Application of ramial wood chips in arable fields to improve carbon storage in the soil and soil quality

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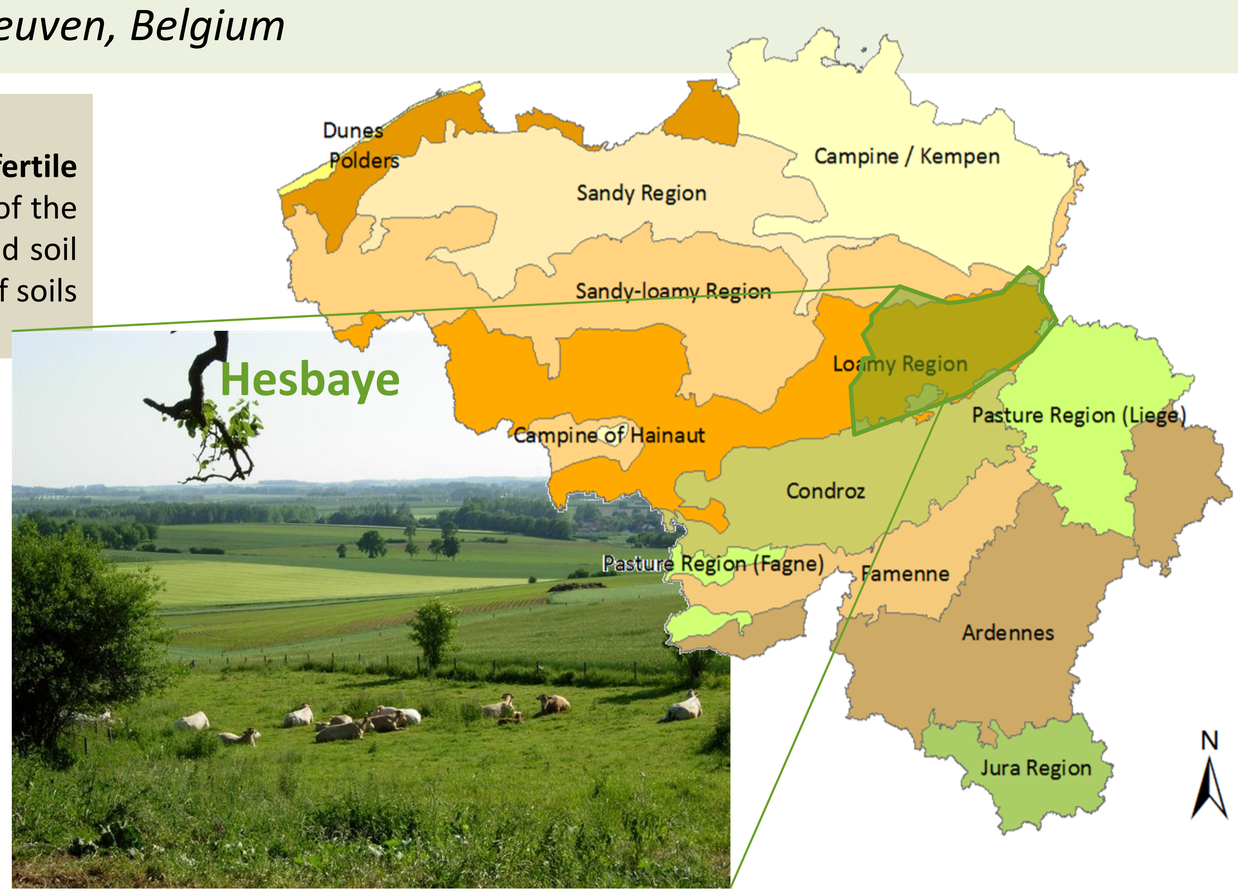
Introduction and objectives

The loamy region of Hesbaye in South-East Flanders has been characterised by highly **fertile agricultural lands** with high yields since centuries. However, according to the statistics of the Soil Service of Belgium, the **organic matter content of the soil** and thus soil quality and soil fertility, has been systematically **declining** since the 1990s, with an increasing number of soils with an organic matter content below optimum.

Beside fertile soils and **slopes**, South-East Flanders is characterised by numerous sunken lanes and hedgerows connecting natural elements in a landscape dominated by farmland. These **woody elements** are valuable for the environment, but may also be valuable for agriculture. To maintain a sustainable use of the adherent fields, regular maintenance of the hedgerows is needed. The **wood waste** resulting from this maintenance is often used as biofuel, but the small fractions are not suited for this. In this study we applied these fractions on arable fields in order to investigate the effects on crop growth and **soil quality** parameters including soil organic matter content, infiltration capacity and erosion risk.



Materials and methods

- 4 demonstrative field trials started in autumn 2016.
- Incorporation of 40 t/ha ramial wood chips * cover crops * no tillage vs normal farmers practice:
  - *trtmt 1&2: wood chips + leguminous cover crop + no tillage;*
  - *trtmt 3: wood chips + non-leguminous cover crop + no tillage;*
  - *rest: no wood chips + farmers practice.*
- Analysis of soil and wood chips, follow-up of mineral N content in the soil.
- Observations of crop emergence and development: sugar beets, chicory, fodder maize.
- Simulation of soil organic carbon (SOC) evolution with RothC:
- DPM/RPM ratio of wood chips: 0.25 (cfr. deciduous woodland (Coleman&Jenkinson, 2014),
- Calibration with historical data of each field,
- Extrapolation of previous crop rotations for the next 30 years,
- Comparison with household waste compost, solid cattle manure and incorporation of wheat straw.

Results

N-content in spring: slightly lower with wood chips; slightly higher with leguminous cover crops; no significant differences.
Crop emergence: no differences for sugar beets; slower emergence of chicory with wood chips combined with leguminous cover crops.
N-content growing season: no significant differences.
Crop development growing season: no significant differences.
Accumulation of SOC: based on RothC simulations (ex. trial Gingelom):

- Crop rotation: potatoes, winter wheat + yellow mustard, sugar beets, winter wheat + grass cutting, fodder maize, winter wheat + yellow mustard
- no organic amendment (blue lines): limited increase of SOC, equilibrium after 25 years at ± 15%C.
- wood chips (brown lines): rapid and significant increase of SOC after one application; with 5 yearly applications drastic and persistent increase of SOC, even after 25 years.
- effects wood chips >> compost (red lines) > solid cattle manure (green lines) = wheat straw (yellow lines).

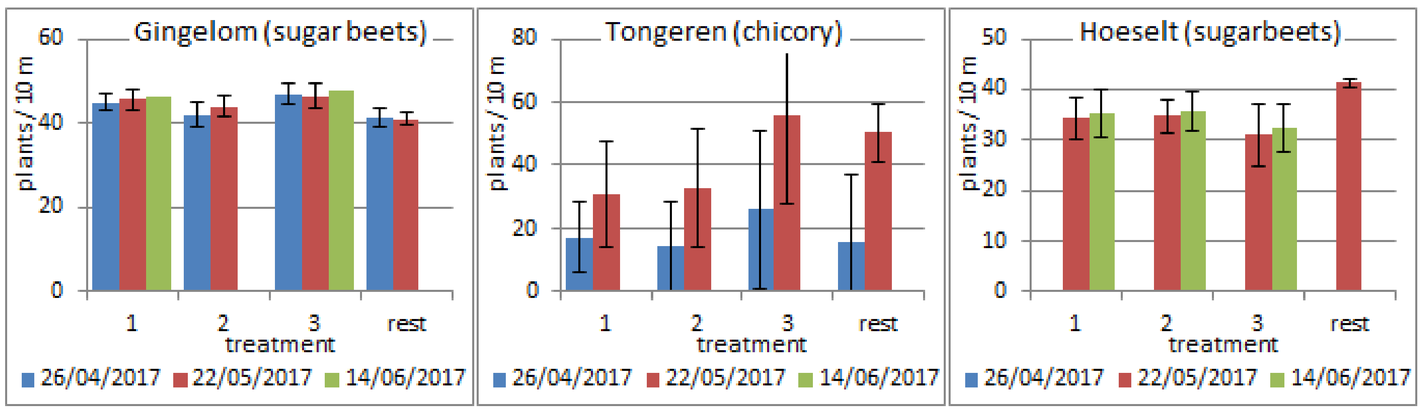


Figure 1: Crop emergence 2017: plant countings at different dates.

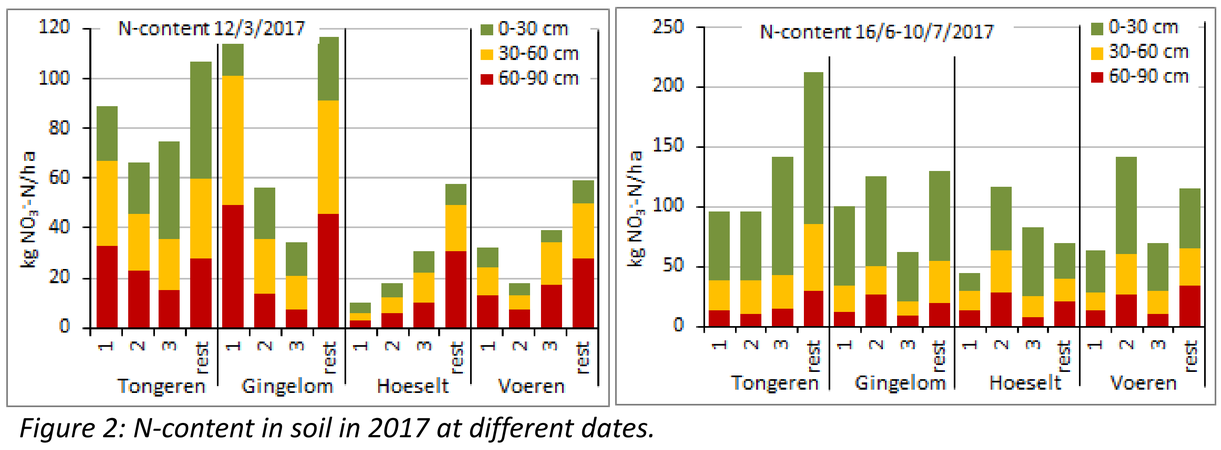


Figure 2: N-content in soil in 2017 at different dates.

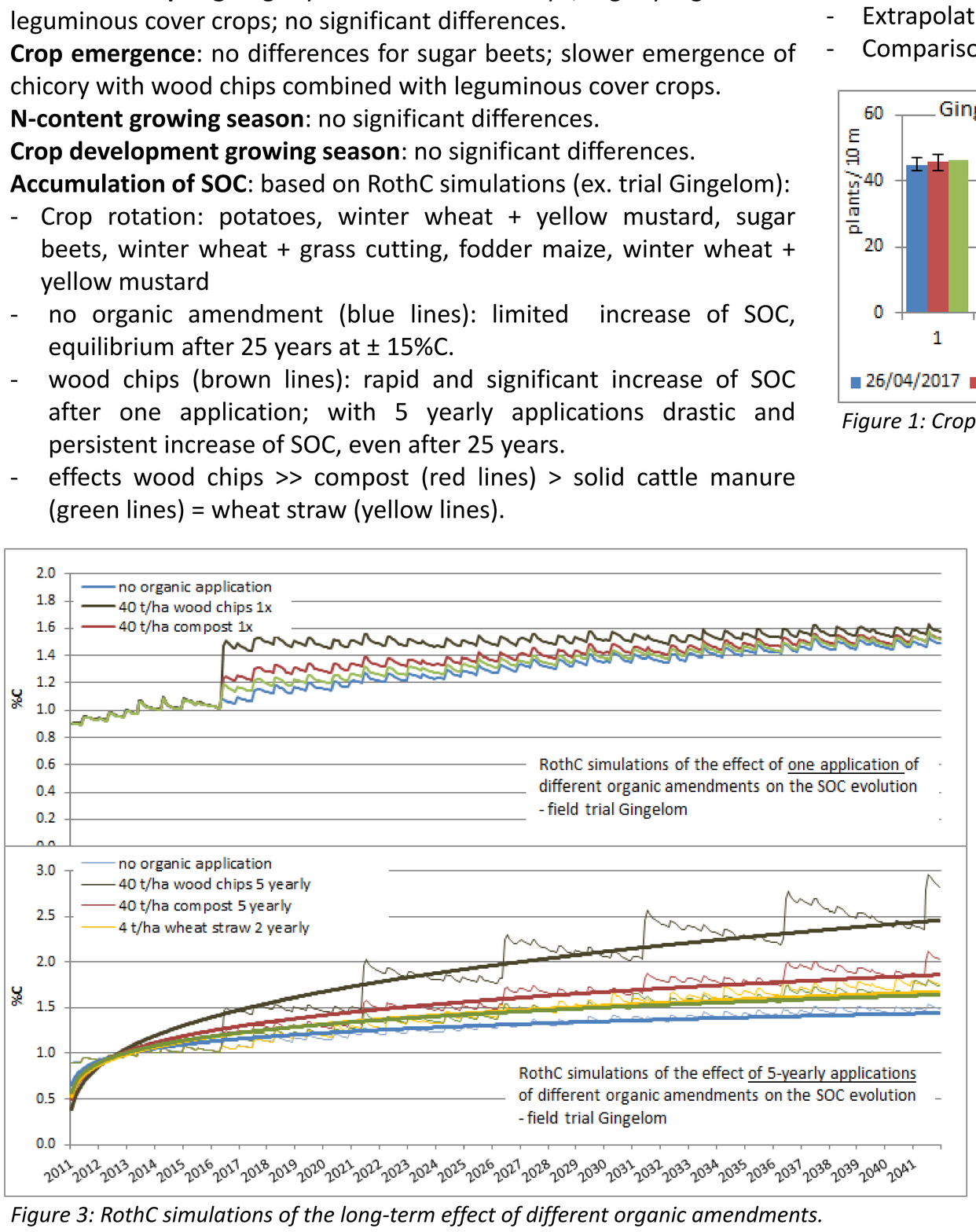


Figure 3: RothC simulations of the long-term effect of different organic amendments.

Conclusions

- "Closing the carbon cycle" by using wood waste from hedgerow management as organic soil amendment in arable land.
- Significant improvement of the quality of agricultural land expected.
- No adverse effects yet on crop emergence and development.
- Positive effects on erosion prevention and infiltration capacity not yet demonstrated (lack of precipitation in growing season 2016-2017).
- Further observations and measurements in 2017-2018 will reveal other effects on soil properties, nitrogen supply and nitrate residues.

Reference used: RothC – A model for the turnover of carbon in soil. Model description and users guide (updated June 2014). Coleman K.; Jenkinson D.S. Rothamsted Research, Harpenden, UK.