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

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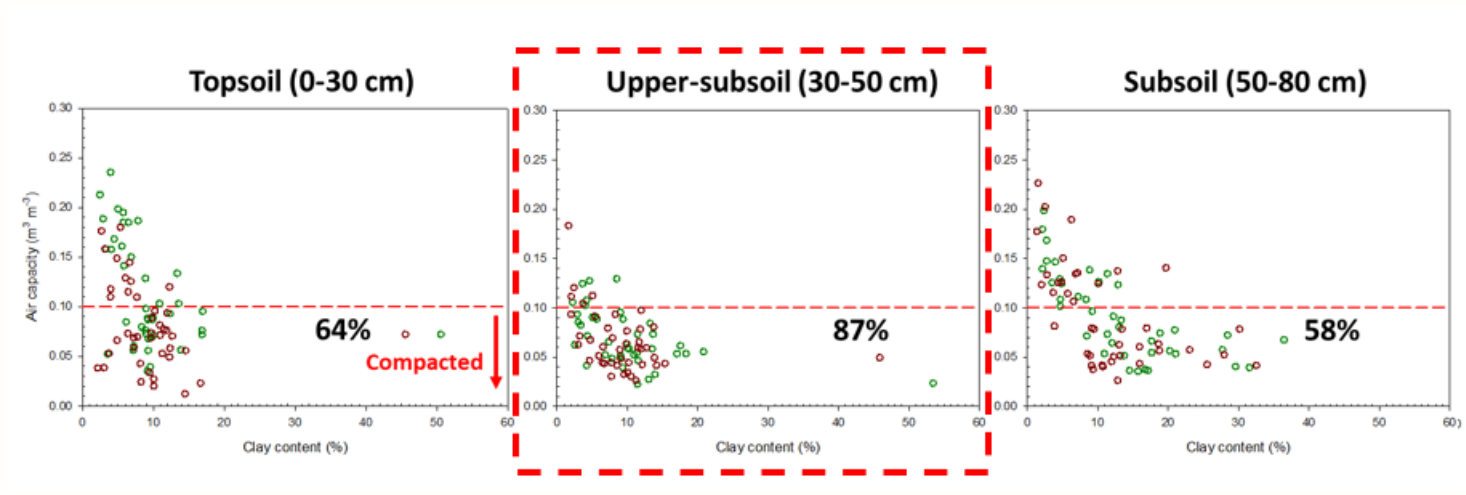
ILVO
Flanders research institute for agriculture, fisheries and food

GHENT UNIVERSITY

Soil compaction in Flanders

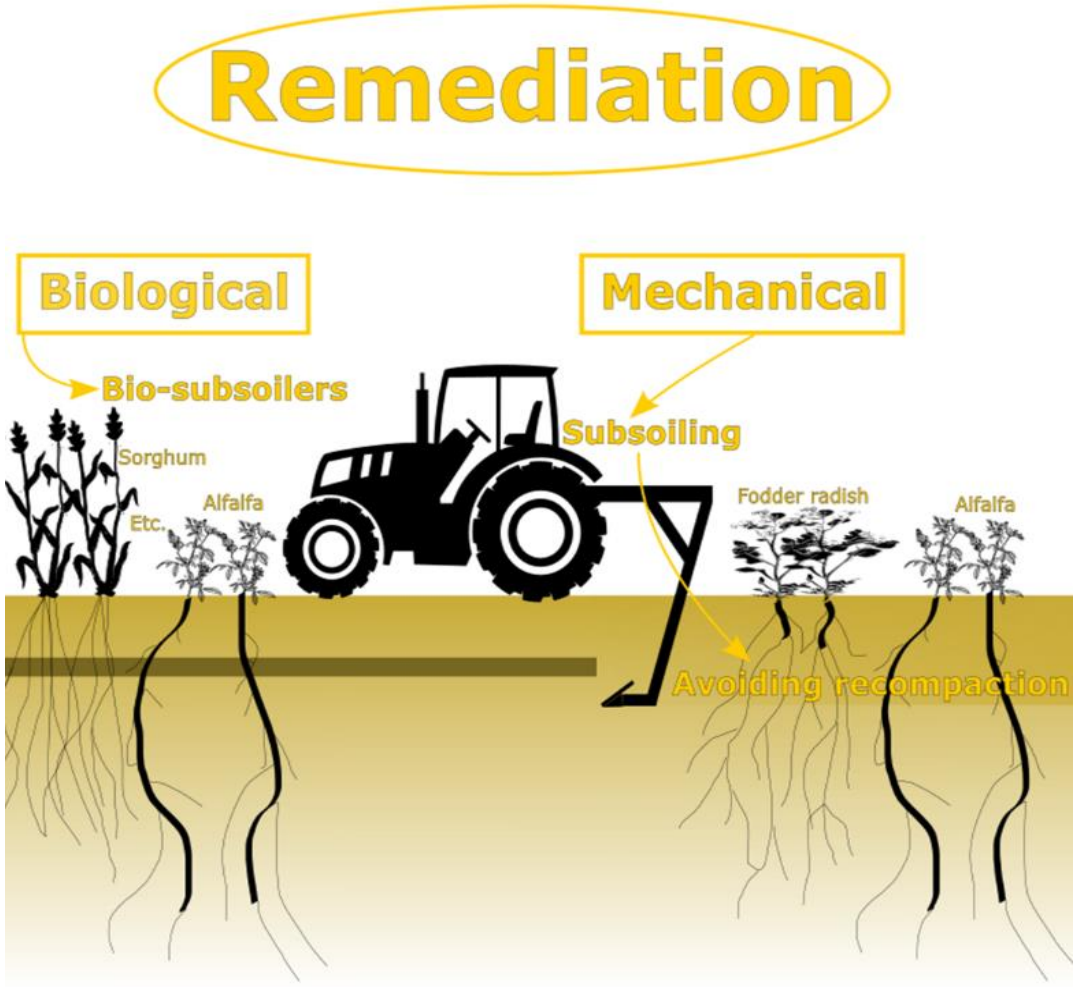
- **Small parcel size** (e.g., 1-2 ha)
- Increased share of crops with a **late-season harvest**
  → Area of maize, potatoes and sugar beets +50% in 40 years (1980-2020)
- **Heavy** farming machinery
- Recent field observations by Lin et al. 2022 in East and West Flanders



Remediation of soil compaction

Deep rooting plant species with the capacity to grow through compacted soil layers

→ **Long-term** (Bakema et al. 2023)

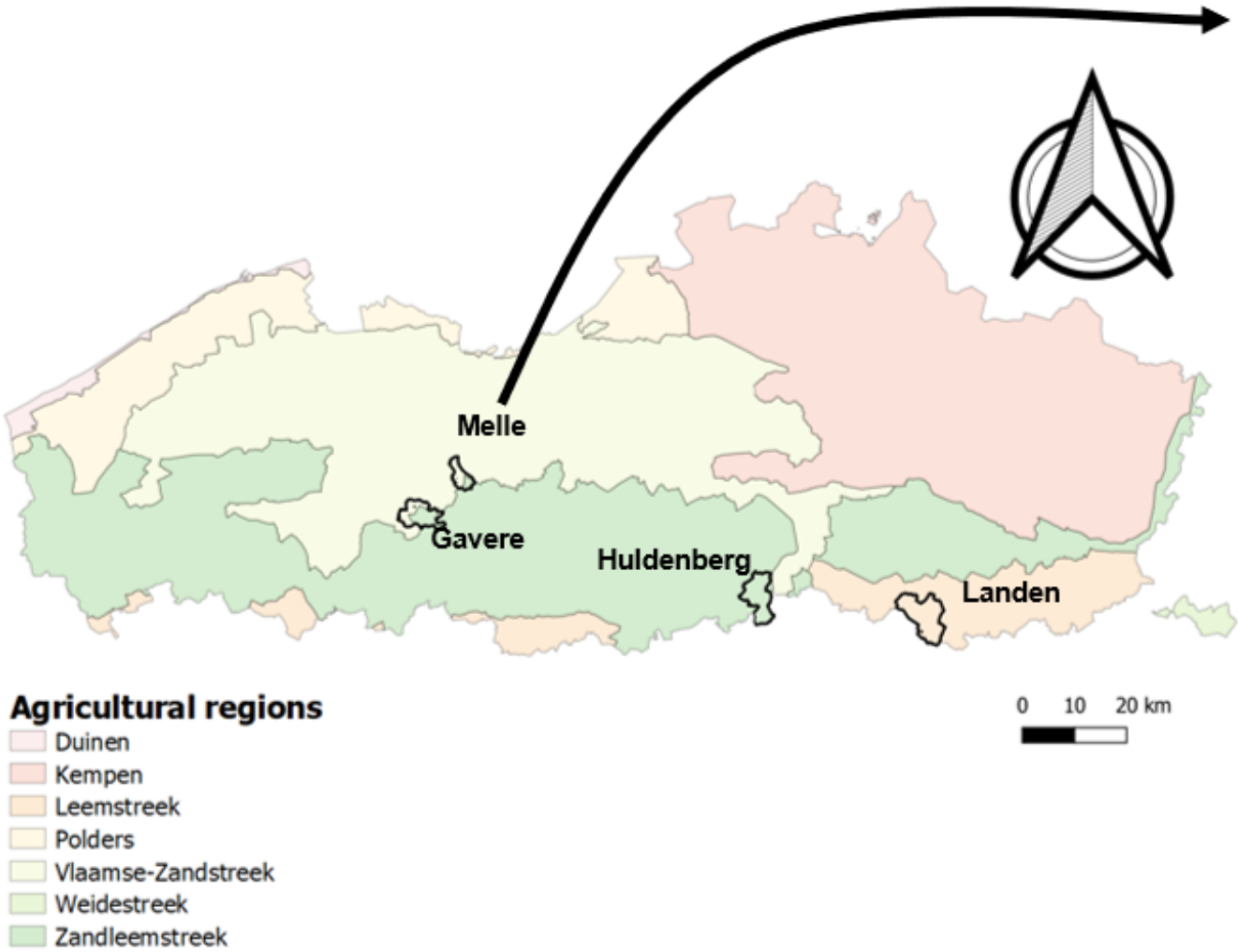


Loosening of the subsoil by lifting it up, without mixing or inversion

→ **Short-term** (Bakema et al. 2023)

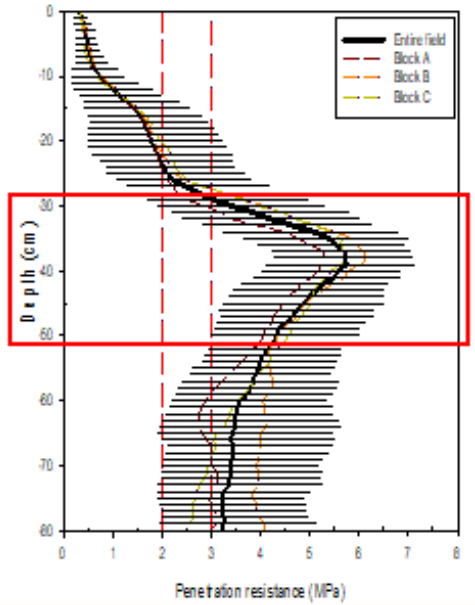
Vanderhasselt, A. 2023. Prevention and remediation of soil compaction from field operations on arable land. PhD thesis. Ghent University.

Field experiment in Melle

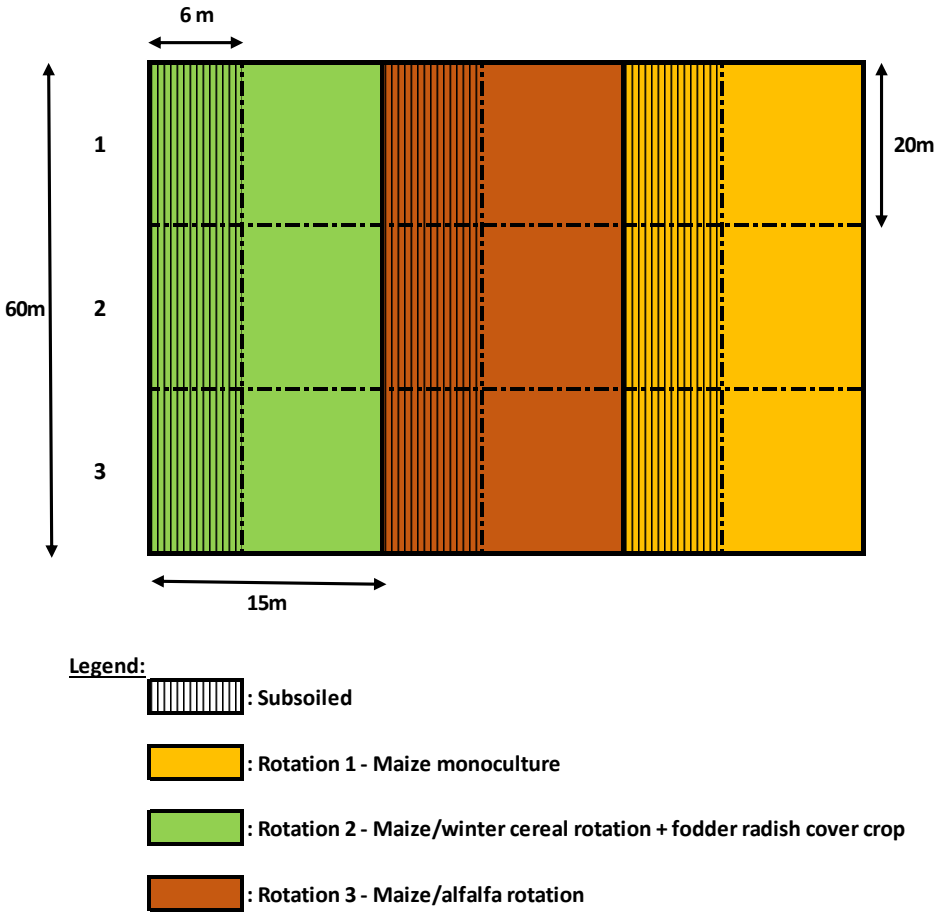


Remediation

- Subsoiling
- Bio-subsoilers
  - Fodder radish (cover crop)
  - Alfalfa (perennial crop)
- Avoiding recompaction



Experimental design



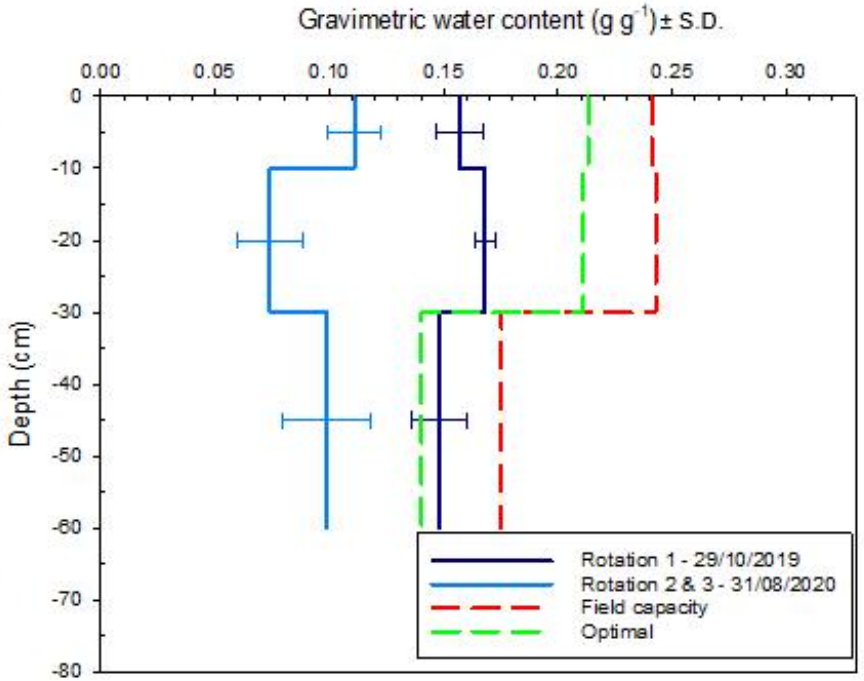
	2019	2020	2021	2022
Rotation 1	Maize ↓↓	Maize	Maize	Maize
Rotation 2	Maize	Winter wheat ↓↓ + Fodder radish	Maize	Winter barley + Fodder radish
Rotation 3	Maize	Winter wheat ↓↓ + Alfalfa	Alfalfa	Alfalfa

↓↓: Subsoiling

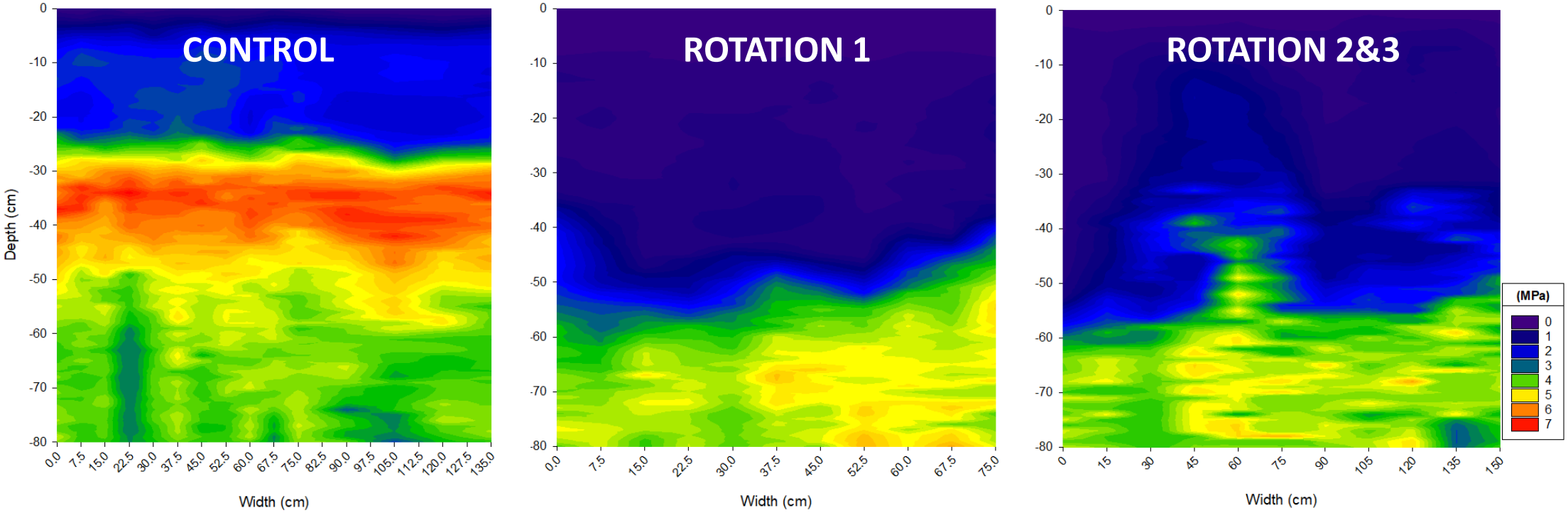
Subsoiling

Rotation 1: **October 2019**

Rotations 2 & 3: **August 2020**



Subsoiling: short-term effect



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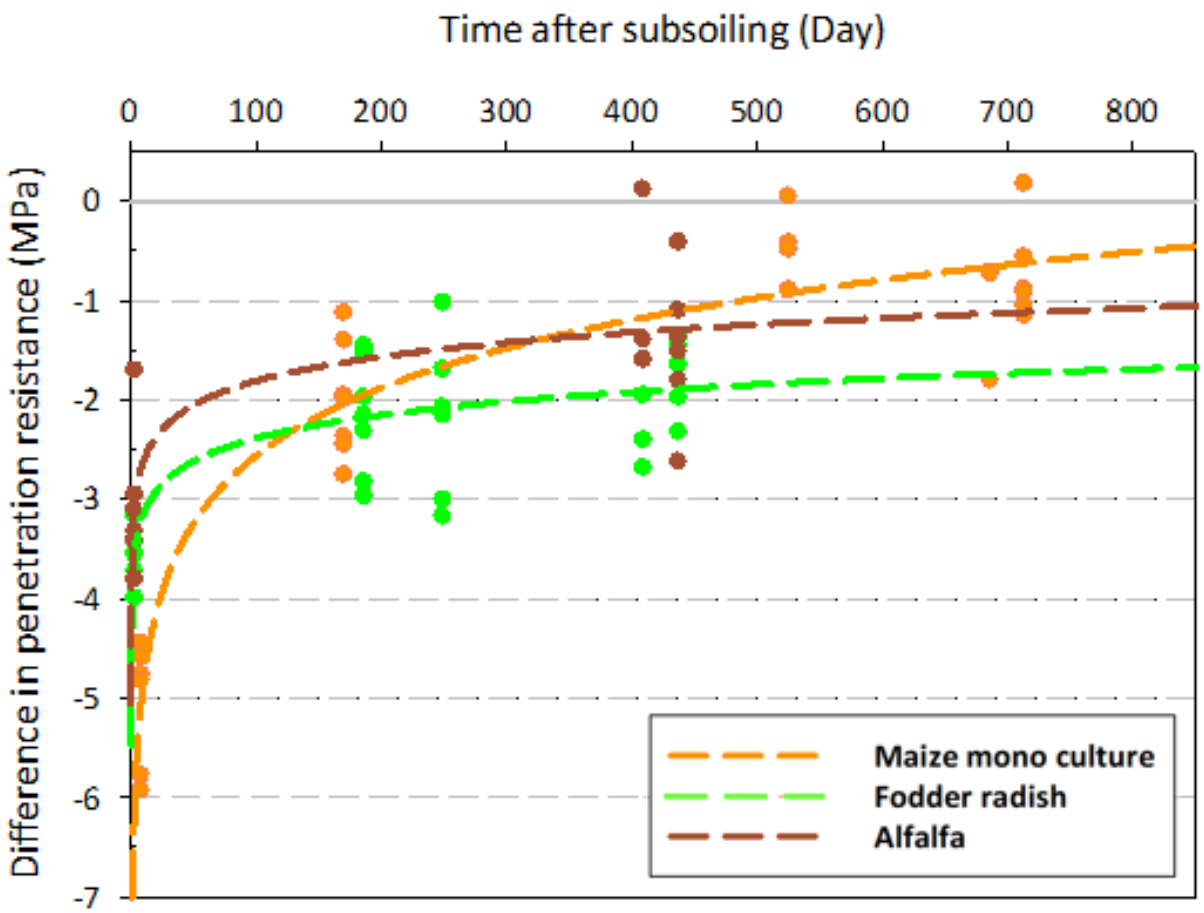
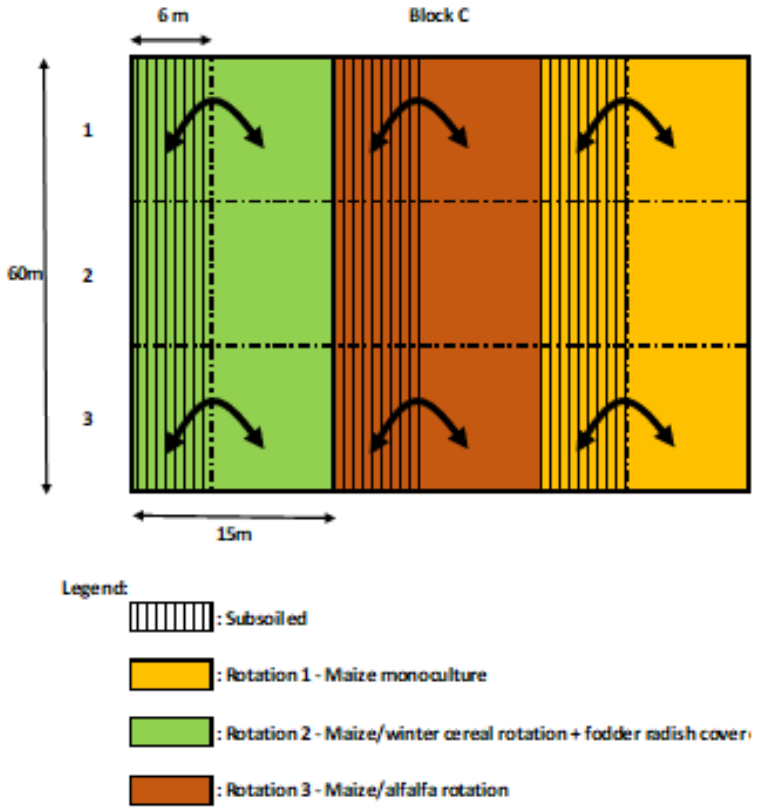
Subsoiling: effect over time



Subsoiled sub-plot – Control sub-plot



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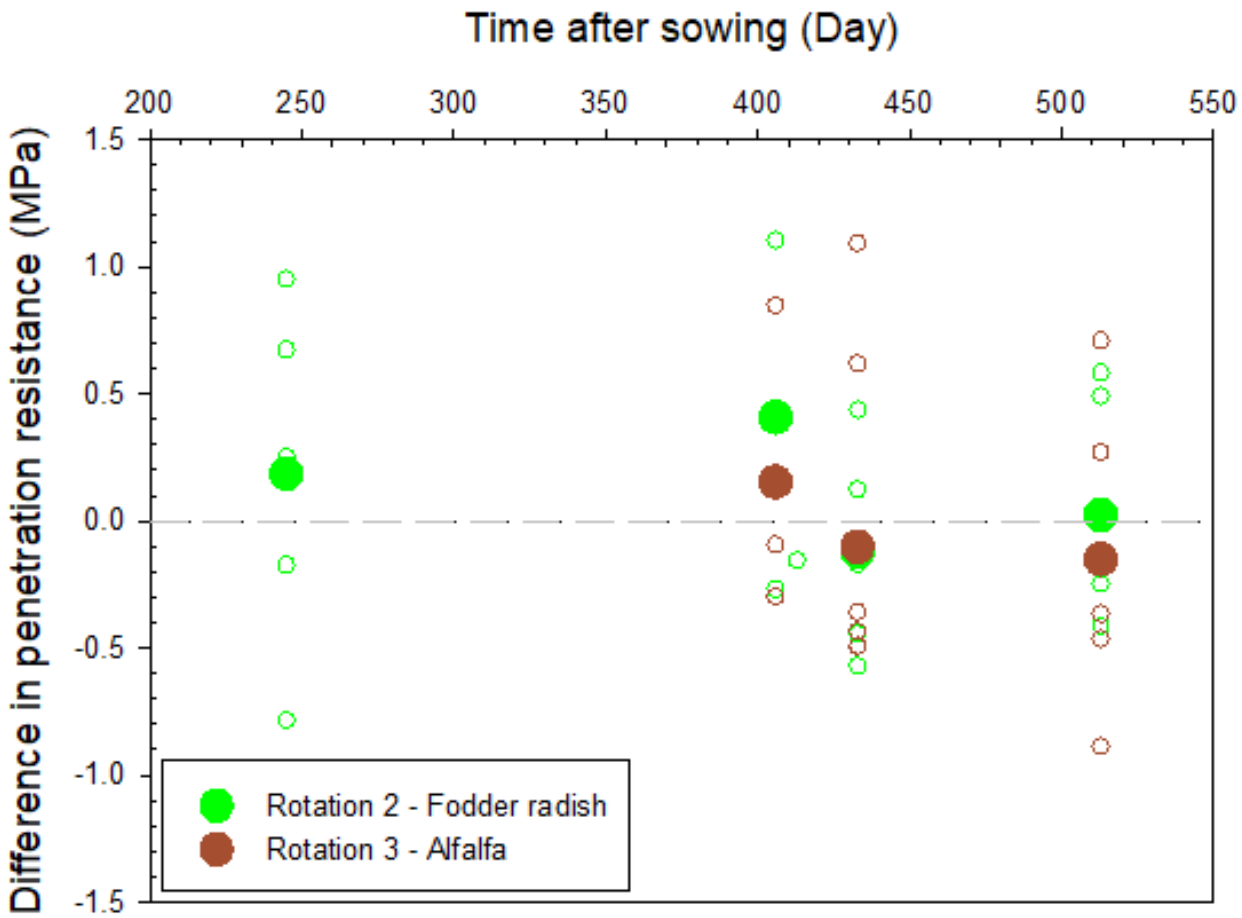
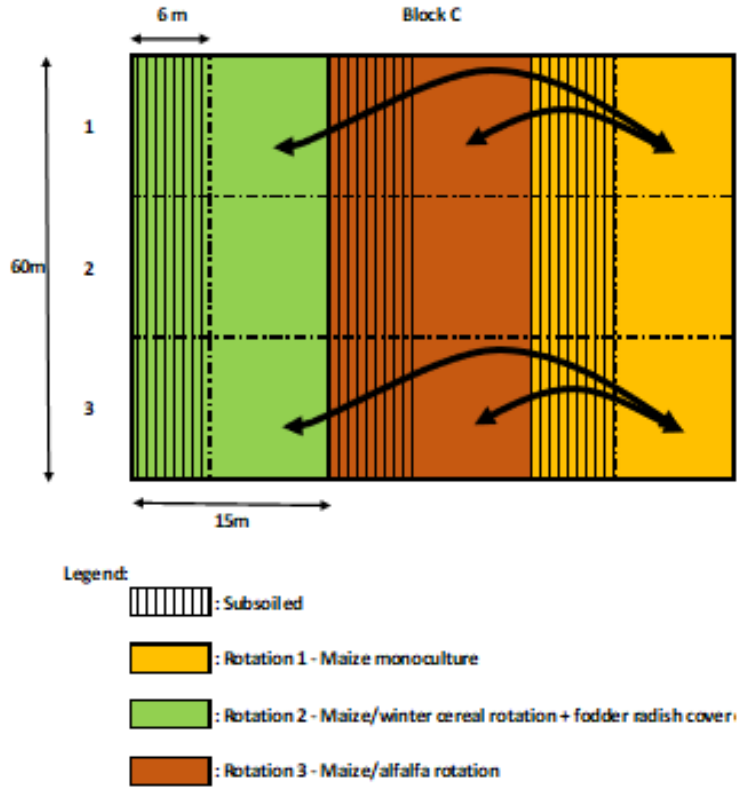
Bio-subsoilers

Control Rotation 2 & 3 – Control Rotation 1





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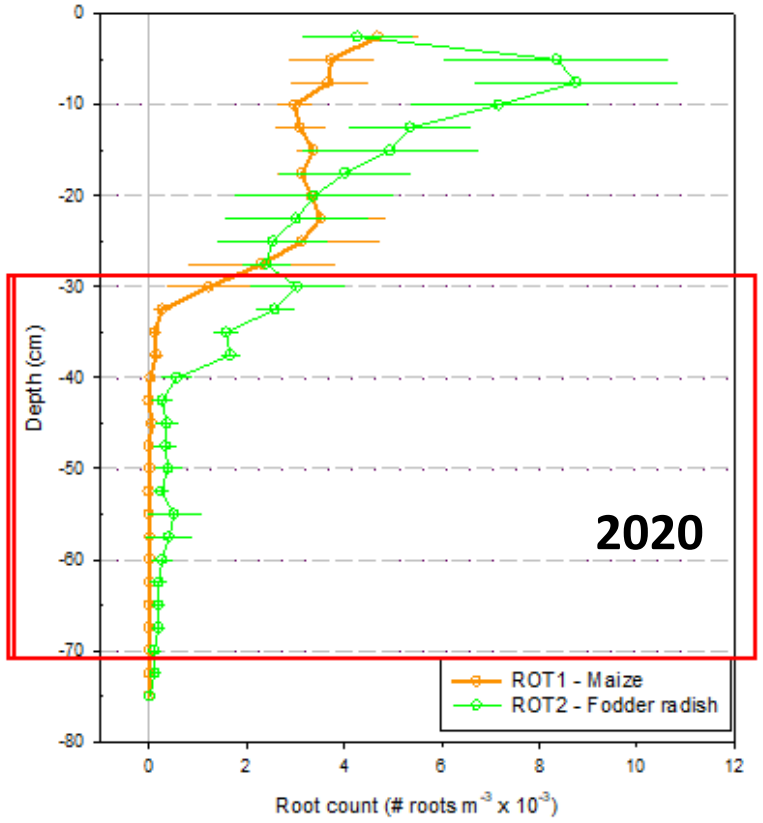
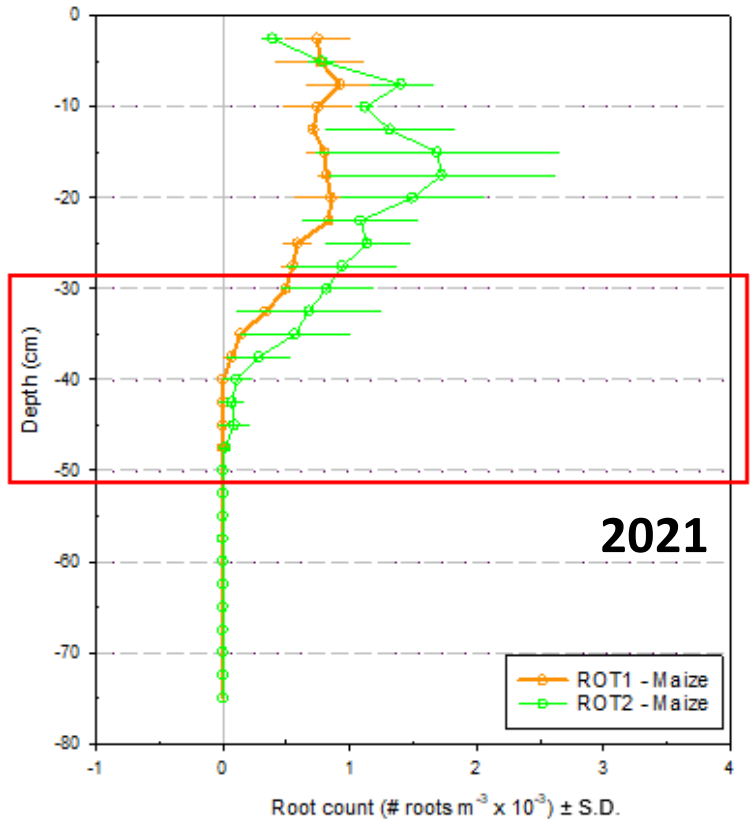
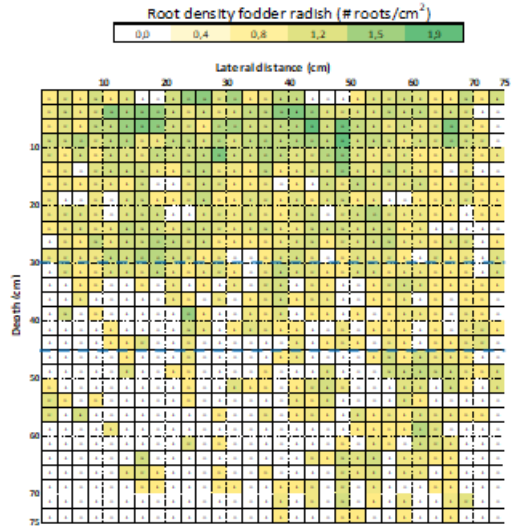
Bio-subsoilers







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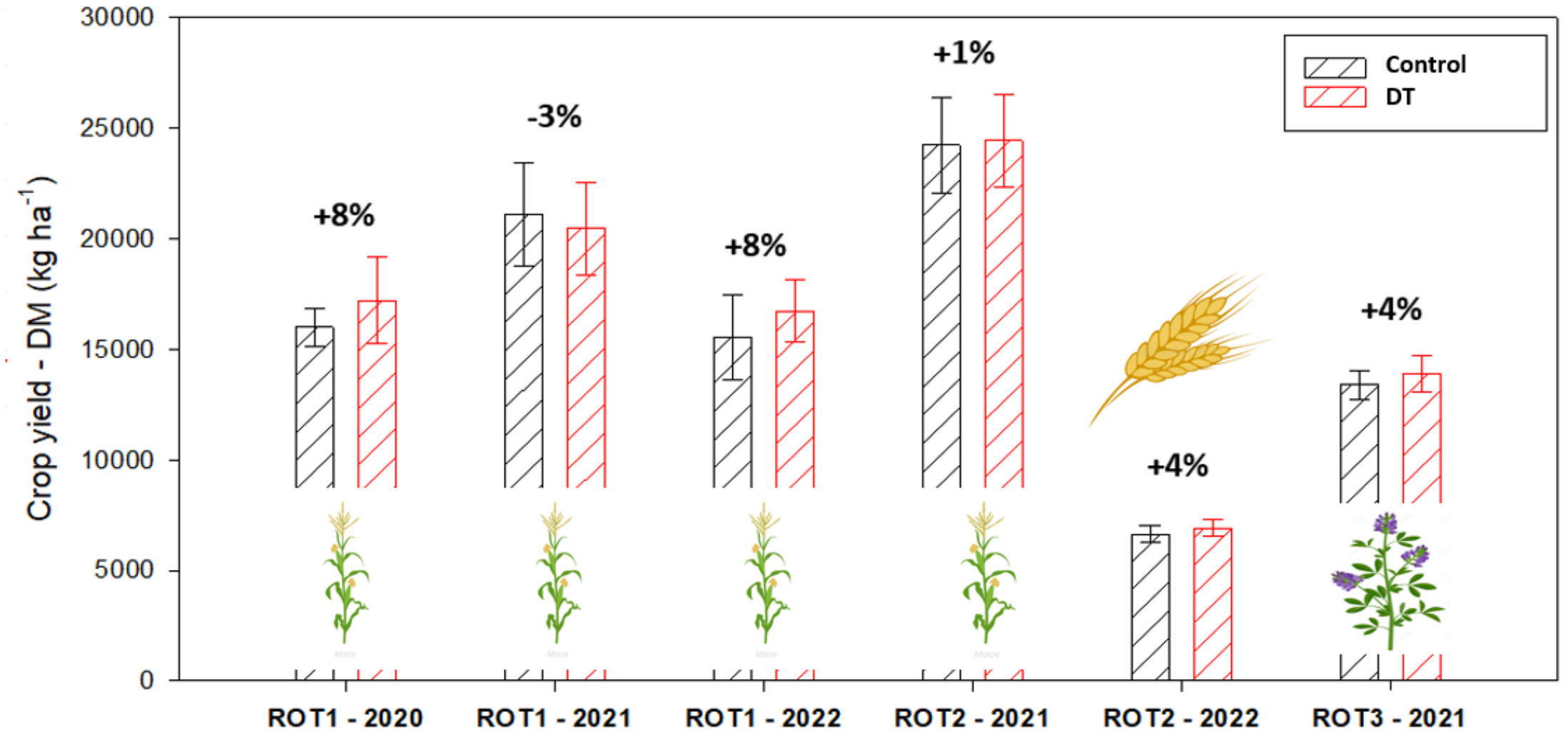
Crop Yields


Crop yield - DM (kg ha-1)
30000
25000
20000
15000
10000
5000
0
Control
DT
+8%
-3%
+8%
+1%
+4%
+4%
ROT1 - 2020
ROT1 - 2021
ROT1 - 2022
ROT2 - 2021
ROT2 - 2022
ROT3 - 2021

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

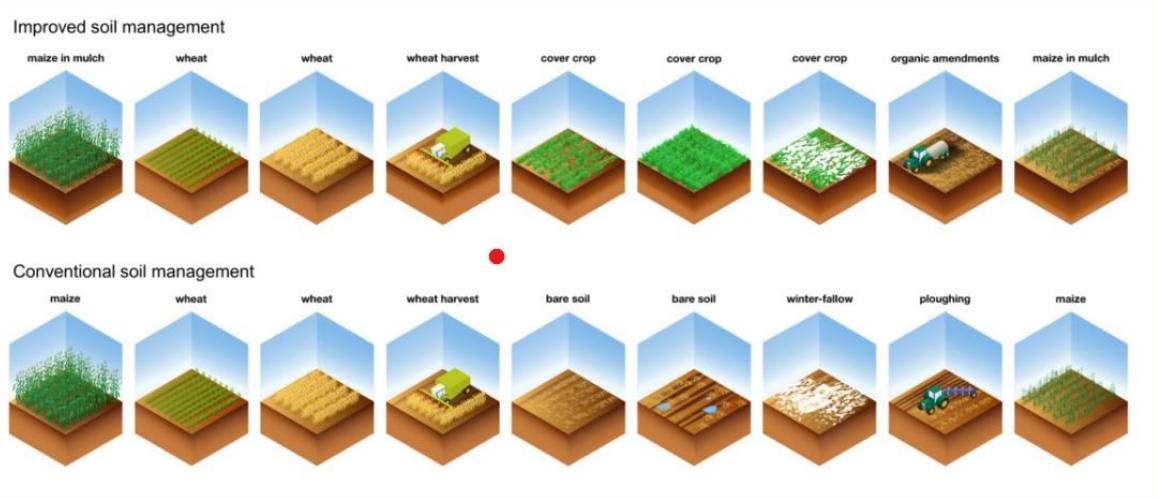
Bio-subsoilers

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

2023

	2019	2020	2021	2022	2023
Rotation 1	Maize ↓↓	Maize	Maize	Maize	Maize
Rotation 2	Maize	Winter wheat ↓↓ + Fodder radish	Maize	Winter barley + Fodder radish	Maize
Rotation 3	Maize	Winter wheat ↓↓ + Alfalfa	Alfalfa	Alfalfa	Maize

- **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!

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