Advanced Corn-to-Ethanol Platform

Platform Coordinator: 
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Director of the Center for Crops Utilization Research
Advanced Corn-to-Ethanol Platform

Goals

- Improve efficiency and reduce costs of producing ethanol from corn.
- Introduce alternative feedstocks such as corn grain fiber and corn stover.
Corn Has Significant Potential for Biofuels

Ethanol Productivity Potential

Endosperm → 435 Gal/Acre
@ 150 bu/ac grain yield

Grain Endosperm

<table>
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<tr>
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<th>05</th>
<th>10</th>
<th>15</th>
<th>20</th>
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<tbody>
<tr>
<td>Bu/Ac</td>
<td>150</td>
<td>180</td>
<td>200</td>
<td>250</td>
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<tr>
<td>Gal/Bu</td>
<td>2.5</td>
<td>2.7</td>
<td>2.8</td>
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<tr>
<td>Gal/Ac</td>
<td>390</td>
<td>486</td>
<td>560</td>
<td>700</td>
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Grain Pericarp

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<tbody>
<tr>
<td>Ton/Ac</td>
<td>0</td>
<td>0.45</td>
<td>0.50</td>
<td>0.625</td>
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<tr>
<td>Gal/Ton</td>
<td>0</td>
<td>40</td>
<td>60</td>
<td>90</td>
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<tr>
<td>Gal/Ac</td>
<td>0</td>
<td>18</td>
<td>30</td>
<td>56</td>
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Stover

<table>
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<tr>
<td>Ton/Ac</td>
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<tr>
<td>Gal/Ton</td>
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<tr>
<td>Gal/Ac</td>
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<td>100</td>
<td>165</td>
<td>270</td>
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</table>

1,000 gallons / acre by 2020?
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Short-term objectives

• Reduce operating and capital costs for dry-grind ethanol facilities
• Employ new enzymes and processes to utilize carbohydrate
• Develop lines of corn with fermentation productivity traits
• Increase feed value of ethanol co-products
• Develop new uses for co-products
• Develop new fermentation products
Long-term objectives

• Understand lignocellulose biosynthesis in corn grain and stover

• Develop new pretreatments for corn fiber and stover

• Develop economical technologies to integrate cellulose conversion with minimum retrofitting into today’s starch-to-ethanol mills
Long-term objectives (cont.)

- Engineer corn plants that can be readily disassembled and converted to fermentable sugars
- Develop improved enzymes and processing treatments to convert lignocellulose to fermentable sugars
- Develop value-added co-products for feed and other uses
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Three Projects

• Advancing dry-grind corn ethanol production
  – Tom Brumm & Larry Johnson

• Increasing the value of co-products
  – Paul Scott

• Enhancing the raw materials supply chain
  – Charles Hurburgh
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Strategies to advance dry-grind corn ethanol facilities

- Reduce energy consumption
- Increase ethanol yield
- Improve process/reactor design
- Increase revenue streams
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Limitations to increasing the value of co-products

- Excessive fat in DDGS for ruminant feeds
- Excessive fiber in DDGS for non-ruminant feeds
- Overly saturated oil in DDGS for swine feeds
- Poorly digestible protein and poor EAA balance
- Absence of high value products
- Incomplete starch conversion diluting feed value of DDGS
Strategies to increase the value of co-products

- Modify the traits of the corn plant
- Improve processing and handling methods
- Identify new uses and value added products
Process and Product Quality Control in Bioprocess Raw Materials

www.iowagrain.org  www.trace.eu.org
Raw Material Supply Issues

- Shortage of local grain storage (0.5 – 0.8 bln bu)
- Shifting of raw material transportation to short hauls by truck.
- Detection and management of key raw material factors (e.g. fermentable starch, germ size, fiber, moisture content, hardness)
Raw Material Supply Issues

- Certified quality management systems (ISO, etc) and supply chain organization for raw materials.
- Traceability of raw materials through processes
- Food safety factors affecting production (eg. mycotoxins, unapproved GMO).
- Segregation of unfit materials for other purposes.
Raw Material Topic Areas

- Grain storage and its impact on the ethanol process
- Management operations for raw materials that impact efficiency, output quantity, and quality
- Certified quality management systems and supply chain organization for raw materials
- 23 faculty involved in some way
Food Safety Connection

- Food Safety Consortium
- Food Safety Research Consortium
- Biosafety Institute for Genetically Modified Agricultural Products
- Center for Food Security and Public Health

- Iowa Grain Quality Initiative
Center for Crops Utilization Research

Committed to expanding value-added agriculture and the bioeconomy through research, development and outreach.
Where to Find Us:

Grain Quality Laboratory

Iowa Grain Quality Initiative

Agricultural and Biosystems Engineering (ABE)
Iowa State University

www.iowagrain.org