

Integrating Phytotechnologies with Energy Crop Production for Biofuels, Bioenergy, and Bioproducts

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Forest biomass constitutes ~30% of the total biomass that can be produced in the United States, making adequate woody feedstock availability necessary for environmental and economic sustainability. Woody feedstock production is vital for achieving our National goal of 16 billion gallons of cellulosic ethanol by 2022. Improved woody biomass production and management systems are needed to: maintain healthy forests and ecosystems, create high paying manufacturing jobs, and meet local/regional energy demands. In recent years, such systems have included incorporating sustainable recycling of landfill leachate and other wastewaters as irrigation and fertilization for short rotation woody crops such as *Populus* species and hybrids (i.e., poplars). Poplars are renewable energy feedstocks for biofuels, bioenergy, and bioproducts that can be strategically placed in the landscape to conserve soil and water, recycle nutrients, and sequester carbon. While establishing poplar genotypes that are adapted to local environmental conditions substantially increases establishment success and productivity, it is difficult to predict field trial success in new landscapes and with varying wastewater irrigation regimes. Building on over a decade of phytotechnologies research at our Institute, I will present information about merging our knowledge of poplar biology with large-scale spatial analysis to predefine zones of potential plant adaptation that are ecologically sustainable and economically feasible across the landscape. I will describe the development of a GIS-based spatial analysis protocol to identify candidate core areas for potential establishment, based on key climatic and soil properties as well as land ownership and use constraints. Given the potential for incorporating intensive forestry with waste management, I will present initial details about our evaluation of land-use, soil health, and water quality changes within these areas to synthesize the environmental and social constraints on woody energy crop development within the Midwest.

Keywords: landfill leachate, poplar, *Populus*, short rotation woody crops, sustainability, waste management, wastewater irrigation, woody feedstocks

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