United States Department of Agriculture

Final Report

Title:	Assessing the Suitability and Yield of Poplar Genotypes for Bioenergy Production

Sponsoring Agency	NIFA	**Project Status**	COMPLETE
Funding Source	Mcintire Stennis	**Reporting Frequency**	Final
Accession No.	233765	**Project No.**	IND011549MS
Project Start Date	10/01/2013	**Project End Date**	09/30/2018
Reporting Period Start Date	10/01/2013	**Reporting Period End Date**	09/30/2018
Submitted By	Julie Estrada	**Date Submitted to NIFA**	02/12/2019

Project Director

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Recipient Organization

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Performing Department

Forestry & Natural Resources

Non-Technical Summary

In addition to serving as a lignocellulosic feedstock for biofuel production via fermentation, poplar biomass can be combusted directly to yield energy, through a process known as combined heat and power, or converted to "drop-in" hydrocarbons via thermochemical processes. Regardless of how the biomass is utilized, accurate growth estimates are needed to make realistic projections. To complete an economic and financial feasibility analysis of the entire Wood-to-Wheels pathway, all of the costs and benefits associated with producing a biofuel from woody biomass need to be incorporated into an economic model. For this model to be of use to potential growers in Indiana, relevant growth data are needed to assemble a yield component. Thus, the proposed research will address one of the fundamental knowledge gaps regarding poplar production systems. This information is vital to the development of a sustainable bioenergy industry in Indiana and will lead to the creation of "green jobs", while also ameliorating the effects of increasing carbon dioxide emissions

Accomplishments

Major goals of the project

The overarching goal of this research is to assess the silvicultural and economic viability of dedicated poplar (species within the genus Populus) energy plantations in Indiana. Specific objectives are to: 1) Establish poplar plantations on sites across Indiana (various soil types and climatic zones), 2) Assess yield and pest susceptibility of various poplar genotypes, 3) Evaluate impacts of various management regimes, and 4) Incorporate growth data into an economic model. The output from this project is relevant growth data that are needed to assemble a yield component for an economic model that estimates all of the costs and benefits associated with producing a biofuel from poplar bioenergy plantations.

What was accomplished under these goals?

One of the key objectives of this work was to determine which genotypes were best adapted for growth in Indiana and the growth potential of these genotypes. We determined that tree bole volume for the fastest-growing 10% of the genotypes was 55% larger than tree volume average for all genotypes tested over all treatments, and 70% larger than the average of two the commercial standard genotypes that were included in the study.

We also evaluated the economic and environmental impacts of using poplar as a feedstock for a hypothetical biomass power plant located in southern Indiana. We found that the biopower plant is economically infeasible in Indiana, as the estimated system break-even price (21.5 cents/kWh) is six times higher than the current wholesale electricity price in Indiana. Based on life-cycle analysis, we found that this pathway has negative net emissions (-1.15 kg CO_2 eq/kWh), due to carbon sequestration. As a coal-intensive power-generating state, Indiana would require a carbon tax above \$93.5/ton CO_2-equivalent to make the biopower plant competitive with other types of power plants (coal and natural gas).

What opportunities for training and professional development has the project provided?

An M.S. student received the necessary training to qualify for admission to a Ph.D. program.

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How have the results been disseminated to communities of interest?

The M.S. thesis is available online and a peer-reviewed publication will be published soon.

What do you plan to do during the next reporting period to accomplish the goals?

{Nothing to report}

Participants

Actual FTE's for this Reporting Period

Role	Non-Students or faculty	Students with Staffing Roles			Computed Total by Role
		Undergraduate	Graduate	Post-Doctorate	
Scientist	1.8	0	0	0	1.8
Professional	2.3	0	0.2	0	2.5
Technical	0.1	0.1	0	0	0.2
Administrative	0	0	0	0	0
Other	2	0	0	0	2
Computed Total	6.2	0.1	0.2	0	6.5

Student Count by Classification of Instructional Programs (CIP) Code

Undergraduate	Graduate	Post-Doctorate	CIP Code
2	1		03.05 Forestry.

Target Audience

Researchers and potential growers of bioenergy crops.

Products

Type	Status	Year Published	NIFA Support Acknowledged
Theses/Dissertations	Accepted	2018	NO

Citation

Jeong, D. "Stochastic Techno-Economic Analysis of Electricity Produced from Poplar Plantations in Indiana" M.S. Thesis, Purdue University, August 2018.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Under Review	2018	NO

Citation

Jeong, D., Tyner, W.E., Meilan, R., Brown, T.R., and Otto C. Doering, O.C. 2018. Stochastic techno-economic analysis of electricity produced from poplar plantations in Indiana. Renewable Energy.

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Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Submitted	2018	NO

Citation

Nelson, N.D., Meilan, R., Berguson, W.E., McMahon, B.G., Cai, M., and Buchman, D. 2018. Growth performance of hybrid poplar clones on two agricultural sites with and without early irrigation and fertilization. Submitted to: Silvae Genetica.

Other Products

{Nothing to report}

Changes/Problems

{Nothing to report}