Tropical Maize: Biofuel, Forage, & Heat

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Tropical germplasm

Photoperiod sensitivity

Growth in the Midwest results in:

• Prolonged vegetative stage
• Asynchrony

Crossing tropical by temperate-adapted cultivars

Integration of agronomic traits of modern cultivars

• Disease and pest resistance and reduced lodging
Tropical Maize – Flexible Utility, Solid Sustainability

1. Bioenergy Production
2. Direct Combustion for Heat
3. Animal Feed
Positive Prospects

Strong potential as a bioenergy feedstock:
• High extractable sugar accumulation in the stalk
• Large amounts of biomass
• Less than half the field corn N fertilizer requirement
• Corn grain ethanol plants can be quickly adapted to extract TM sugar

Remaining stover can be:
• Burned for energy
• Used for cellulosic ethanol production
• Mixed with DDG from grain-based ethanol plants to enhance ruminant animal feed value
Low Risk of Tropical Maize

• High energy balance ratio
• More readily accepted than perennial grasses
• Familiar management and equipment as field corn
• Harvested earlier for easy establishment of cover crops
Tropical Maize Hybrids

High Sugar
Reduced grain production offset by accumulation of sugar in the stalk and high biomass levels for future cellulosic ethanol conversion technologies

Dual-Purpose
High-quality grain for animal feed and high biomass levels for thermal use
2013 Tropical Maize Study

UIUC Crop Sciences Research Farm

Hybrids
High Sugar
Dual-Purpose

Planting
June 20, 2013
35,000 plants Ac-1

Nitrogen Rate
0 lbs N Ac-1
120 lbs N Ac-1
Whole Plant Sampling, 2013

Harvest 1 and Harvest 2
September 9 and October 1
10 whole plant samples plot-1
- biomass and ethanol yield

Harvest 3
November 1
6 whole plant samples plot-1
- biomass yield
- grain removal
- grain yield, grain quality, yield components
# Effect of N Rate on Biomass Accumulation and Grain Yield

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Above Ground Biomass</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>0 lbs N Ac(^{-1})</td>
<td>120 lbs N Ac(^{-1})</td>
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<tr>
<td><strong>High Sugar</strong></td>
<td>___________________</td>
<td>ton</td>
<td>Ac(^{-1})</td>
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<tr>
<td>September 9</td>
<td>6.5</td>
<td>7.9</td>
<td></td>
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<tr>
<td>October 1</td>
<td>7.0</td>
<td>8.4</td>
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<tr>
<td>November 1</td>
<td>7.6</td>
<td>8.1</td>
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<td>Grain Yield (bu Ac(^{-1}))</td>
<td>18</td>
<td>59</td>
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<td><strong>Dual-Purpose</strong></td>
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<tr>
<td>September 9</td>
<td>6.2</td>
<td>8.1</td>
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<tr>
<td>October 1</td>
<td>6.4</td>
<td>10.9</td>
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<tr>
<td>November 1</td>
<td>8.3</td>
<td>9.0</td>
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<tr>
<td>Grain Yield (bu Ac(^{-1}))</td>
<td>93</td>
<td>109</td>
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</table>
Animal Feed Study

3 acres of Tropical Maize
   Dual-Purpose hybrid
Planted May 22\textsuperscript{nd}
   70,000 seeds Ac-1
60 lb N Ac-1 as anhydrous
Pre-plant herbicide
   Keystone – 1.5 quarts Ac-1
Harvested September 9\textsuperscript{th}
   44.5 tons Ac-1
<table>
<thead>
<tr>
<th>Item</th>
<th>Ensiled TM</th>
<th>Corn Silage</th>
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<tr>
<td></td>
<td>%</td>
<td>%</td>
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<tr>
<td>Dry Matter</td>
<td>30.7</td>
<td>31.5</td>
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<tr>
<td>Crude Protein</td>
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<td>ADF</td>
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<td>NDF</td>
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<td>Starch</td>
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<td>PH</td>
<td>3.9</td>
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<td>Lactic Acid</td>
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<td>TDN</td>
<td>62</td>
<td>68</td>
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</tbody>
</table>

Data courtesy of Shike Lab, Dept. of Animal Sciences Univ. of IL
2014 Sustainability Study

Hybrids
- High Sugar
- Dual-Purpose

Tillage Methods
- Conventional – Chisel Plow
- Strip tillage

Nitrogen Rate
- 0 lbs N Ac-1
- 60 lbs N Ac-1
- 120 lbs N Ac-1

Cover Crops
- Annuals
  - Annual Ryegrass, Pennycress
- Perennials
  - Buffalo Grass, Creeping Bentgrass
Cover Crops

Cool Season Winter Annuals
- Annual Ryegrass
- Pennycress

Cool Season Perennial
- Creeping Bentgrass

Warm Season Perennial
- Buffalo Grass

Images: ISU & plantcovercrops.com
Cover Crop Establishment

Buffalo Grass

Annual Ryegrass

Creeping Bentgrass

Pennycress
Conclusion

Strong potential as a biofuel feedstock

- Compatible with agriculture in the Midwest
- Vigorous growth with little to no supplemental nitrogen
- Potential for improvement of the tropical maize hybrids

Adoption of all utilities could provide substantial benefits