



## The Potential for Pennsylvania Crops as Biofuels

Higher energy costs over the past few years have created opportunities for the use of crops and crop residues for energy. These opportunities could have significant implications in the future for many Pennsylvania residents in terms of new energy sources, opportunities for rural economic development, increased energy independence, and stronger markets for agricultural commodities. Our research program at Penn State is targeted at understanding the potential of some new energy crops for Pennsylvania production and collaborating with our colleagues to develop a better understanding of the potential for sustainable production of energy from existing crops. Key crops that we work with include corn, soybeans, barley, and canola.

### Corn

Corn is a major crop in the state and can be used for ethanol production or for direct combustion in grain stoves or furnaces. Both of these areas have been experiencing rapid growth. U.S. corn yields have been increasing by about 2 percent per year, causing surpluses and low prices. Corn is often undervalued based on its energy content. For example, a bushel of corn at \$2.50/bushel could be converted into 2.7 gallons of ethanol valued at \$2.50/gallon and 17 pounds of distillers' grains. An average Pennsylvania corn yield of 122 bushels per acre could produce 329 gallons of ethanol per acre. In addition, the corn stover could be collected and used for cellulosic ethanol, or electricity, as some Penn State researchers recently demonstrated (<http://live.psu.edu/story/18683>). As a home-heating fuel, corn is worth about \$7.00/bushel when propane is \$2.00/gallon. We have worked with Dennis Buffington, professor of agricultural and biological engineering, to promote the corn as a home-heating fuel (<http://energy.cas.psu.edu/burncorn/shellcorn.html>). We have also worked with representatives from the ethanol industry to provide some insight into the potential for ethanol production and use in Pennsylvania. Our research in corn production has focused on the development of production strategies that use new hybrids and less fertilizer, insecticides, and tillage to reduce the cost and energy consumption of corn production in the state.

### Barley

Barley is an alternative energy crop that is used as a substitute for corn. It requires less fertilizer and also grows over the winter, protecting the soil. In addition, many farmers can grow a crop of soybeans after they harvest the barley. Barley markets have been low as many feed companies prefer corn, so barley is undervalued compared to corn. This has not stimulated barley production or research, but this crop has great potential to be a low-cost alternative ethanol or home-heating fuel crop. One special type of barley—called hulless barley—is especially well suited for ethanol production. We obtained a grant from the Pennsylvania Department of Agriculture to study and develop some of the hulless varieties for use in Pennsylvania and have made significant progress in this regard. We are working with Virginia Tech, the University of Maryland, and the University of Delaware to develop strategies to grow and use these barley varieties in the Mid-Atlantic region. A hulless barley crop can yield about 74 bushels per acre of grain or about 173 gallons of ethanol per acre. Maryland has recently enacted an ethanol production credit of \$0.20/gallon for ethanol produced from small grains, so this may provide more markets for Pennsylvania barley and hulless barley production in the future (see [http://www.eere.energy.gov/afdc/progs/view\\_all.cgi?afdc/MD/0](http://www.eere.energy.gov/afdc/progs/view_all.cgi?afdc/MD/0)).

## **Soybeans**

Soybean acreage is on the increase in Pennsylvania, and soybeans are being targeted as a key crop for biodiesel development. Soybeans contain about 22 percent oil and 42 percent crude protein, so they contain much more protein than oil. The protein is used for animal feed. Oil yield per acre for a typical soybean yield of 41 bushels per acre is 58 gallons. Historically, soybean processing has been limited in Pennsylvania, so most soybeans were sent to Ohio or Virginia for processing. Now, more interest has developed for in-state processing and biodiesel production. Our research program has focused on screening new varieties for yield and oil content and working with the Pennsylvania Soybean Board on emerging soybean production issues, such as soybean rust—a disease that has moved into the United States and could threaten Pennsylvania.

## **Rapeseed/Canola**

Rapeseed is an alternative oilseed crop that could be used for biodiesel production. Canola is a special type of rapeseed that produces food-grade oils. These crops are primarily grown in the Dakotas and western Canadian provinces. They are also widely grown in Europe for the rapidly expanding biodiesel industry there. Rapeseed and canola can be grown here and will yield well, but there are no existing markets for the crop. Canola typically contains 40 percent oil and can produce oil yields of 129 gallons of biodiesel per acre from a production of 56 bushels per acre, so this crop has the potential to significantly increase biodiesel production per acre compared to most other crops. Canola has some production complications that we are addressing in our research such as winterkill, disease susceptibility, and shattering. We have initiated some evaluations of winter canola varieties with Kansas State University, as well as some evaluations of spring varieties with the University of Idaho. We are also estimating the cost of production compared to other crops and formulating some recommendations for winter and spring production.

## **Contact Information**

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Penn State College of Agricultural Sciences research, extension, and resident education programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

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