

Bioenergy

Agricultural feedstocks for cellulosic ethanol and biodiesel

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There are a number of different kinds of crops besides corn that can be used as feedstocks for producing biofuels. Some feedstocks produce readily-available starches or sugars that can be converted to produce ethanol while others produce oil that can be used in biodiesel production (most organic materials can also be burned to produce heat or electricity in the same way that coal is used). Organic materials can also be used to produce cellulosic ethanol which is the same as corn ethanol but requires more processing.

Crop residues

Crop residues, like corn stover (Fig. 1), are the materials left on the field after a crop is harvested and can be used



Figure 1. Corn stover baled following corn harvest (F.J. Hay, University of Nebraska-Lincoln)

to make cellulosic ethanol. The amount of residue, however, that can be harvested without causing adverse impacts to soil erosion or fertility must be considered. America's first commercial scale cellulosic ethanol plant, in Emmitsburg, IA, uses corn stover to produce 20 million gallons of ethanol per year.

Perennial Grasses

Perennial grasses are dedicated cellulosic crops that can be used in the same ways as crop residues. Typical species include native warm-season grasses (Fig. 2) such as switchgrass, big bluestem, little bluestem, indiangrass, eastern gamagrass, plus miscanthus.



Figure 2. Switchgrass field in Tennessee.

Benefits of perennial grasses include no annual establishment costs, low chemical input requirements, high biomass production, increased soil organic matter, reduced erosion and improved wildlife habitat. Giant Miscanthus is probably the highest yielding grass for Tennessee's climate but has the highest establishment costs and is not a native plant which could lead to invasive issues.

Sorghum

Sorghum is a summer annual crop with a number of different varieties that can be used for bioenergy production. Sweet sorghum produces readily available sugars that can be fermented to ethanol using the same process as corn ethanol. Forage sorghum (Fig. 3)



Figure 3. Forage sorghum production at Tennessee State University Agricultural Research and Education Center

produces high levels of biomass which can be used to produce cellulosic ethanol.

Grain sorghum produces an animal feed that is of lower quality than corn but can be used to produce ethanol in existing corn ethanol facilities.

Woody crops

Fast-growing woody crops like shrub willow, hybrid poplar (Fig. 4), loblolly pine, and eucalyptus can be regularly harvested and used to produce cellulosic ethanol.



Figure 4. Hybrid poplar production at Tennessee State University Agricultural Research and Education Center

Some of these trees can be harvested year-round (like willow), while others are harvested every 5-7 years (like poplar). They provide benefits to the ecosystem and have consistent energy contents. Forest residues from

logging and management practices can also be used to produce cellulosic ethanol and alone produce over 300 million dry tons of production per year (SFAB, 2011).

Oilseed crops

Oilseed crops like soybean, sunflower, and canola (Fig. 5) can be used to produce biodiesel.



Figure 5. Winter canola production at Tennessee State University Agricultural Research and Education Center

The extracted oils can be converted to biodiesel and the meal that is remaining can be used as an animal feed. Sunflower and canola generally contain about 40% oil in the seed while soybean has around 20% oil. Canola can be grown in the winter in Tennessee to help reduce erosion while at the same time producing an additional revenue source for farmers.

References and Resources

SFAB, 2011. Sustainable Feedstocks for Advanced Biofuels
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http://www.extension.org/ag_energy

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http://www.tnstate.edu/extension/publication_index.aspx

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