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Corn Gene Therapy Decreases Cost of Ethanol Production

LANSING, MICH. – The ever increasing price of petroleum fuel has not only undermined the United States' economic strength, but has also threatened our national security. To help decrease the U.S. dependence on foreign oil, various biofuels have been developed in recent years with corn ethanol standing out as the leader in the industry. As compared to gasoline, ethanol is readily biodegradable and releases significantly less air-borne pollutants than petroleum. The majority of ethanol is derived from the starch of corn kernels, but much research is being done to expand ethanol production to include cellulosic ethanol, which can be produced from other parts of the corn plant, such as stalks and cobs.

Research has shown that just as the starch of corn kernels can be converted into ethanol, corn stalks left in the fields can be transformed into fermentable sugars for ethanol production. The conversion of corn stalks into ethanol would further assist the U.S. in the pursuit for energy independence. However, past research attempts have shown one major hurdle; the process of converting corn stalk residue into fermentable sugars for ethanol production is very costly.

In an effort to find an effective means of reducing the cost of converting corn stalk residue into ethanol, the Corn Marketing Program of Michigan (CMPM) partnered with Dr. Mariam Sticklen of the Department of Crop and Soil Sciences at Michigan State University (MSU) to conduct research on corn stalk residue conversion into cellulosic biofuel. "As we look to lessen our dependence on foreign oil and grow our economy here in Michigan, these types of biofuel projects continue to be invaluable," said Clark Gerstacker, CMPM president, National Corn Growers Association Corn Board member and a corn grower from Midland. "However, to be a viable fuel alternative, new cellulosic fuels like those made from corn stover need to be cost competitive, which is why the process needs further refining."

Corn stalks, like other crop residue, contain several different components that must be broken down for the ethanol production process. The first is a soft fiber called cellulose, which is an organic compound composed of sugars connected together by chemical bonds. After corn stalks are ground and treated, the chemical bonds can be broken into fermentable sugars for the production of cellulosic ethanol. The second component of crop residue is a harder fiber called lignin. Unlike cellulose, lignin contains no sugar, but rather is an organic matter consisting of a series of complex molecules. In order to produce ethanol from crop residue such as corn stalks, chemical and/or extreme heat pre-treatment processes are necessary to break-down and remove lignin. Depending on the method used, pre-treatment processes can cost from $1.15 to $2.25 per gallon of cellulosic ethanol. In addition to expenditures associated with crop production, harvest, storage, cellulose treatment, and the fermentation of sugars into ethanol, the lignin treatment is an excessive cost which restricts expansion of the industry.

Through her research, Dr. Sticklen has developed a patented corn plant containing lower lignin and relatively higher cellulose. Although the plant has about ten percent less lignin, it maintains the same kernel yield, height and strength. Lower-lignin corn plants have the potential to significantly reduce the cost of converting stalk residue into fermentable sugars, ultimately lowering the cost of cellulosic ethanol production.

The technology used by Dr. Sticklen is much like human "gene therapy", as it reduces the effect of undesirable traits. Several of the corn plants that underwent gene therapy contain a higher amount of cellulose, meaning it shifted the energy normally utilized to make lignin and has redirected it into making more cellulosic fibers. In the case of corn gene therapy, the second generations of lower lignin/higher cellulose corn plants develop a rustic brown coloration indicating its decreased lignin.

Based on her research, Dr. Sticklen believes her new corn crop could be utilized for more than just low-cost corn stover cellulosic ethanol production. She believes the crop would also serve as an excellent corn silage feed for livestock as the lower lignin corn will be digested faster by animals, while the higher level of cellulose will increase an animal's energy levels. Additional testing and further research will be done in the future to expand other potential uses for her corn crop.

"We are grateful for the work Dr. Sticklen has done at MSU regarding the low lignin/higher cellulose corn crop and its potential uses. The results from this project show great promise for the cellulosic corn stover ethanol industry and will create another value-added market for Michigan-grown corn. As corn farmers continue to increase their efficiencies and produce more corn each year, new and emerging technologies such as this will be an important avenue for our crop," said Gerstacker.

Headquartered in Lansing, the CMPM is a legislatively-established statewide program that utilizes one-cent per bushel of Michigan corn sold. Investments are made in the areas of research, education, market development, and new uses in an effort to enhance the economic position of Michigan corn farmers. The CMPM works cooperatively with the Michigan Corn Growers Association (MCGA), a grassroots-membership association representing the state's corn grower's political interests since the 1970's. Michigan's corn industry adds more than one billion dollars to the state's economy annually and in 2010, Michigan's corn farmers harvested a record setting crop of more than 315 million bushels.. For more information, visit the website of the MCGA and the CMPM at www.micorn.org.

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