Corn Marketing Program of Michigan
Michigan Corn Growers Association

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Environmentally-Friendly Bacterial Strain Developed to Produce Succinic Acid from Corn

LANSING, MICH. – As petroleum prices continue to increase, so does our desire to be less dependent on foreign oil. This has led the United States to look for products which provide an alternative to those made from petroleum. In addition to its major use as a motor fuel, petroleum is utilized for many non-fuel uses including the manufacturing of petrochemicals, which account for 10 to 15 percent of total petroleum use. As an alternative to these petrochemicals, the sugars and starches derived from plants like corn during the fermentation process, can serve as feedstocks for microorganisms which can be utilized in bio-chemical production. Depending on the strain of microorganism and how it is fermented, microorganisms can produce a wide range of bio-chemicals with the same composition and function as petrochemicals.

"As we look to lessen our dependence on foreign oil and grow our economy here in Michigan, these types of projects continue to be invaluable," said Clark Gerstacker, Corn Marketing Program of Michigan (CMPM) president, National Corn Growers Association Corn Board member and a corn grower from Midland. "It seems that as petroleum dependence changes, we can look to these new technologies."

Prior to the petroleum boom in the 1960's, many chemicals were manufactured using the fermentation process. This process was put aside when the cost of manufacturing petrochemicals became less expensive. Today, there is a growing movement to again produce chemicals from biological processes, primarily using fermentation. Ethanol is one such product that has become very successful, but others, particularly those used as chemicals, are emerging as well.

Significant research and development is underway to bring more bio-chemicals into production—all of which must compete with existing petrochemicals. The main competitive hurdles to breaking into those markets include the need to understand, discover and modify microorganisms to produce the bio-chemicals; the design of cost-effective processes; the availability of sugars, starches and other feedstock; the assurance that products are more environmentally-friendly than their petroleum-based counterparts; and increasing the public's preference for bio-based products. Ultimately, the replacement of petrochemicals with bio-chemicals will shift the type of chemicals used on a day-to-day basis, helping to reduce toxicity and U.S. dependence on foreign oil.

In order to assist Michigan's farmers in understanding the potential benefits of bio-chemical production, and how their crop can play a vital role in the blossoming bio-chemical market, the CMPM partnered with Working Bugs, LLC to conduct succinic acid research. Bio-based succinic acid serves as an important platform chemical for numerous products, including personal care products, environmentally-safe solvents, fuel additives, engine coolants and more. The study sought to develop a new, environmentally-friendly strain of bacteria to produce succinic acid from corn which could be used in large-scale commercial production.

To accomplish these objectives, Dr. Cory DeMattei, a researcher at Working Bugs, LLC, worked with a newly developed strain of bacteria with altered deoxyribonucleic acid (DNA) in a naturally occurring bacterial strain. Dr. DeMattei hoped to force an optimal balance between high amounts of succinic acid and high growth rates, to create the highest amount of succinic acid possible.

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From reviewing past research efforts, several potential complications were identified. First, selective markers such as antibiotic-resistance are normally used to determine if the genetic work was performed properly, however, the resistance to antibiotics also poses environmental concerns. Another common issue with other strains developed has been their requirement for cost-prohibitive nutrients to obtain sufficient concentrations of succinic acid. The new strand developed by Working Bugs, LLC through their CMPM-funded research does not present either of these problems, giving their bio-chemical succinic acid a significant market advantage.

To ensure an environmentally-stable bacteria was produced, DeMattei used a non-antibiotic system which does not utilize the traditional method of adding selective markers for antibiotic-resistance. This innovative, commercial bacteria strain for producing succinic acid was accomplished by removing specific genes in order to divert the organism's use of sugar away from other pathways and towards the production of succinic acid. This process does not produce a genetically-modified organism (GMO), as defined in most regulatory agencies, because there is no transgenic recombination (outside genes being introduced) being performed; all the genes utilized originated within the bacterial species. The new strain was brought to full development using numerous lab-scale fermentation runs to bring about maturity in the strain. Working Bugs, LLC now plans to use the final mature strain in scale-up and pilot production.

"We are grateful for the work Working Bugs, LLC has done regarding succinic acid and its co-products. The results from this project will not only create another value-added market for Michigan-grown corn, but it will also allow corn farmers and consumers across the state to decrease their dependence on foreign petroleum products, as well as their environmental impact, by using a renewable resource—corn," said Gerstacker.

For more information on this project or the CMPM, contact the CMPM office at 1-888-323-6601 or visit the CMPM online at www.micorn.org.

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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