Sulphur improves feed quality in intensively managed grassland in Germany

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The sulphur cycle

0.5 to 3% of organic sulphur
5-15 kg S/ha

10 kg SOx/ha
3-7 kg S/ha

S input
deposition: 3-7 kg S/ha
mineralisation: 5-15 kg S/ha
total: 8-22 kg S/ha

S uptake in intensively managed grassland:
25-40 kg S/ha
Trial description

- 2-factorial trial
  - a) N rate
  - b) S supply
    4 replicates each, randomized

- N application split between cuts:
  100 – 80 – 60 – 40 – 40 kg N/ha at 100% rate

- no organic fertilizer

- base dressing with optimum P and K rates annually in spring

- assessments:
  - FM and DM yield
  - analysis for feed quality in each cut
  - nutrient analysis in each cut

<table>
<thead>
<tr>
<th>no.</th>
<th>product</th>
<th>rate (% of rec. rate)</th>
<th>N applied (kg/ha)</th>
<th>S applied (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>control</td>
<td>--</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>CAN+S</td>
<td>100</td>
<td>320</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>CAN+S</td>
<td>120</td>
<td>393</td>
<td>98</td>
</tr>
<tr>
<td>4</td>
<td>CAN</td>
<td>100</td>
<td>320</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>CAN</td>
<td>120</td>
<td>393</td>
<td>0</td>
</tr>
</tbody>
</table>
Trial sites

Rockstedt
• sandy soil, soil index 32
• low P and K index, pH 5.0
• trial established in 2015
• avg. 780 mm rainfall, 8.5°C

Kleve
• clay loam, soil index 49
• medium P and K index, pH 5.9
• trial established in 2015
• avg. 712 mm rainfall, 10.0°C

Moosburg
• silt loam, soil index 83
• medium P and K index, pH 6.9
• trial established in 2016
• avg. 814 mm rainfall, 7.7°C
• base dressing with sulphur
Sulphur fertilization increased tissue S content in grassland on all sites

HSD (5%) = 0.004 s.

Sulphur concentration [\% S in DM]
Effect of N rate and S fertilization on grassland yield - all sites

sandy soil

HSD (5%) = 0.88 s.

clay loam

HSD (5%) = 0.50 s.

silt loam

HSD (5%) = 1.12 s.

n.s.

HSD (5%) = 0.50 s.

n.s.

n=3
Effect of N rate and S fertilization on protein content - all sites

**Sandy soil**

- 100%N
- 120%N
- S
- xS

**Clay loam**

- 100%N
- 120%N
- S
- xS

**Silt loam**

- 100%N
- 120%N
- S
- xS

Crude protein content [% DM]

- n.s.
- n.s.
- n.s.
- n.s.

n=3
Effect of N rate and S fertilization on energy content

**ME (metabolizable energy) [MJ/kg DM]**

- **Sandy soil**
- **Clay loam**
- **Silt loam**

- Control
- 100%N
- 100%N+S
- 120%N
- 120%N+S

*n=3*
## Effect of sulphur application on yield and quality parameters

<table>
<thead>
<tr>
<th>soil type</th>
<th>yield</th>
<th>protein content</th>
<th>energy content</th>
<th>protein yield</th>
<th>energy yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>sandy soil</td>
<td>+</td>
<td>+</td>
<td>0</td>
<td>393 kg/ha</td>
<td>10.4 GJ/ha (+7%)</td>
</tr>
<tr>
<td>clay loam</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-27 kg/ha</td>
<td>2.6 GJ/ha (+2%)</td>
</tr>
<tr>
<td>silt loam</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>-87 kg/ha</td>
<td>4.3 GJ/ha (+3%)</td>
</tr>
<tr>
<td>avg. all sites</td>
<td>+0.3 t DM/ha</td>
<td>+0.2%DM</td>
<td>+0.18 MJ/kg DM</td>
<td>+93 kg/ha</td>
<td>+5.8 GJ/ha (+4%)</td>
</tr>
</tbody>
</table>
Effect of N rate and S fertilization on energy yield – results from 2 years (2016-2017)

6.5 GJ replaces 0.5 t of concentrate with an energy content of 13 MJ ME/kg DM

n=6
Conclusion

S deficiency is a problem in grassland production
- decreasing sulphur deposition
- low efficiency of sulphur from organic sources

Grassland responds significantly to sulphur application
- Increase in dry matter yield and quality

Sulphur application gives a benefit to the farmer
- As a result from two years, increased energy yield of 4% potentially saves expenses for 500kg of concentrates
Effect of N rate and S fertilization on energy yield

metabolizable energy yield [GJ/ha]

sandy soil

clay loam

silt loam

100%N 120%N
 S xS

n=3
Effect of N rate and S fertilization on energy yield

- Sandy soil:
  - Control: 80 GJ/ha
  - 100% N: 160 GJ/ha
  - 120% N+S: 160 GJ/ha
  - Increase: +3%

- Clay loam:
  - Control: 60 GJ/ha
  - 100% N: 140 GJ/ha
  - 120% N+S: 140 GJ/ha
  - Increase: +1%

- Silt loam:
  - Control: 100 GJ/ha
  - 100% N: 160 GJ/ha
  - 120% N+S: 160 GJ/ha
  - Increase: +3%

All treatments have an error of 3%.
Effect of N rate and S fertilization on protein yield

- Sandy soil
- Clay loam
- Silt loam

Protein yield [kg/ha]

100%N  120%N  -S  +S

n=3
Effect of N rate and S fertilization on protein yield

- Sandy soil
- Clay loam
- Silt loam

Protein yield [kg/ha]

n=3