A Management Guide for Planting and Production of switchgrass as a biomass crop in Europe

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What is switchgrass?

- Perennial C₄ grass
- Yields 6 to 25 tonnes/ha
- Seed propagated
- Deep roots (2m)
- Low input
- 15 year cycle
- Leafier and smaller than Miscanthus

Applications:
- Fibre/pulp
- Power/heat
- Ethanol
- Feed

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Critical elements

- Variety choice
- Establishment
- Fertilisation
- Harvest management
<table>
<thead>
<tr>
<th>Variety</th>
<th>Ecotype</th>
<th>Ploidy level</th>
<th>Origin</th>
<th>Seed weight†</th>
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<tbody>
<tr>
<td>Alamo</td>
<td>lowland</td>
<td>Tetraploid</td>
<td>South Texas 28°</td>
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<td>Blackwell</td>
<td>upland</td>
<td>Octoploid</td>
<td>Northern Oklahoma 37°</td>
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<td>lowland</td>
<td>Tetraploid</td>
<td>Central Oklahoma 35°</td>
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<td>Nebraska 28</td>
<td>upland</td>
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<td>Northern Nebraska 42°</td>
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<tr>
<td>Pangburn</td>
<td>lowland</td>
<td>Tetraploid</td>
<td>Arkansas 34°</td>
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<td>Pathfinder</td>
<td>upland</td>
<td>Octoploid</td>
<td>Nebraska / Kansas 40°</td>
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<td>REAP 921</td>
<td>upland</td>
<td>Tetraploid</td>
<td>Southern Nebraska 41°</td>
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<td>Shelter = NY4006</td>
<td>mixed?</td>
<td>Octoploid?</td>
<td>West Virginia 40°</td>
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<tr>
<td>Summer</td>
<td>upland</td>
<td>Tetraploid</td>
<td>South Nebraska 41°</td>
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<td>Sunburst</td>
<td>upland</td>
<td>?</td>
<td>South Dakota 44°</td>
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<td>Octoploid</td>
<td>Nebraska 40°</td>
<td>185</td>
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</table>
Variety choice

- Early senescence
- Low moisture
- Low ash
- Low nutrients
- Poor winter survival
- Poor stand survival
- High moisture
- High ash
- High nutrients

Relative yield

Latitude of origin of variety

Netherlands Greece

Texas North Dakotah
**Variety Choice**

- **Switchgrass varieties grown too far north will have:**
  - Later or no flowering and maturity
  - High yields in first year
  - Lower yield in later years
  - Decreased winter survival
  - High moisture content at harvest
  - Higher nutrient contents at harvest
  - Decreased stand survival in long term?

- **Switchgrass varieties grown too far south will have:**
  - Early flowering and maturity
  - Lower yields
  - Good winter survival
  - Low moisture content at harvest
  - Good stand maintenance

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Establishment

- Follow the rules and it will work!
  - Establishment takes > 1 year
  - Site selection
  - Site preparation
  - Variety choice
  - Germination test
  - Time of planting
  - Don’t worry too much about weeds

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Establishment: Site selection

- Best is deep soil, good water holding capacity and drainage, but;
- Well adapted to averse condition:
  - Shallow soils, stony soils
  - Occasionally waterlogged soils
  - Low soil fertility and
  - (Very) low pH
Establishment: Site preparation

Weed free - false sowing?

No fertilisation (will promote weed growth)

Compact soil before and after seed drilling!

No-till establishment works!

Monti et al.,
Seed rate and row spacing

Perform germination test!

Seed rate 10 to 20 kg seed/ha
200 - 400 PLS in North
100 - 200 PLS in South
Goal is a minimum of 10 to 30 plants / m²
Establishment: Planting time and equipment

- Plant at same time as Maize (>10 °C)
- Too early → weed problem
- Too late → moisture problems

- Planting can be done with normal equipment
- Row spacing:
  - >15 in north
  - 30 - 50 in south
- Seeding depth 10mm
Weed control and pests and diseases

- Weeds can (will) be problem in first year
  - Goal is to have sufficient seedling survival!
  - Seedbed preparation -
  - Chemical control possible generally not necessary
  - Mowing weeds is efficient

- Pests and diseases
  - Less of a problem
  - Damping off
  - Some rusts
Fertilisation: Management and yield development

- Fertilisation
  - Not in first year
  - Following years:
    - low P and K
  - Nitrogen:
    - 0-50 kg in North
    - 50-100 in South
- Yield development takes 3 to 5 years

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![Relative yield vs Years graph with data points for Sand and Clay soils]
Main problems:

- Lodging
- Weeds in first year
Harvest and storage

Harvest in winter/spring
At low moisture (<20%)

Estimated cost (without land cost) vary:
- 24 Euro DW/t in Greece
- 62 Euro DW/t in the Netherlands

Compares favorably to Miscanthus since the cost and risk of establishment is lower
## Quality and harvest time

<table>
<thead>
<tr>
<th>Harvest time</th>
<th>N</th>
<th>P</th>
<th>K</th>
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<tbody>
<tr>
<td>Fall</td>
<td>0.46</td>
<td>0.12</td>
<td>0.95</td>
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<tr>
<td>Winter/Spring</td>
<td>0.33</td>
<td>0.04</td>
<td>0.06</td>
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</table>

<table>
<thead>
<tr>
<th>Ash content</th>
<th>Clay</th>
<th>Sand</th>
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<tbody>
<tr>
<td>Switchgrass</td>
<td>5.5</td>
<td>2.1</td>
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<tr>
<td>Miscanthisus</td>
<td>5.9</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Where and how to grow switchgrass?

- Make use of specific attributes
  - Low establishment costs (seed)
  - Low fertilisation
  - Low perticide use
  - Low water use
  - Erosion control
  - Adapted to low pH soils
  - C-storage
  - Wildlife shelter
  - Height, max 2 m
Further information:

- www.switchgrass.nl