

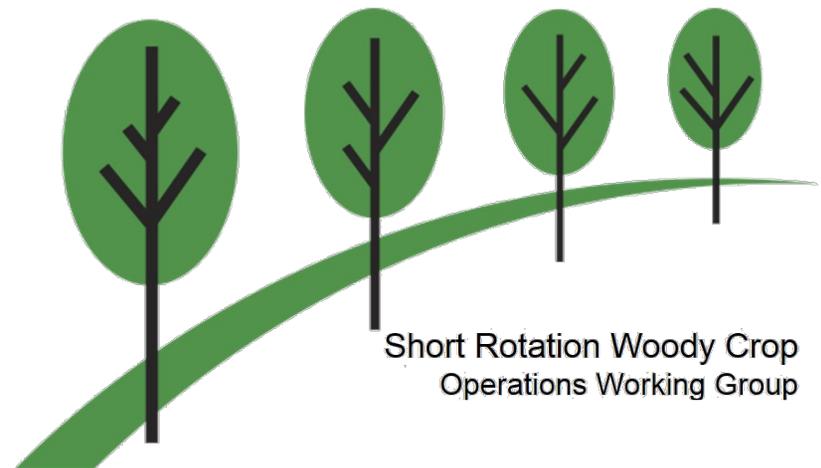
Differences Among and Within Poplar Genotypes for Cellulose, Hemicellulose, and Lignin

Bill Headlee¹, Ron Zalesny Jr.², Edmund Bauer², Bruce Birr²

¹UAM School of Forestry & Natural Resources
Arkansas Forest Resources Center
Monticello, AR



²Institute for Applied Ecosystem Studies
USFS Northern Research Station
Rhineland, WI

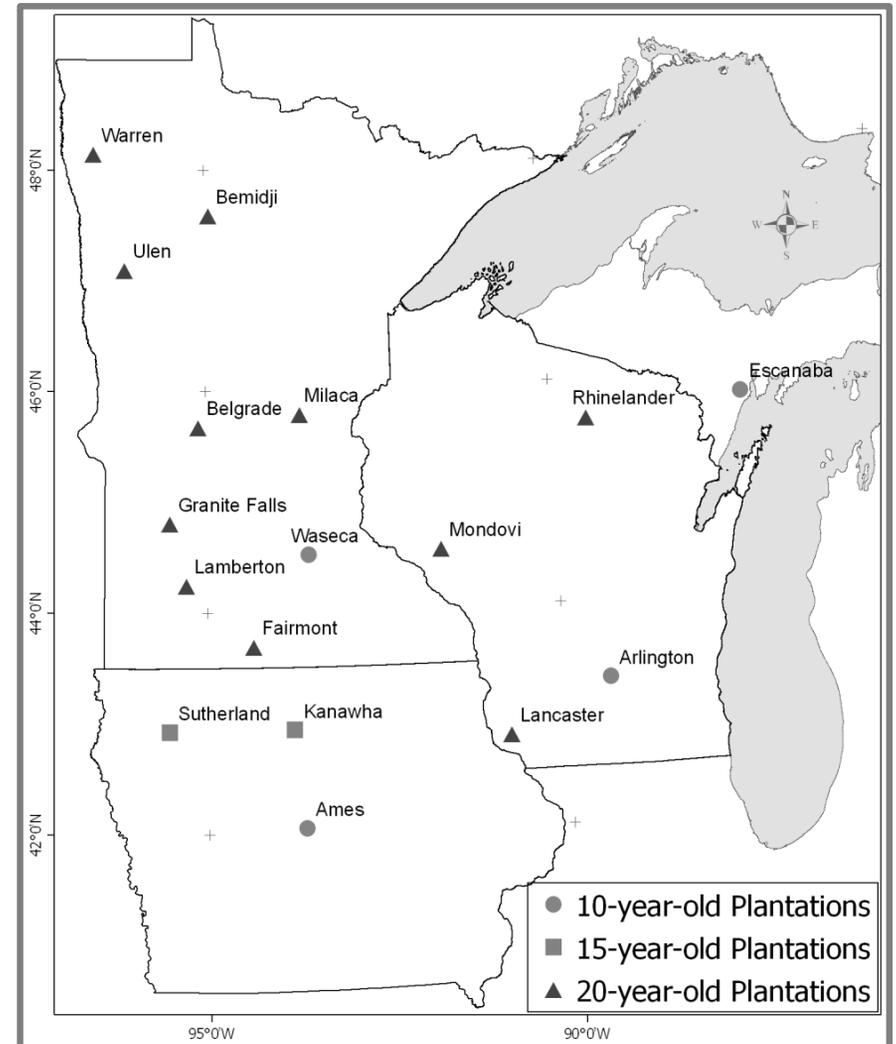


Overview of Research

- Evaluate growth and wood properties of various genotypes of poplars from regional planting networks in Upper Midwest
 - Biomass production and allocation
 - Carbon concentrations and total sequestration
 - Water use efficiency
 - Specific gravity
 - **Fiber composition (cellulose, hemicellulose, lignin)**
- Study differences in species and management practices for nanocellulose applications in Arkansas
 - Specific gravity
 - Fiber composition

Fiber Composition – Methods

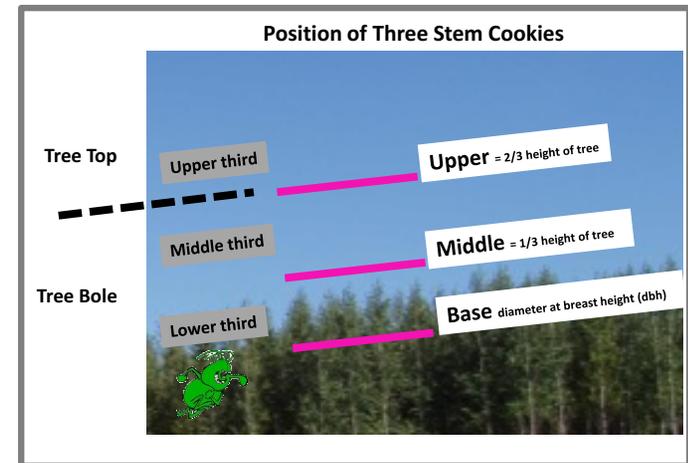
- 17 study sites in 4 states (IA, MI, MN, WI)
- 3 plantation networks (10, 15, and 20 year-old sites)
- 12 genotypes from 5 types of crosses
 - AG: *Crandon*
 - DD: *C916000, C916400, C918001*
 - DN: *DN34, DN182*
 - NM: *NM2, NM6*
 - TDD: *NC13564, NC13649, NC13624, NC14018*
- Harvested ~ 4 trees genotype⁻¹ site⁻¹ (204 total trees)



Fiber Composition – Methods

- Trees measured for DBH, height, and green weight
- Disks collected at 3 bole positions

- **Bole (DBH: 1.37m)**
- Middle (1/3 height)
- **Top (2/3 height)**



- Disks measured for moisture content, specific gravity, C concentration and isotopes, **fiber composition**

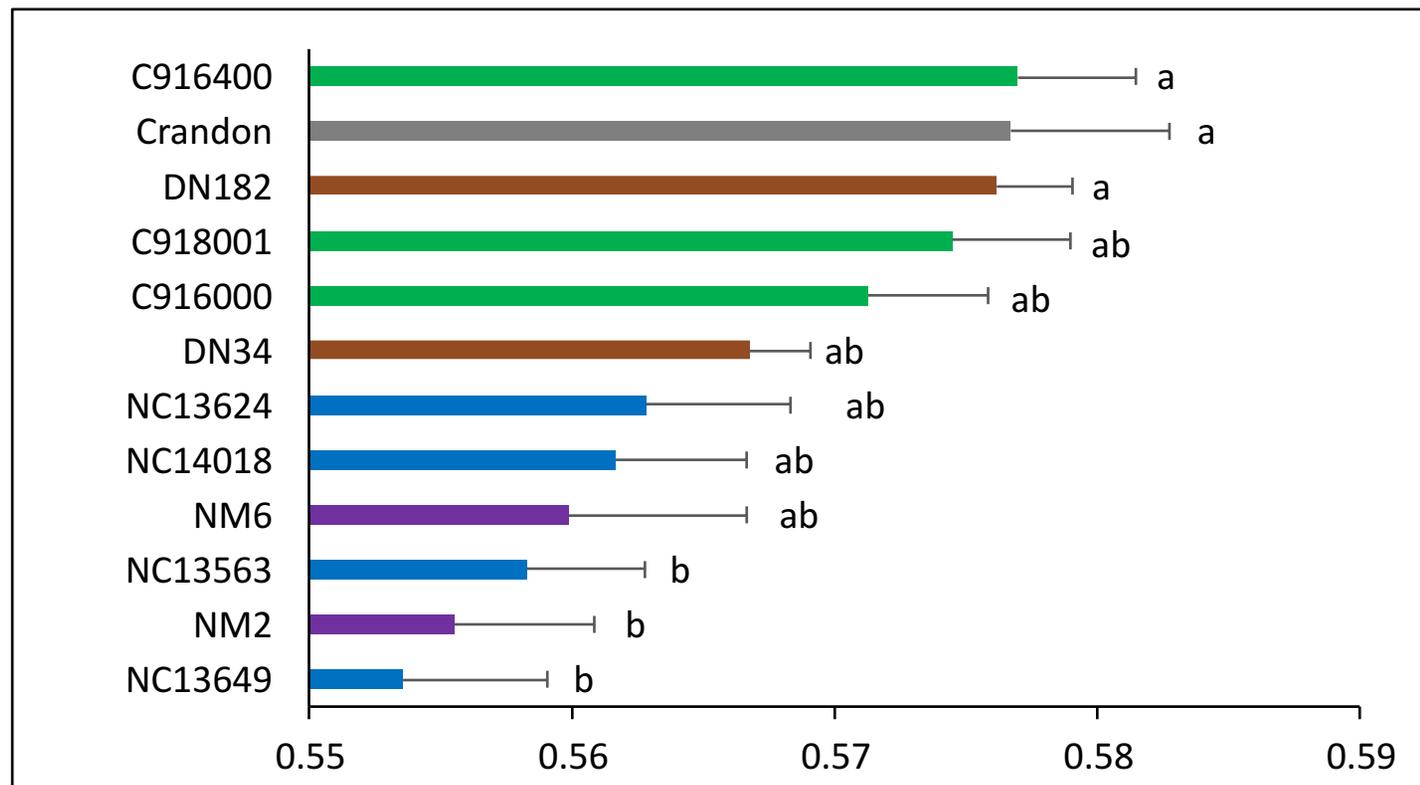
Fiber Composition – Methods

- Fiber composition measured with ANKOM fiber analyzer using sequential wash method
 - Neutral detergent fiber (NDF): removes extractives (~11% of initial mass)
 - Acid detergent fiber (ADF): removes hemicellulose
 - Acid detergent lignin (ADL): removes cellulose
 - Lignin & ash remain (ash ~1% initial mass)



Fiber Composition – Results

- Significant differences in genotypes for cellulose

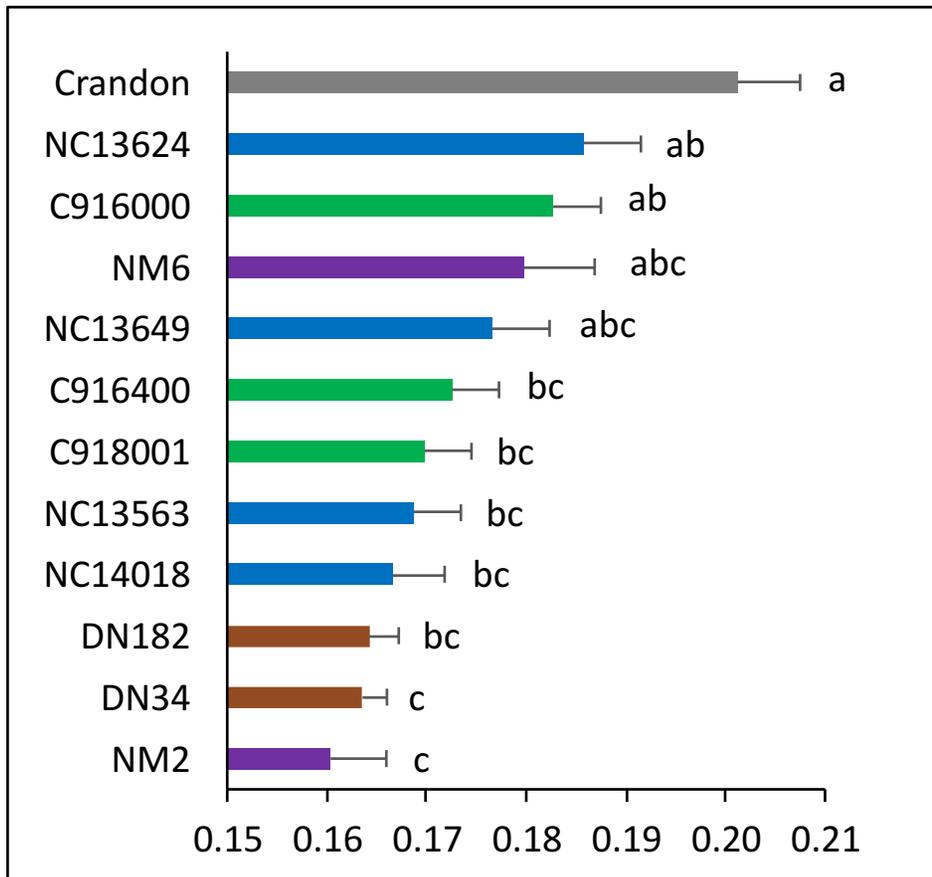


- Boles higher on average (0.572) than tops (0.560)

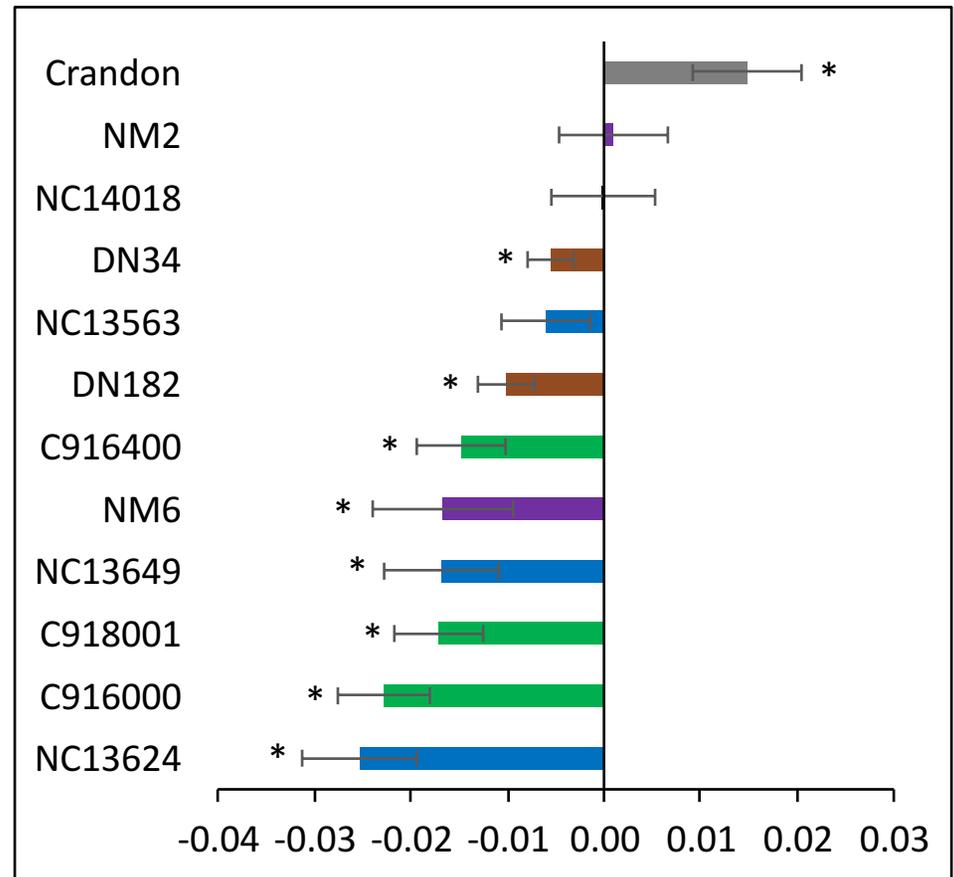
Fiber Composition – Results

- Significant genotype \times position for hemicellulose

Bole



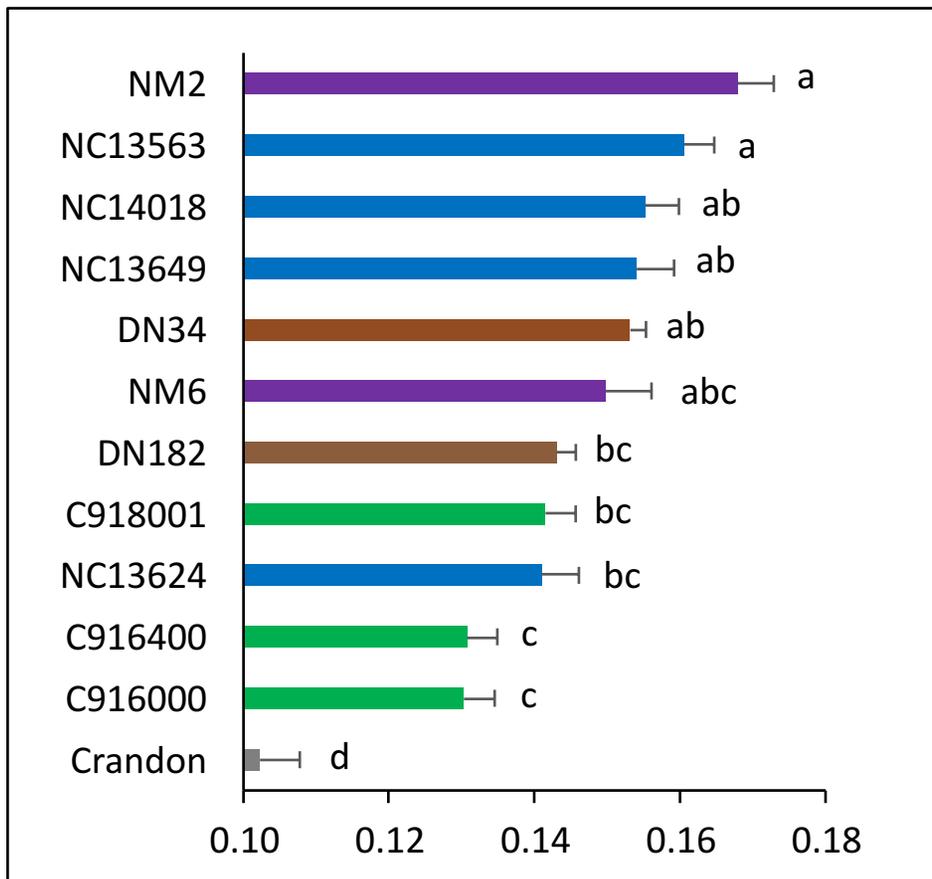
Change from Bole to Top



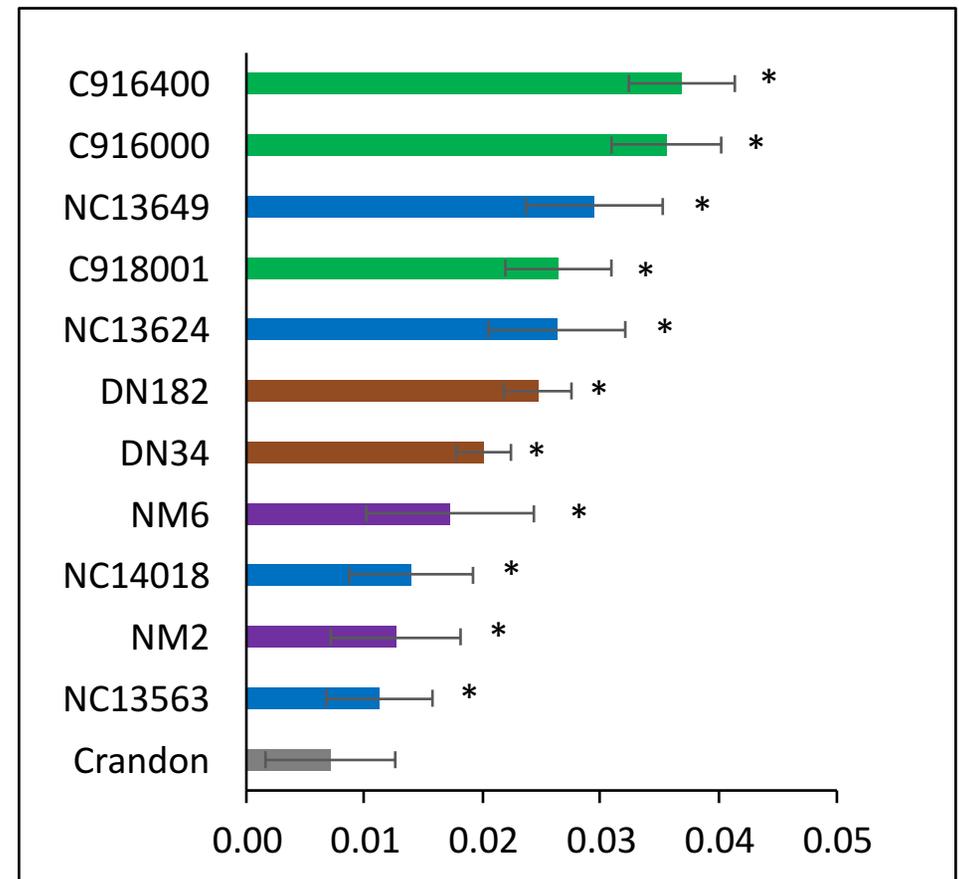
Fiber Composition – Results

- Significant genotype \times position effect for lignin

Bole



Change from Bole to Top





Fiber Composition – Summary

Bole

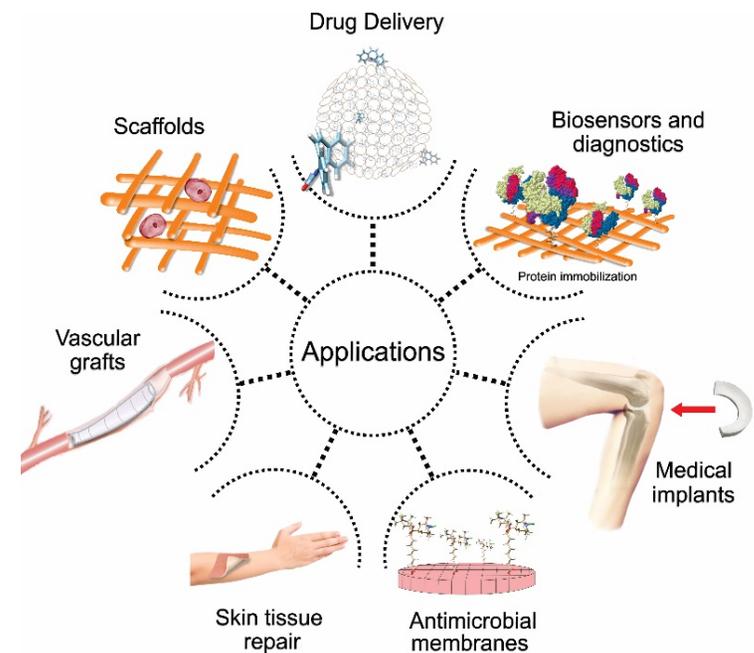
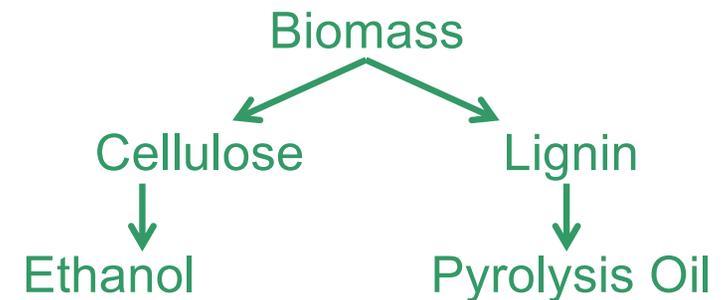
Genotypes	Cellulose	Hemicellulose	Lignin
AG	High	High	Very Low
DD	High	Medium – High	Low
DN	Medium – High	Low	Medium
NM	Low	Low – Medium	Medium – High
TDD	Low – Medium	Medium – High	Medium – High

Top

Genotypes	Cellulose	Hemicellulose	Lignin
AG	< Bole	> Bole	= Bole
DD	< Bole	< Bole	> Bole
DN	< Bole	< Bole	> Bole
NM	< Bole	≤ Bole	> Bole
TDD	< Bole	≤ Bole	> Bole

Potential Implications

- Composition may impact conversion efficiency for various biofuel platforms
- May also impact nanocellulose applications – NSF project looking at feedstocks in Arkansas
 - Poplars – genotype and planting density effects
 - Loblolly pine – tip moth and planting density effects



Thank you for your time!

- Funding and other support provided by:
 - USFS Northern Research Station Institute for Applied Ecosystem Studies
 - Wisconsin FOCUS ON ENERGY Program
 - Arkansas Forest Resources Center
 - NSF EPSCoR Center for Applied Surface Engineering
- Questions?

