Monitoring the temporal evolution of soil structure in three innovative production systems in the field

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1. CONTEXT

- Alternative practices are emerging to ensure more sustainable production systems
- New agricultural practices and varying climatic conditions = impacts on soil structure and hydraulic properties
- Temporal variations are poorly studied and rarely considered in models
- Mostly investigated using punctual measurements, leading to inconsistent results

2. PROJECT

The aim of this project is :

- to carry out hydrological monitoring of three innovative systems
- to extract the temporal evolution of hydrodynamic properties and soil structure

The systems are pesticide-free and have long-term rotations of 8 years with intercrops :

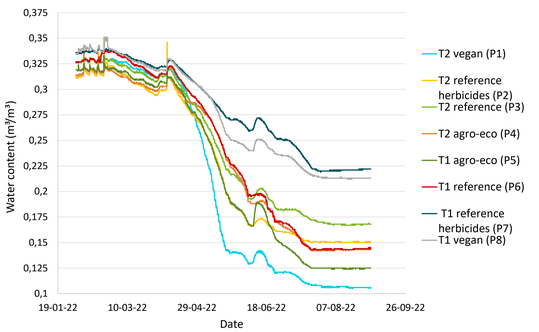
1: animals out of soil with only importations and exportations (reference)

2: animals in an agro-ecological interaction with grazing periods

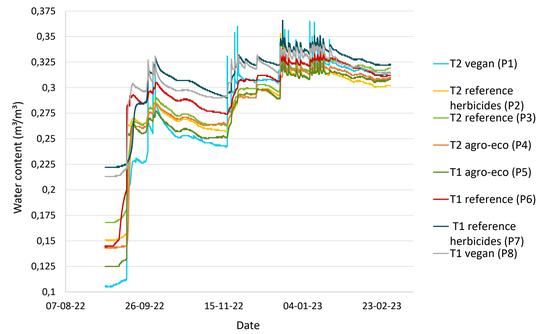
3: animal-free and considered vegan

YEAR 2 : 2022-2023

Drying up from February to September 22

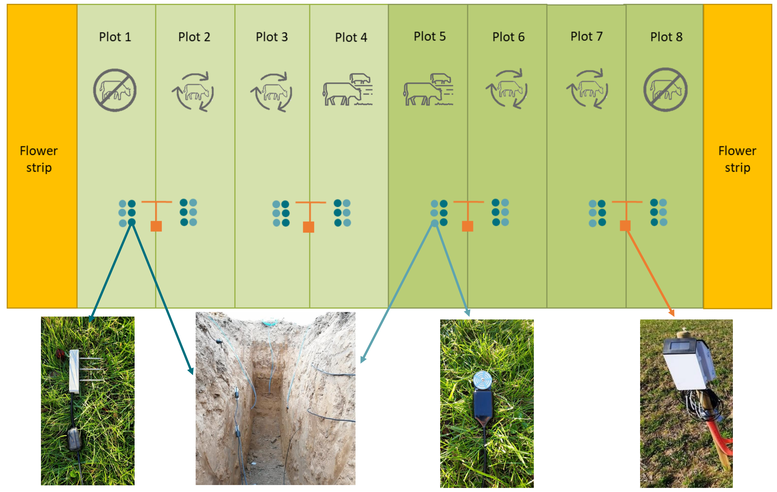


Humidification from 22 to February 23



- Year 2 = winter wheat on all plots
- Different soil drying dynamics
  ⇒ impact of the previous crop
- Plots T2 (rapeseed year 1)
  ⇒ lower water retention than T1
- T1 reference herbicide retain water better than without herbicides
  ⇒ less weeds that pump water
- Plot T1 vegan (camelina year 1) has better water retention than plot T1 reference (beet year 1)
  ⇒ reduced tillage and lighter machinery
- T1 agroeco plot (maize year 1) has lower water retention than other T1 plots
  ⇒ earlier harvest and different root system
- Gradual wetting from September 22

3. EXPERIMENTAL DESIGN



Three systems + a variant with the use of herbicides of the reference system

The four rotations are implemented at two temporalities (year 1 for plot 5 to 8 and year 5 for plot 1 to 4).

⇒ implemented on 8 plots (84x18 m) at Gembloux on a typical loamy soil of northern Wallonia

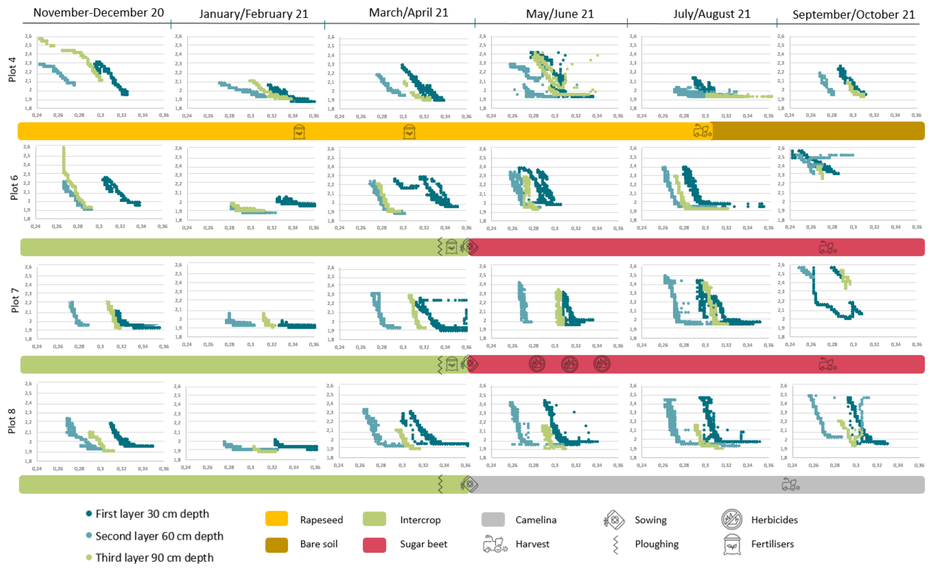
In each of the 8 plots, hydrological monitoring is performed using :

- Three Teros 12 water content sensors at 30, 60 and 90 cm
- Three Teros 21 potential sensors at 30, 60 and 90 cm
- A ZL6 data logger, connected to the six probes, which allow data collection

4. RESULTS

YEAR 1 : 2020-2021

Temporal evolution of the retention curve of 4 plots. Graphs of pF versus water content (m³/m³)



- May/June : more dispersed curves in rapeseed = varied weather conditions and several changes in soil structure
- Water infiltration is lower in T1 plots where plowing and seeding have created a more aerated soil structure various crops can influence the soil structure up to at least 90 cm
  ⇒ crops can influence the soil structure up to at least 90 cm
- After March/April : the curve at 30 cm shifts significantly to the left for plot 6 without herbicides and not for plot 7
  ⇒ Many weeds on plot 6 may have caused a change in the surface soil structure
- Between July/August and September : all curves move upwards to the left for plots 6 and 7 because of the harvesting of beets with heavy machinery.
- In contrast, harvesting camelina with a small, lighter harvester has little effect on retention curves.
  ⇒ Soil compaction to a depth of at least 90 cm

5. CONCLUSIONS

- Hydrodynamic properties vary over time and are affected by agricultural practices and weather conditions
- Agricultural practices can lead to changes in the hydrodynamic properties and thus in the soil structure to a depth of at least 90 cm
- Various crops can influence water retention behavior the following year
- These changes in the hydrodynamic properties of soils over time must be taken into account
- Monitoring must continue in order to assess the relevance of these innovative agricultural systems

ACKNOLEDGEMENT

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