# A comprehensive database for evaluating the impact of contrasting agricultural systems on soil water dynamics and agrochemical leaching

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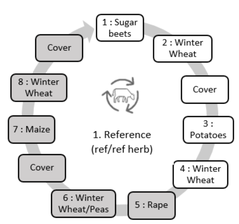
## 1. CONTEXT

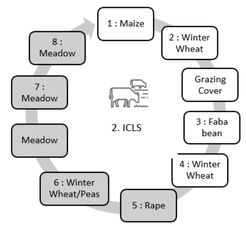
- Soil water and solute dynamics are important for many environmental challenges (climate change, water protection, food security, ...)
- Sustainable agricultural practices are needed, but their effects on the temporal variability of hydraulic properties are poorly studied and overlooked in models
- This leads to poor decision-making and incorrect predictions of floods, droughts, …
- Need to study the long-term in-situ evolution of soil water and structure under contrasting sustainable production systems to assess their relevance for the future

## 2. ECOFOODSYSTEM EXPERIMENT

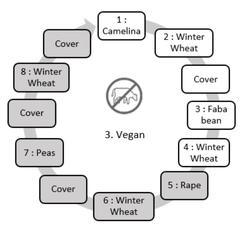
Designed to produce food for the future according to the EAT-Lancet, the three systems have long-term rotations of 8 years with intercrops and limited inputs:



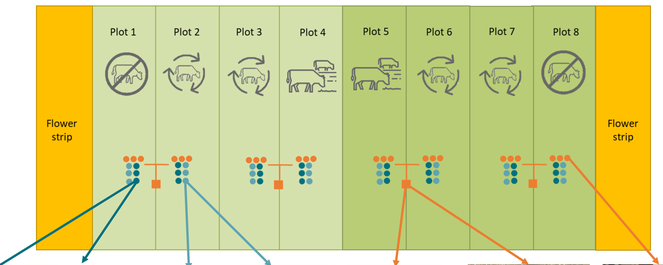

1: animals out of soil (with/without herbicides)




2: Integrated crop-livestock with grazing periods




3: animal-free




The four rotations are implemented at two temporalities (year 1 for plot 5 to 8 and year 5 for plot 1 to 4) on 8 plots (84x18 m) in Gembloux on a typical loamy soil of northern Wallonia (Belgium)

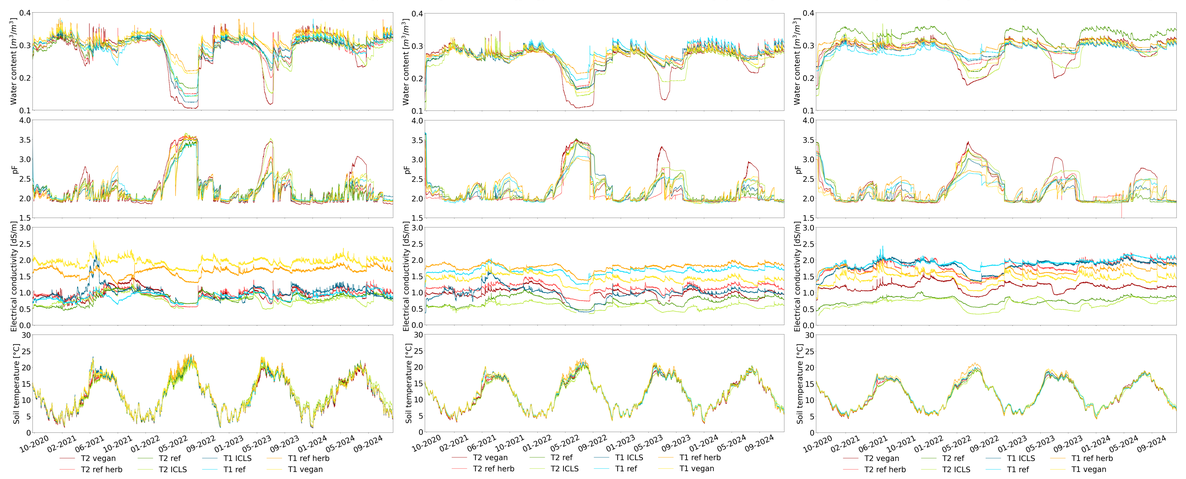
In each of the 8 plots, hydrological monitoring is performed since October 2020 using :

- Three MeterGroup Teros 12 water content/electrical conductivity/soil temperature sensors at 30, 60 and 90 cm depth
- Three MeterGroup Teros 21 potential sensors at 30, 60 and 90 cm depth
- Three EcoTech glass soil solution sampling plates at 120 cm depth
- A ZL6 data logger connected to the six probes used to collect data + An isothermal box containing water collecting bottles with a vacuum system

## 3. DATA

### A. Soil water dynamics

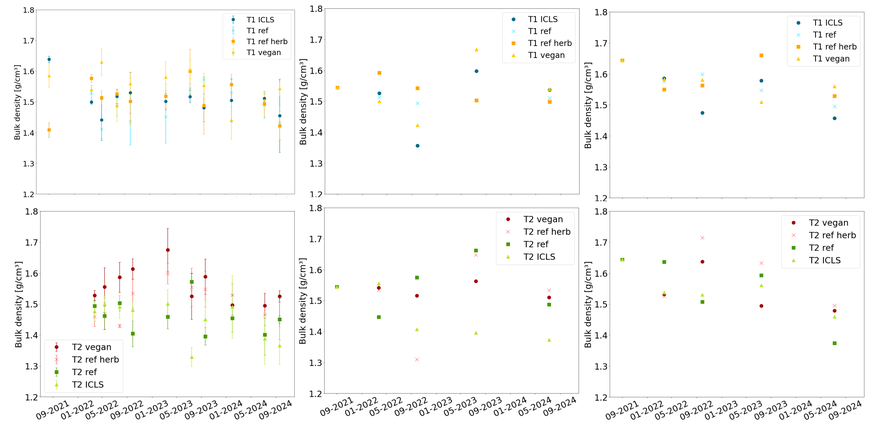
**Temporal evolution of water content (m³/m³), matric potential (pF), electrical conductivity (dS/m) and soil temperature (°C) at 30, 60 and 90 cm depth for the 8 plots from 2020 to 2024**




- 24 Teros 12 water content sensors, 24 Teros 21 potential sensors and 8 ZL6 data loggers
- Data collected every 15 minutes from October 20 to December 24, will be updated until 2028
- Minimal data loss = 2.7% since the start of the experiment
- Contrasting climatic conditions between the years (floods in 2021, drought in 2022, in-between in 2023)
- Variable soil water dynamics and resilience to climate extremes depending on crop rotation, root type, weed control and residue management, also at greater depths

### B. Soil structure dynamics

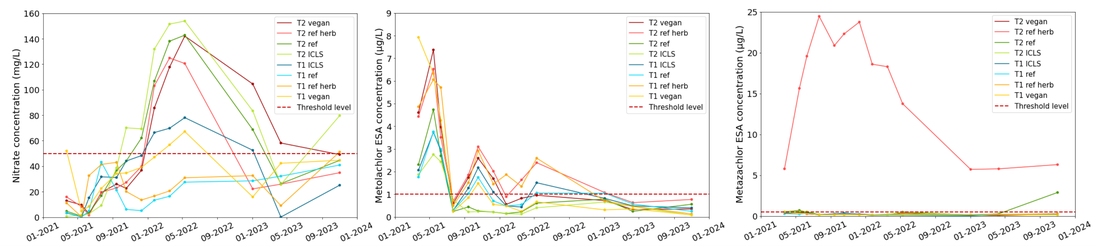
**Temporal evolution of soil bulk density (g/cm³) at 30, 60 and 90 cm depth for the 8 plots from 2021 to 2024**




- Samples taken regularly in intact structure on the 8 plots between 2021 and 2024 (Kopecki 100 cm³)
- Short- and long-term changes in soil structure for the eight plots according to agricultural practices and production systems
- Structural changes also at depth, up to 90 cm

### C. Agrochemicals leaching

**Temporal evolution of nitrate, metolachlor-ESA and metazachlor-ESA concentration at 120 cm depth for the 8 plots from 2021 to 2023**




- Monitoring of 22 molecules
- Few pesticide residues found despite repeated use and heavy rainfall
- Metabolites in high concentrations, even four years after last use (Metazachlor applied in 2021 Q2 ref herb)
- High levels of nitrate in the water, depending on the crop, application rate, residue management and form of nitrate

## 4. DATA USE AND IMPORTANCE

- Soil hydrodynamic properties vary over time and are affected by agricultural practices and climatic conditions, up to 90 cm depth
- This database provide valuable insights of temporal dynamics of soil hydraulic properties, soil structure and agrochemicals leaching
- Monitoring these changes in long-term production systems directly in the field and at multiple depths is critical for assessing the impact of sustainable agricultural practices, optimising soil water and pollution management, and addressing future challenges such as climate resilience and food security
- Data can be used to refine models and improve their predictive accuracy

## RELATED ARTICLE

How does soil water retention change over time? A three-year field study under several production systems.
Eur. J. Soil Sci. e13558, 0–20.

## ACKNOLEDGEMENT

Agriculture Is Life platform of Gembloux Agro-Bio Tech who implemented the systems

The Société Publique de Gestion de l'Eau (SPGE) who funded this project