Maryland researchers turn poplar trees into biofuel

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In response to a national call for homegrown, Earth-friendly fuels to fill Americans' gas tanks, a couple of University of Maryland researchers are planting trees.

Fuel derived from the hardy, fast-growing common poplar could eventually replace some of the billions of gallons of petroleum-based fuel now pumped a year, say biologist Gary Coleman and engineer Ganesh Sriram, who have partnered to help turn the woody plant into a widely used biofuel.

"Oil is a finite resource," said Coleman, a professor of plant science in the College of Agriculture and Natural Resources. "I don't think there is any doubt in 10 years people will be using advanced biofuels."

The Obama administration has made development of biofuels a priority, citing the national security and environmental concerns with petroleum-based fuel -- a problem driven home by the devastating oil spill along the Gulf Coast. The president toured the Midwest last week to tout renewable energy development, and the U.S. government already has mandated that biofuel production reach 36 billion gallons by 2022, tripling current levels.

Most biofuel now comes from corn in the form of ethanol, which is added to gasoline to increase its octane and decrease its harmful emissions. But the government is moving away from corn kernels, a food source, and has called for at least 60 percent of new biofuel to be

derived from other sources.

A portion will come from cellulosic, or fiber-based, biofuel -- the kind that comes from trees. To that end, millions in federal funds have been dedicated to research and processing plant construction.

Globally, other crops such as sugar are used to make biofuel. And more, including willow trees, algae and switchgrass, are in the race with poplars to become the next viable crop. But the government and scientists see poplars as having an edge because they naturally grow to about 70 feet in five or six years and grow just about anywhere.

Sugar, used to make biofuel in Brazil, for example, is sensitive to the cold in much of the United States.

Poplars would use up land, too, but not as much as corn and not in place of food crops, said Sriram, a professor of chemical and biomolecular engineering in the A. James Clark School of Engineering. Poplars, also called cottonwood or aspen, already are farmed, but for paper and timber.

"The scientific community already decided that poplars would make a good biofuel," Sriram said. "It's been studied since the '70s."

But after the 1970s oil crisis ended and gas prices dropped, so did the sense of urgency and research dollars, he said. Enough technology developed to turn trees into ethanol for use as a gas additive, but there's a lack of infrastructure and the cost would be high.

New research aims to make a cheaper and more advanced biofuel that could replace gasoline. Making that possible is a $3.2 million grant the researchers recently won from the National Science Foundation's Plant Genome Research Project, which funds work on plants that have

potential economic and agricultural importance.

Also helping is the recent completion of the tree's genome by the scientific community. The complete tree map allows the researchers to identify and manipulate thousands of specific genes in their quest to understand and improve poplars' use of nitrogen, a key factor in the life cycle of the tree.

The plants store nitrogen in their branches in winter and send it back to the leaves in the spring. If researchers can make a tree cycle the nitrogen more efficiently, it will grow faster and use less fertilizer, a major cost saving.

"The more efficient we make the process, the more economical this will be," Coleman said. "But we're not there yet."

The trees would also absorb carbon as they grow, offsetting emissions from poplar-based fuel, he said.

Once the researchers perfect the cycle, they will hand off the job of making fuel to others.

As this is happening over the next decade, officials at the Department of Energy will move forward on other fronts. They expect that in a couple of years, ethanol from nonfood sources such as trees, grasses, algae, and forestry and crop waste will replace much of the corn-based fuel and the amount added to gasoline will be increased.

Ethanol is not likely to replace petroleum because, unlike advanced biofuels, it would require its own delivery system and modified cars to run on it, said Valerie Sarisky-Reed, acting program manager for the Energy Department's Biomass Program.

But ethanol will remain important in the short term as an additive that helps the environment and expands the petroleum-based fuel supply, she said. And it will remain important in the long term because a recent government study predicted those advanced biofuels will only be able to replace about a third of the transportation fuel used in the United States in the coming decades.

Meanwhile, financing technology development and processing plants will remain a challenge, Sarisky-Reed said. The private sector will be reluctant to invest in unproven technologies and the government has limits.

She also acknowledged critics who fear growing genetically modified crops for fuel will squeeze out traditional crops and have unknown consequences. The government has policies to try to prevent their spread, but she said that modifying crops to use less water and fertilizer is desirable. (The Maryland professors now destroy all of the trees they grow in labs for research.)

"Cost is the major drawback here," she said. "Petroleum has plenty of years on us. The technology is coming along, but it's difficult for industry to get financing for technology that is not tested."

An official at the Renewable Fuels Association, which represents the U.S. ethanol industry, agreed and said the economic downturn has made financing even tougher. Spokesman Matt Hartwig said the Department of Energy needs to do more.

Hartwig said corn-based ethanol plants can be altered to accommodate fuel from cellulosic sources such as trees more cheaply than building new plants. Once the woody material is broken down into sugar it is fermented and turned to fuel, like sugar from corn. But it would still be a gamble since there aren't developed markets.

Some members are forging ahead with new plants, however, for the environment and for their own future bottom lines, he said. Others will follow when costs decline.

"This will all happen in phases," he said. "A few million gallons are being produced at various demonstration and pilot plants across the country. It's not a lot, but once it's proven then others will look at how to scale that up to 50 million or 100 million. The average corn-based ethanol plant produces an average of 100 million gallons a year."

In that same time, Americans will use 130 billion gallons of gasoline.

Renewable transportation fuels

The government, scientific community and industry are working on biofuels to help wean the country from petroleum-based fuels that are considered harmful to the environment, a national security problem and a finite resource. Here are the pros and cons of some of the crops being examined and used, as described by some of those involved in the process:

Corn: Is used to produce most of the ethanol that is added to gasoline now to improve octane and reduce emissions. But its use diverts crops from the food supply. Ethanol also remains largely an additive in gas because as a fuel new infrastructure and modified cars are needed.

Sugar: Is used in Brazil to produce ethanol but doesn't grow well in colder climates found in much of the United States. It's also a food crop.

Food oils, both new and used: Environmentally, this is better than gasoline, and in some cases this is use of a waste product. But cars need to be modified to run on it. It can be added to petroleum-based diesel fuel to make a biodiesel that improves emissions.

Trees, grasses and corn and wood waste: Would be expensive to make into ethanol because of a lack of infrastructure. There is promise in making advanced fuels that would emit fewer greenhouse gases, but they would use up land, though not as much as corn and not on existing farms. This fuel could replace gasoline without modified cars or a new delivery system.