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

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Context

- Nowadays, agricultural practices are one of the major pressures on natural resources quality, especially water.
- Alternative, more environmentally friendly, agricultural practices are emerging, but their impact on soil structure and hydrodynamic properties is poorly known or studied.
- Moreover, these properties are generally obtained by one-time laboratory measurement on an undisturbed soil sample and cannot represent the soil properties under natural conditions in dynamic situations.

Project

The aim of this project is to carry out hydrological monitoring of three innovative production systems in order 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.
The three innovative systems studied are :

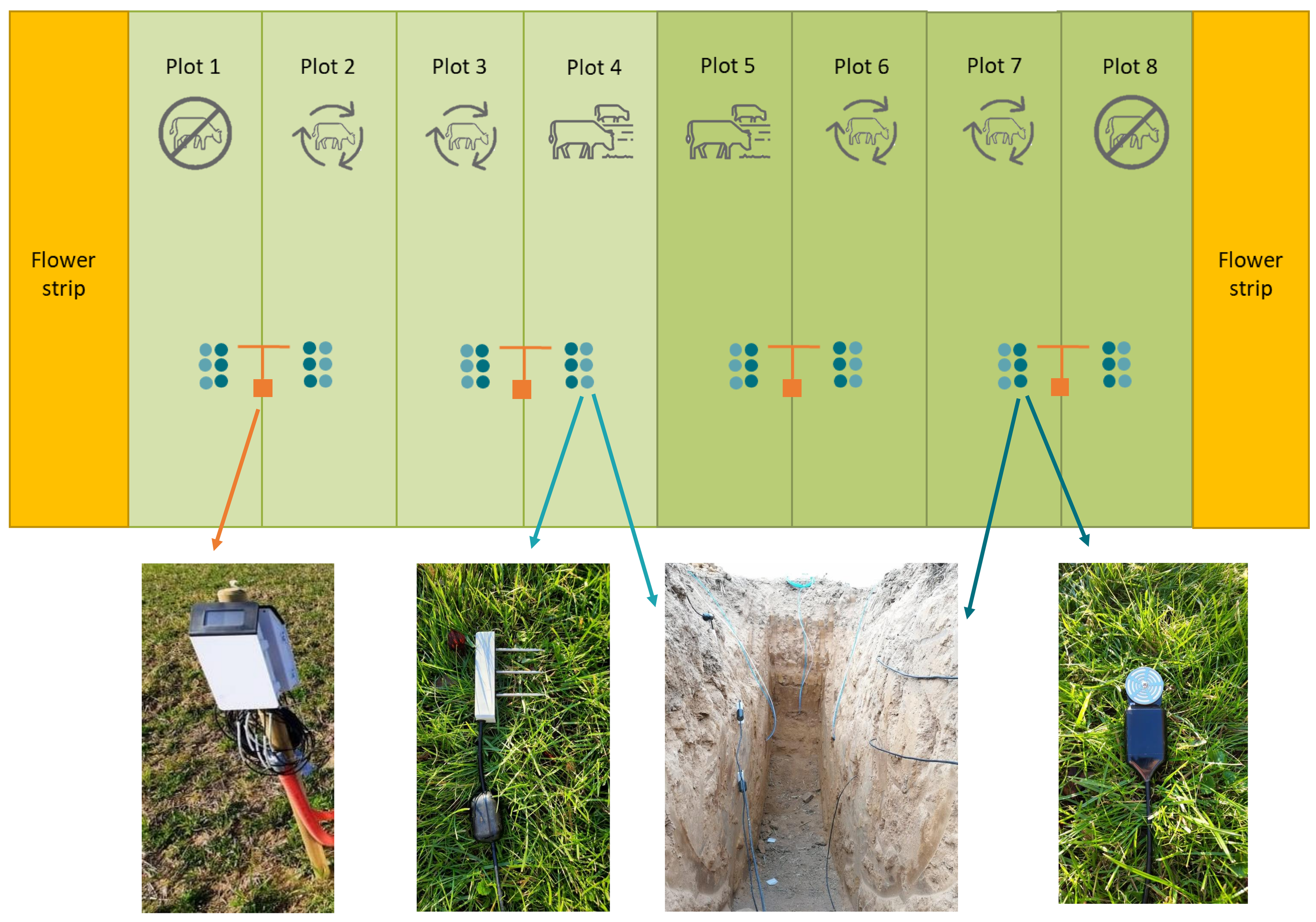
- The first system integrates the animal out of soil with only importations and exportations of animal products
- The second system is in an agro-ecological interaction with grazing periods
- The third system doesn't include animals and is considered vegan

Experimental design

The three innovative systems are implemented on 8 plots (84x18 m) at Gembloux on a typical loamy soil of northern Wallonia. The first system includes a variant with the use of herbicides. In addition, the four rotations are implemented at two temporalities (year 1 for plot 5 to 8 and year 5 for plot 1 to 4).

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

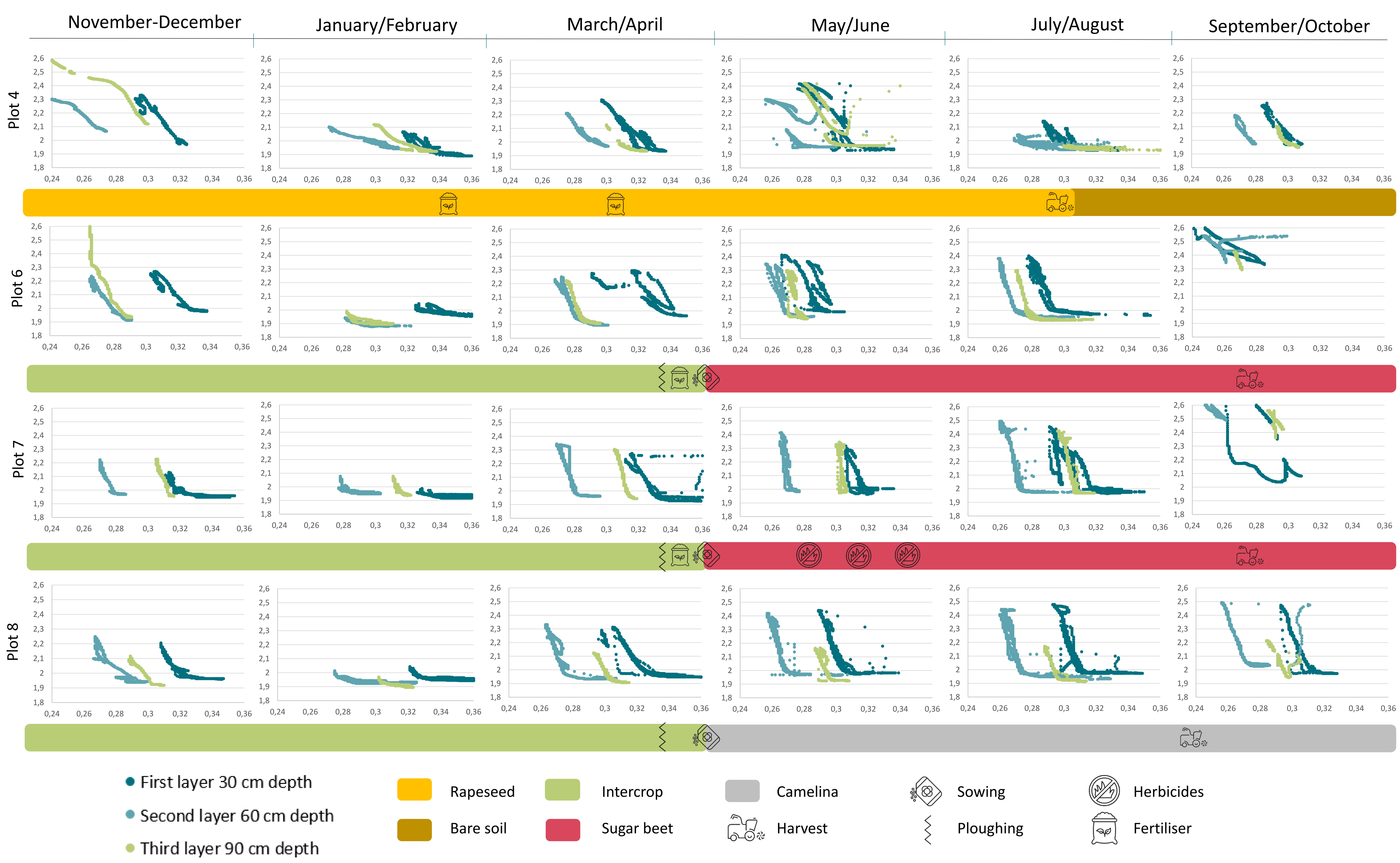
- Three MeterGroup Teros 12 water content sensors at 30, 60 and 90 cm depth
- Three MeterGroup Teros 21 potential sensors installed at 30, 60 and 90 cm depth
- A Metergroup ZL6 data logger, connected to the six probes of the plot, which allow real-time data collection



Results

- Between May/June and July/August, the curves become flatter for plot 4, while they remain similar for plots 6 and 7. These differences show that various crops can influence the soil structure up to at least 90 cm.
- Between March/April and May/June, the retention curve at 30 cm depth shifts significantly to the left for plot 6 without herbicides while it remains more similar for plot 7 with herbicides. The presence of 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. This trend can be due to the harvesting of beets with heavy machinery, which may have resulted in soil compaction to a depth of at least 90 cm. In contrast, harvesting camelina with a small, lighter harvester has little effect on the retention curves.

Temporal evolution of the retention curve of 4 different plots. Graphs of pF versus water content (m^3/m^3) for the first year of measurement



Conclusion

- Preliminary results from the first year of monitoring show that the hydrodynamic properties of soils vary over time and are affected by agricultural practices and meteorological 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.
- These changes in the hydrodynamic properties of soils over time must be taken into account.

Acknowledgements

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