Recent Progress in the Development of Short-Rotation Woody Crops As Feedstock for Alternative Fuels

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The Regional Feedstock Partnership

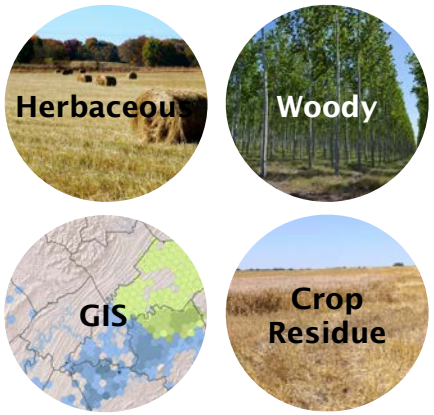
Sun Grant Initiative/DOE-Bioenergy Technologies Office

Abstract

As the demand for bioenergy and advanced biofuels increases, feedstock will need to be generated from a portfolio of sources, such as agricultural crops, managed forests and residue streams from other industries. Providing optimal performance for a variety of conversion platforms, these dedicated biomass production systems will also need to address other important considerations, including: 1) enhanced ecological and environmental benefits, 2) improved economic performance, 3) flexibility in meeting landowner objectives, and 4) minimization of supply chain uncertainty and risk. Short rotation woody crops (SRWC) represent one such system, and have a key role to play as a broad range of energy crops becomes available. SRWC offers several attractive characteristics that include low ash content, high energy density and year-round availability for harvest. There remains a need for continued research leading to further improvements in genetics, management practices, and performance properties to enhance the genetic diversity, range of adaptability and overall economics of these systems. In the Regional Feedstock Partnership (RFP), an ongoing collaboration between the U.S. Department of Energy's Bioenergy Technologies Office and the Sun Grant Initiative, production potential for currently available genetic material has been assessed for willow and hybrid poplar through coordinated field trials. The ultimate goal of the program is to utilize genetic diversity for the production of faster growing, disease resistant genotypes to increase biomass yield. Additionally, the woody crops team is improving management systems, developing recommendations for region-specific variety selections and improving economic and environmental models. This poster highlights progress resulting from the Regional Feedstock Partnership including implications of this feedstock production technology for the emerging biofuels industry.

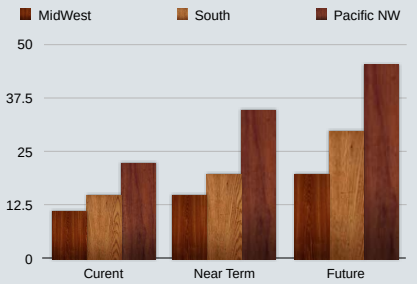
The Regional Feedstock Partnership

The RFP has been charged with three biomass resource tasks of assessment, development and education and outreach. Teams of the nation's leading scientists were assembled to complete the tasks and to further assess yield potential, initiate field trials of the most promising options and estimate and enhance the nation's bioenergy production potential. Task teams include: 1) corn residue, 2) cereal residue, 3) herbaceous energy crops and 4) woody energy crops. In addition, resource assessment, education and outreach teams were also formed. Although complex, the Partnership has established an extensive network of field trials and generated volumes of unique data.



Key Results and Observations

Future Direction



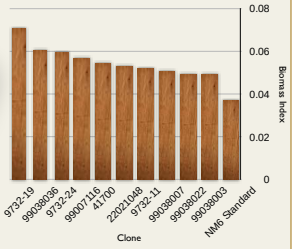
SRWC are a valuable complement to herbaceous energy crops and will play a key role in sustainable biomass production for year-round feedstock supply. The above figure shows projected gains in poplar biomass yield for different regions of the U.S. For the South and Mid-South, genetic improvements promise near term increases of 50%. As molecular genetics become more prominent in the future, yields of 12 dry tons/acre are achievable. Similar increases are projected for willow with considerable genetic diversity.

- Willow - 6 trials with 16-20 clones in 2009; 6 trials with 20 clones in 2010
- Poplar - 5 new sites with 80 clones/test in 2010; additional sites in 2012

Hybrid Poplar

Clone Testing and Breeding Program:
Because of its extensive range and high genetic variability, poplar offers the potential for dramatic increases in yield in the near term. New trials planted 80 clones at each of four locations around the country including: MN, MO, MS and GA. The coordinated approach allows for the evaluation of adaptability of poplar clones to different regions of the country, environmental effects and biomass yield. General insight has been obtained, including:

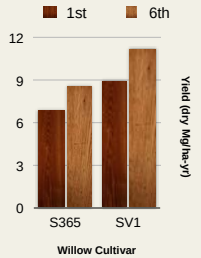
- Select clones from breeding programs in the Midwest have demonstrated the potential to greatly improve biomass yield.
- The average height of the consolidated clone tests after 1 year of growth were: 12.4' in MO, 5.9' in MS, and 4.0' in MN.
- Survival exceeded 80 percent for 3 sites; however, survival in GA was only 30 percent due to suspected *Septoria* disease.

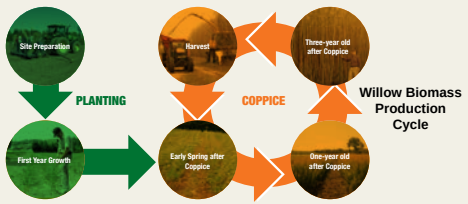


Comparison of new clones from breeding program to NM6 commercial standard in 2010 field test after 4 years in MN.

Willow

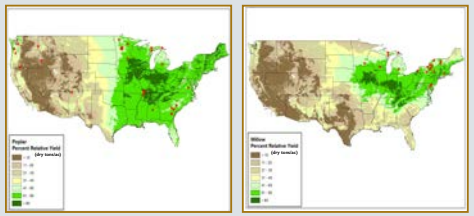
Long-Term Productivity Studies:
Willow biomass crops have been advanced in the northeast and midwest as a coppice harvest system with a three-year rotation. Trials include between 6 and 30 cultivars with 3-4 replications. The first set incorporates trials established with plant material developed in the 1980s and 1990s. Data is now available through six rotations. Commercially available cultivars in this trial produced more biomass in the sixth rotation compared to the first rotation.





Genetic Improvement: Data show that new cultivars of willow have 15 to 25% higher yields. Economic assessments show that the internal rate of return increases from 5 - 8.5%, reducing payback by one rotation.

Yield Projections



The poplar and willow teams have assembled a database of yield data for woody biomass energy plantations to facilitate an effort to map estimates of yield potential. This database serves as the foundation for development of model estimates of woody biomass yields nationally by the PRISM Climate Group at OSU. Insights include:

- Continued breeding holds great potential to increase growth rate and site-to-site stability and is critical to the development of a commercially viable biomass crop
- Spacing and coppice effects on yield are still unknown
- Continued measurement of existing clone trials and large-block yield tests are needed
- Clone selection is critical
- Potential opportunities for significant yield improvement through genetics at all locations

For more information, see B. Berguson's presentation (Session 2 - Part 1) and visit the Bioenergy KDF https://www.bioenergykdf.net.

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SRWC Production

A. Planted poplar cuttings in Columbus, MS
B. East TN site after six weeks of growth
C. Two year old stand in East TN
D. Single-stem harvest of 10-year old poplar in Boardman, OR (GreenWood Resources)
E. Coppice harvest of 3-year old willow in New York

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