Production of cover crops for anaerobic digestion

Biomass from cover crops

Bram Vervisch - Inagro

Combination maize & rye

Main Crop
Maize

Cover Crop
Rye

May  October  May
Cover crops

Advantages:
- enhanced soil fertility
- reducing erosion
- capturing residual nutrients (N, P)

Disadvantages:
- workload
- tight schedule growth season

Nitrate residue

<table>
<thead>
<tr>
<th>Nitrate (kg/ha NO3-N DM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

- Fallow
- Rye
Impact of Rye on following crop: Maize

<table>
<thead>
<tr>
<th>Year</th>
<th>ton DM/ha</th>
<th>Rye</th>
<th>Maize</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>7.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>8.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>9.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 0%  
- +6%  
- -14%
Subsidy for greening measures is linked to the direct payment

### Greening conditions
- conservation of permanent grassland
- crop diversification
- ecological focus areas

**Ecological focus area**

- 5% of the area arable land (>15ha)
- 1 m² of cover crops = 0.3 m² ecological focus area
- 15 ha arable land => 0.75 ha EFA => 2.5 ha cover crops
Varieties

- Speedogreen, Turbogreen, Borfuro, Protector and Jobaro
- Two harvest moments: 23 April and 6 May.
Digestion

Lab trial

Pilot scale

Lab trial: Methane yield Fresh Matter
Lab trial: Methane yield Organic Dry Matter

![Graph showing methane yield over time for Rye and Maize]

- **Organic Matter**
  - Rye: 27%
  - Maize: 36%

Pilot scale

- **Electricity production (kWh)**

  - **Reference periode:** Manure + Maize
    - 21 kWh
  - **Trial:** Manure + Maize + Rye
    - 17 kWh

- **642,2 kg OM**
  - 0,32 m³ CH₄/ kg OM (lab trials)

- **601,5 kg OM**
  - 0,33 m³ CH₄/ kg OM

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Conclusions

- Soil structure & fertility
- Extra biomass yield
- N leaching

Economic assessment

Cultivation costs vs. market value of the silage

Rye production costs & revenues

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Seeds, fertilizers, materials</td>
<td>171  €/ha</td>
</tr>
<tr>
<td>Fuel &amp; machine costs</td>
<td>509  €/ha</td>
</tr>
<tr>
<td>Total costs</td>
<td>680  €/ha</td>
</tr>
<tr>
<td>Market value of the silage</td>
<td>912  €/ha</td>
</tr>
<tr>
<td>Revenues for farmer</td>
<td>232  €/ha</td>
</tr>
</tbody>
</table>

Winter rye can generate additional income for the farmer

Manpower costs: 130€/ha
Environmental assessment (LCA)

Environmental impacts of energy production through anaerobic co-digestion of winter rye vs. maize

Comparison based on 1 MJ of energy

Yield linked environmental challenge for energy production

Characteristics maize vs. rye

<table>
<thead>
<tr>
<th>Metric</th>
<th>Maize</th>
<th>Rye</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield t ha⁻¹</td>
<td>79 (80)</td>
<td>32 t ha⁻¹</td>
</tr>
<tr>
<td>%Yield</td>
<td>28 (29) %FM</td>
<td>26 %FM</td>
</tr>
<tr>
<td>N₂O kgFM⁻¹</td>
<td>200 (212)</td>
<td>170 l CH₄ kgFM⁻¹</td>
</tr>
<tr>
<td>LCH₄ kgFM⁻¹</td>
<td>3.4 (3.6) MJ</td>
<td>2.8 MJ kgFM⁻¹</td>
</tr>
</tbody>
</table>

Environmental assessment (LCA)

Results at the midpoint and endpoint level

Water related impacts

Reduction of negative impacts on water through reduction of nutrient leaching

<table>
<thead>
<tr>
<th>Impact</th>
<th>No cover crop</th>
<th>Cover crops included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater eutrophication</td>
<td>100%</td>
<td>50%</td>
</tr>
<tr>
<td>Marine eutrophication</td>
<td>100%</td>
<td>50%</td>
</tr>
<tr>
<td>Terrestrial ecotoxicity</td>
<td>100%</td>
<td>50%</td>
</tr>
<tr>
<td>Freshwater ecotoxicity</td>
<td>100%</td>
<td>50%</td>
</tr>
</tbody>
</table>

Soil related impacts

Reduction of negative impacts on the soil through reduction in ammonia emissions

<table>
<thead>
<tr>
<th>Impact</th>
<th>No cover crop</th>
<th>Cover crops included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrestrial acidification</td>
<td>100%</td>
<td>15%</td>
</tr>
<tr>
<td>Terrestrial ecotoxicity</td>
<td>100%</td>
<td>15%</td>
</tr>
<tr>
<td>Agricultural land occupation</td>
<td>100%</td>
<td>15%</td>
</tr>
<tr>
<td>Urban land occupation</td>
<td>100%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Summarized indicator

Co-digestion of higher volumes of winter rye (as compared to maize) does not contribute to the increase in the total impact
Cover Crops for co-Digestion
Conclusions

Winter rye used for anaerobic digestion…

• can generate additional income for the farmer\(^b\)
• does not contribute to increase of the total impact\(^c\) as compared to digestion of maize silage\(^d\)
• allows reducing negative impacts on water compartment through the reduction of nutrient leaching\(^e\)
• allows reducing negative impacts on the soil through reduction in ammonia emissions\(^e\)
• allows for more efficient soil use (2 crops on the same land)

\(^a\)no subsidy schemes included
\(^b\)expressed as a single score indicator
\(^c\)considering the constrain linked to the higher volume of rye necessary to exchange maize in anaerobic digestion process for receiving the same energy amount
\(^d\)compared to co-digestion of maize only

Thank you for your attention