BIOGAS PRODUCTION WITH SORGHUM BIOMASS
Why sorghum for biogas in Germany?

Cultivar screening in Straubing, Bavaria

Methane yield and influencing factors

Sorghum as energy crop: key issues for breeding
INSTITUTE DESCRIPTION

TECHNOLOGY AND SUPPORT CENTER (TFZ)

- Institution of the Bavarian Ministry of Food, Agriculture and Forestry

- Applied research:
  - Energy and raw material crops
  - Biofuels
  - Combustion

- Support of bioenergy projects, e.g. biomass heating stations

- Transfer of knowledge
WHY SORGHUM FOR BIOGAS?

SORGHUM IS MORE THAN FEED

- High yield potential
- Requires only a short growing period → Sorghum as catch crop in cropping systems with whole crop cereals
- Lower input than maize
- Can be grown on light soils/under conditions, where maize has no stable yield
- Methane yield of sorghum is satisfying
- Sorghum is rarely used as fodder in Germany → Hydrocyanic acid/prussic acid content
WHY SORGHUM FOR BIOGAS?

RESTRICTIONS AND REGULATIONS

- Sorghum was alternative crop choice where Western corn rootworm (*Diabrotica virgifera virgifera*) occurred
  - Cropping system restriction allowed only in 2 out of 3 years maize
  - Since 2014, *Diabrotica* is no longer listed as quarantine pest → no cropping system restriction

- Maize as biogas substrate was limited to 60% for biogas plants under Renewable Energy Law 2012 (EEG 2012)
  - Other crops such as sorghum, whole crop cereals, ley became more attractive for biogas plant owners

INCREASE OF POTENTIAL CROP AREA

Germany 1961–1990

Germany 2011–2040

- not suitable
- hardly suitable
- suitable
- well suitable
- most suitable
- no data
BIOMASS YIELD & DRY MATTER CONTENT

Dry matter yield

Dry matter content

S. bicolor (food)
S. bicolor (grain)
S. bic. x S. sud.
Maize late
Maize early

Dr. Maendy FRITZ, Biogas Production with Sorghum Biomass

BUCHAREST
3-4 NOVEMBER 2016
Sorghum Screening 2016

Biomass Yield & Dry Matter Content

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BUCHAREST 3-4 NOVEMBER 2016
SEVERE LODGING IN 2016

LODGING EVEN IN GRAIN SORGHUM
WILD BOARS PREFER MAIZE ...
INGREDIENTS MAIZE VS. SORGHUM

- **XA**: crude ash
- **XP**: crude protein
- **XL**: crude lipids
- **ADF**: cellulose + lignin
- **org.Res.**: organic residues
- **Hemicellulose + org. Residues** = N-free extracts

**Graph Explanation**
- The graph compares maize and sorghum ingredients content.
- The x-axis represents the ingredient content as a percentage from 0% to 100%.

**Legend**
- **G**: Maize Sorghum types
- **F, X, M**: Further types of sorghum

**Data Insights**
- The graph visually illustrates the difference in ingredient content between maize and sorghum, highlighting the proportions of ash, protein, lipids, cellulose, lignin, and organic residues.
CULTIVAR ‘GK EMESE’, 2013

Methane output of sorghum biomass from cultivar 'GK EMESE' in 2013. The graph shows the methane yield (Nl/kg oDM) for different fractions of the crop, including whole crop, grain (G), residue (R), and various ratios of residue to grain (R:G 1:1, 1:2, 2:1). The chart also indicates the percentage dry matter (%DM) and the ratio of sugar to starch (Sugar/Starch).
METHANE YIELD 2012–2014

HIGH VARIABILITY BETWEEN YEARS

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BUCHAREST
3-4 NOVEMBER 2016
# Methane Yield 2012–2014

**Biomas Yield Determines Methane Yield**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Number of data</th>
<th>Methane yield in Nl CH(_4)/kg oDM</th>
<th>Methane yield in Nm(^3) CH(_4)/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. bicolor</em> F</td>
<td>66</td>
<td>293,2</td>
<td>5143</td>
</tr>
<tr>
<td><em>S. bicolor</em> G</td>
<td>37</td>
<td>315,4</td>
<td>4392</td>
</tr>
<tr>
<td><em>S. bic. x S. sud.</em></td>
<td>40</td>
<td>296,8</td>
<td>4892</td>
</tr>
<tr>
<td>Maize</td>
<td>6</td>
<td>347,2</td>
<td>7045</td>
</tr>
</tbody>
</table>

Maize + 15% + 48%
METHANE OUTPUT

WHAT IS REQUIRED FOR HIGH METHANE YIELD PER HECTARE?

- High biomass yield per hectare
- High methane yield per kg DM
- High digestibility of the biomass
- Low ash content
- High content of N-free extracts
- Content of starch, sugar, etc. is less important
THANK YOU FOR YOUR ATTENTION