Subsoiling and bio-subsoilers to alleviate subsoil compaction in three maize-based cropping systems on a sandy loam soil

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Soil compaction in Flanders

- **Small parcel size** (e.g., 1-2 ha)
- Increased share of crops with a **late-season harvest**
  - Area of maize, potatoes and sugar beets +50% in 40 years (1980-2020)
- **Heavy** farming machinery
- Recent field observations by Lin et al. 2022 in East and West Flanders
Remediation of soil compaction

Deep rooting plant species with the capacity to grow through compacted soil layers → **Long-term** (Bakema et al. 2023)

Loosening of the subsoil by lifting it up, without mixing or inversion → **Short-term** (Bakema et al. 2023)

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Field experiment in Melle

**Remediation**
- Subsoiling
- Bio-subsoilers
  - Fodder radish (cover crop)
  - Alfalfa (perennial crop)
- Avoiding recompaction
# Experimental design

### Legend:
- **Subsoiled**
- Rotation 1 - Maize monoculture
- Rotation 2 - Maize/winter cereal rotation + fodder radish cover crop
- Rotation 3 - Maize/alfalfa rotation

<table>
<thead>
<tr>
<th>Rotation 1</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>↓↓</td>
<td>Maize</td>
<td>Maize</td>
<td>Maize</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rotation 2</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>Winter wheat ↓↓ + Fodder radish</td>
<td>Maize</td>
<td>Winter barley + Fodder radish</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rotation 3</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>Winter wheat ↓↓ + Alfalfa</td>
<td>Alfalfa</td>
<td>Alfalfa</td>
<td></td>
</tr>
</tbody>
</table>

↓↓: Subsoiling
Subsoiling

Rotation 1: October 2019

Rotations 2 & 3: August 2020
Subsoiling: short-term effect
Subsoiling: effect over time

![Graph showing the effect of subsoiling over time with difference in penetration resistance (MPa) against time after subsoiling (Day)].

**Legend:**
- Orange: Maize mono culture
- Green: Fodder radish
- Brown: Alfalfa

**Subsoiled sub-plot – Control sub-plot**

Legend:
- Blue: Subsoiled
- Yellow: Rotation 1 - Maize monoculture
- Green: Rotation 2 - Maize/winter cereal rotation + fodder radish cover
- Brown: Rotation 3 - Maize/alfalfa rotation

*Vanderhasselt 2023*
Bio-subsoilers

Control Rotation 2 & 3 – Control Rotation 1

Vanderhasselet 2023
Bio-subsoilers

2020

2021

Vanderhasselt 2023
Crop Yields

Crop yield - DM (kg ha⁻¹)

- ROT1 - 2020
- ROT1 - 2021
- ROT1 - 2022
- ROT2 - 2021
- ROT2 - 2022
- ROT3 - 2021

Control

DT
Conclusions

Subsoiling
• Highly effective to remove restricting subsoil layers
• Crop response highly variable; depends on weather and subsoil
• Very fast (i.e., after one year) recompaction

Bio-subsoilers
• Slower remediation process, but indications of beneficial impact (fodder radish)
• Avoiding recompaction after subsoiling
2023

- **Silage maize is grown** in all rotations
- **3 different N-levels** (0, 100 & 200 kg N/ha)
- **EJP SOIL – SOIL X**: determination of soil physical, hydraulic and mechanical properties
Thank you!