Effect of alley cropping agroforestry on soil microbial communities

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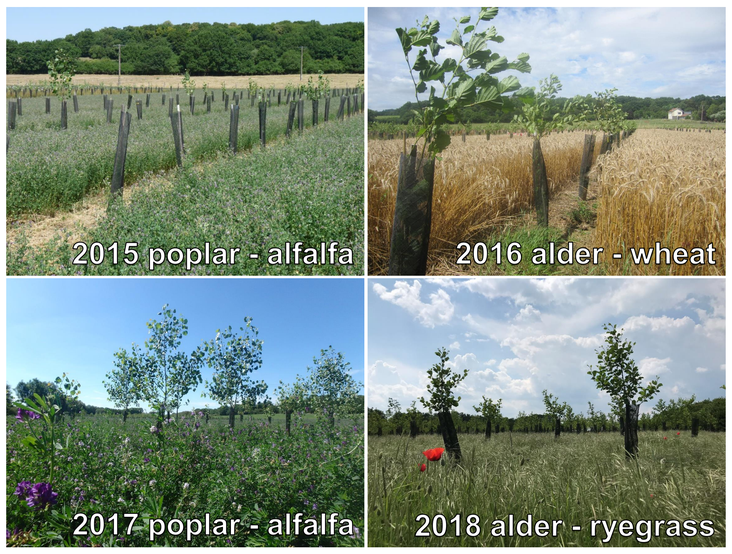
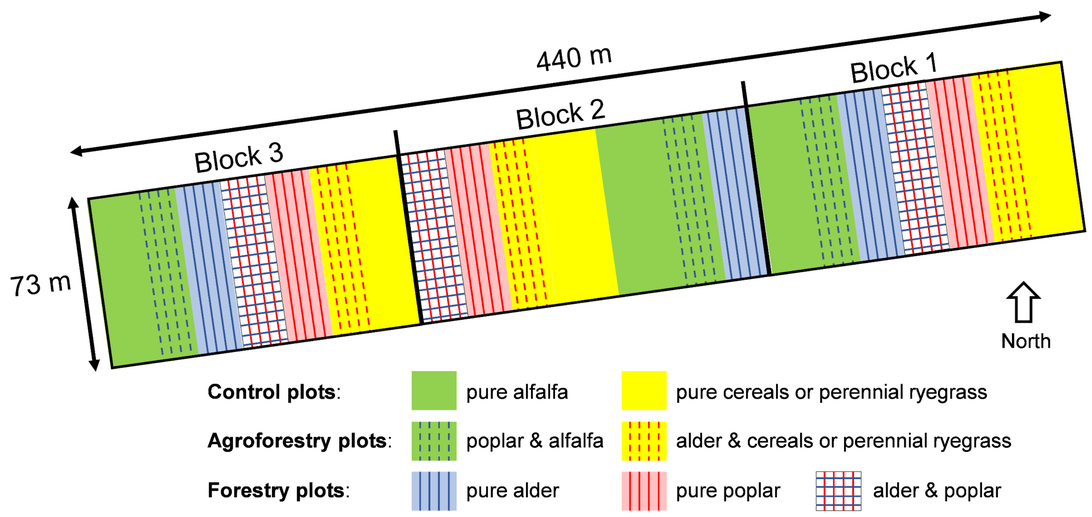
Aims

A field experiment was conducted in north-eastern France to evaluate the early effects of temperate agroforestry practices (association of nitrogen-fixing species to non-fixing species) on soil organic matter (SOM) and microbial activity.

We hypothesized that enzyme activity and labile pools of SOM were early and sensitive indicators of changes induced by tree introduction in the cropping systems.

Experimental site (2014-2018)





Tree spacings : 5x2 m in agroforestry and 2.5x2 m in forestry plots

Methods

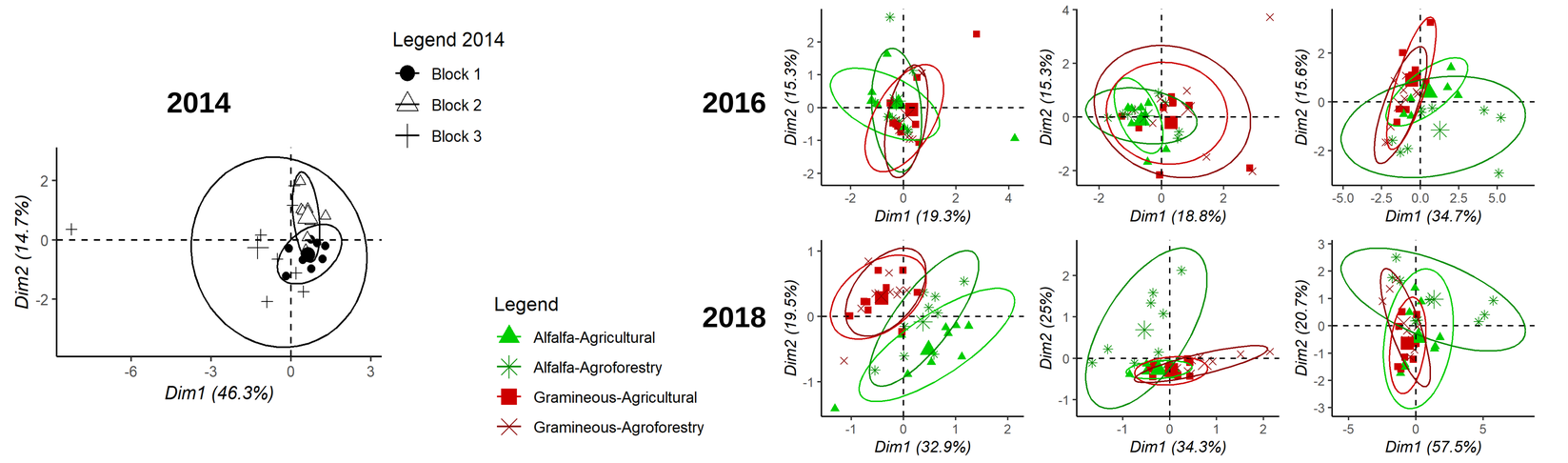
For 4 years after tree planting, topsoils (0-15 cm) sampled in poplar-alfalfa and alder-gramineous associations and in their respective monocultures were compared as regards:

- **Soil**: carbon (C), nitrogen (N) and water contents, near infrared spectra (NIRS)
- **SOM labile pools**: microbial biomass (C and N), extractable organic C (EOC), permanganate oxidizable C (POXC)
- **Enzyme activities**: arylsulfatase (ARS), β-glucosidase (BG), leucine aminopeptidase (LAP), N-acetyl-β-glucosaminidase (NAG), phosphatase (PH) and protease (PROT)

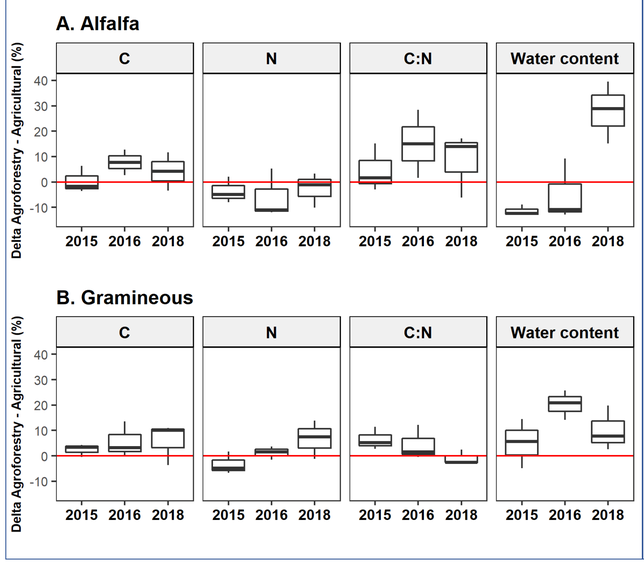
Results

Principal component analyses (PCAs) of soil NIRS spectra showed differences in soil quality between the 3 blocks at field establishment and a greater differentiation after 4 years between agroforestry and control plots in the alfalfa-based system (1). The results showed an increasing trend of soil C (labile and total) and water contents in the agroforestry plots as compared to the control plots (2 and 3). Microbial biomass N was significantly higher in the agroforestry systems (3). Overall, microbial activity tended to be higher over time in the agroforestry plots, mostly in the alfalfa-poplar system (4).

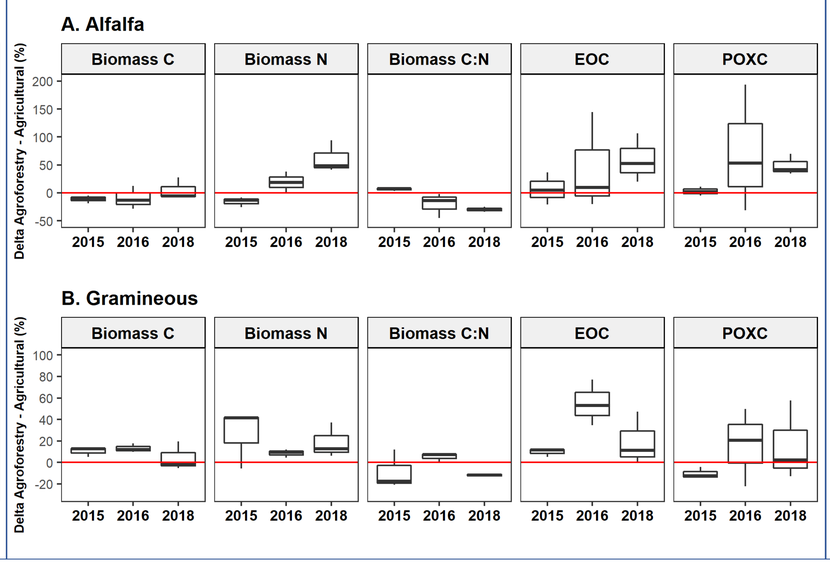
1. PCAs soil NIRS



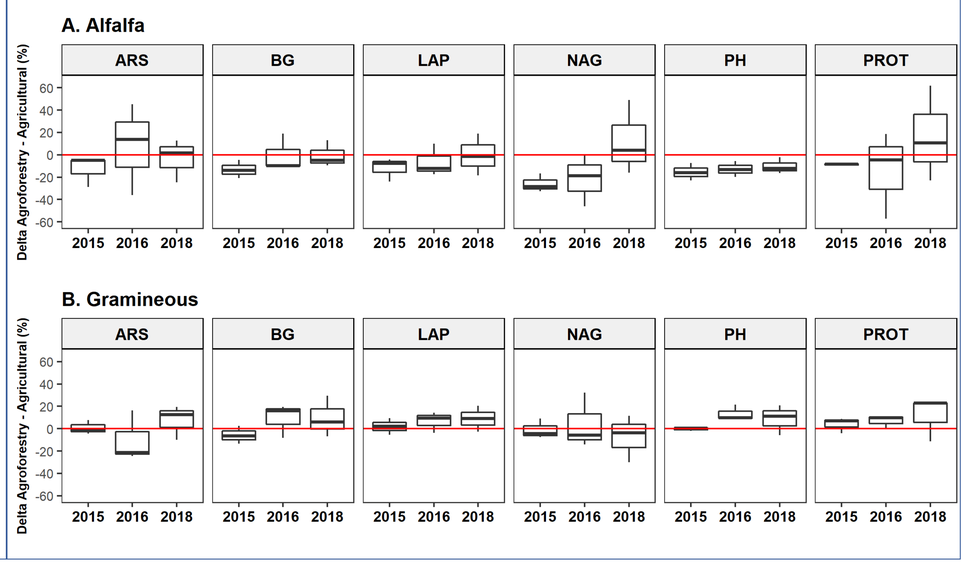
2. Soil



3. SOM labile pools



4. Enzyme activities



Conclusion

Four years after tree planting, we detected increasing trends of SOM labile pools and microbial activity and changes in soil quality mostly in the alfalfa-poplar system compared to the agricultural control treatment, probably due to higher tree growth than in the alder-gramineous system. These effects could suggest positive repercussions on SOM and on soil microbial functioning.

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