA.

We are acquiring knowledge from existing published manuscripts pertaining to poplar productivity potential, genotype × environment interactions, and other pertinent silvicultural aspects that are important for deploying short rotation woody crops (see Coyle et al. – poplar database), along with standard forest carbon modeling methods, to develop baseline carbon estimates for standing poplar biomass. For the field testing, 4 trees of 10 clones (C916000, C916400, C918001, Eugenei, NM2, NM6, NC13563, NC13624, NC13649, NC14018) belonging to 4 genomic groups (*P. deltoides*; *P. deltoides* × *P. nigra*; *P. nigra* × *P. suavelons*; (*P. trichocarpa* × *P. deltoides*) × *P. deltoides*) were selected during September 2009 based on productivity from previous trials and the need for adequate genetic variation to characterize the variability in carbon sequestration potential. All clones were present in 10-year-old plantations established at Escanaba, Michigan, USA and Ames, Iowa, USA. Trees of most clones will also be tested from a 22-year-old clonal orchard in Rhinelander, WI, USA, with potential future testing at Arlington, Wisconsin, USA and Waseca, Minnesota, USA. The Escanaba trees were harvested in October 2009, while all others will be collected during summer 2010. At all sites, diameter at breast height will be recorded before harvesting. Then, trees will be felled, total height measured, and cross-sections (i.e., cookies) will be collected at breast height and at one- and two-thirds the height of the tree (i.e., approximately mid-height and just below the live crown). The cookies will be sanded and digitally scanned for growth ring analysis. In addition, specific gravity will be determined and wood from each ring will be sampled and analyzed for total carbon content. Using volume estimates based on data collected above and stand productivity estimates from process-based modeling (e.g., 3PG), yearly carbon sequestration potential will be estimated within a rotation, as well as rotation-age stand-level carbon sequestration rates. A carbon sequestration yield table will be developed for appropriate clones and sites, with the long-term objective of developing a regional table. Preliminary results from Escanaba, Ames, and Rhinelander will be presented in Orvieto.

Keywords: ecosystem services, *Populus*, sustainability

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