Theme 1
Status and trends of global soil nutrient budget

Initial changes in microbial biomass, functional diversity and soil organic matter mineralisation after sowing maize in an old meadow field

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INTRODUCTION

In the new European agricultural policies there is an evident concern for the soil, highlighting the need to protect biodiversity, care for soil resources and implement a circular economy. Galicia is located in the Atlantic area of Spain under a temperate-humid climate. One of the traditional crops is maize, which is currently grown intensively and almost exclusively for fodder, following two types of rotations: fallow-maize or prairie-maize. The new European policies encourage agricultural practices that reduce the use of inorganic fertilizers, avoid the loss or promote the recovery of organic matter, reduce/avoid erosion and foster biodiversity of cropland soils. To this end, a project investigating several agricultural alternative practices has been recently initiated. As a first step the present study investigates the impact that the transformation of a natural meadow into a maize crop has on the soil functionality.

MATERIAL

The study area was a more than 50 years old meadow which was partly transformed for the production of rainfed forage maize. In both meadow (GRASS) and maize cropland (ZEA) areas, three plots were established and soil samples (composed of several subsamples) were collected at 0-10 and 10-20 cm depth at the end of May (2 weeks after maize sowing) of the first year of transformation.

SOIL CHARACTERISATION

The soil physico-chemical characterisation was carried out following the methods described by Guitián and Carballas (1976). Microbial biomass C was determined by the fumigation-extraction method (Vance *et al.*, 1987), soil basal respiration was determined measuring the CO2 emitted by soil samples incubated under optimal temperature and moisture conditions (Guitián and Carballas, 1976) and microbial community-level physiological profiles (CLPPs) were analysed using Biolog EcoPlates™.

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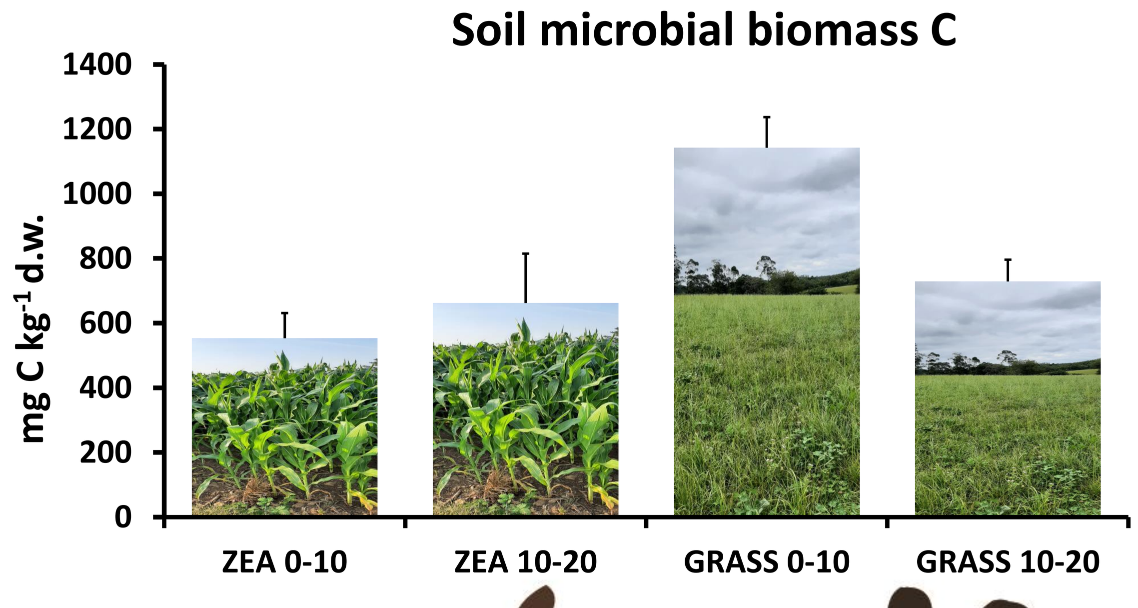
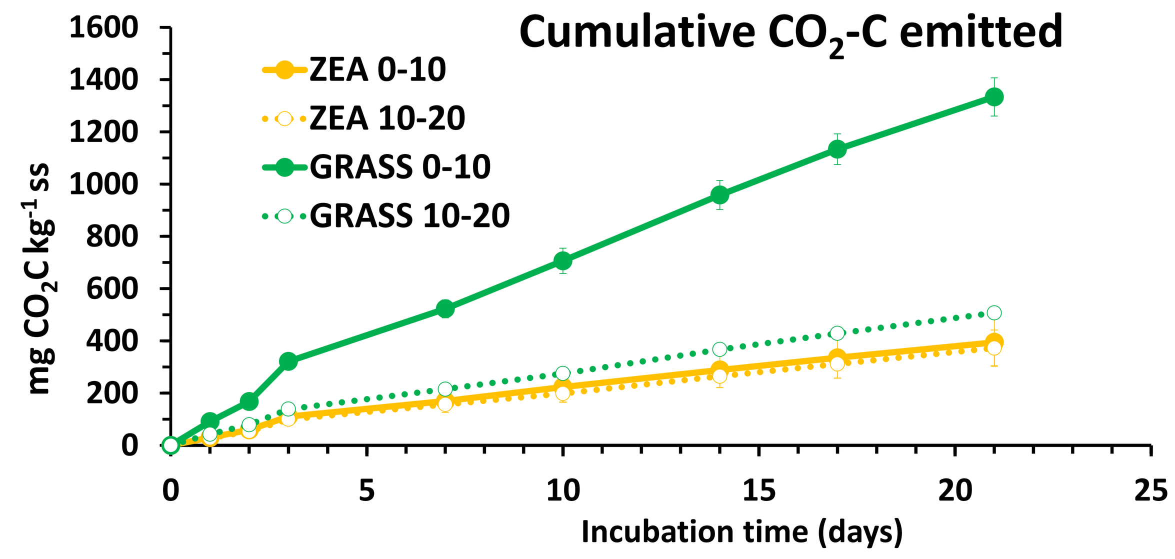
RESULTS AND DISCUSSION

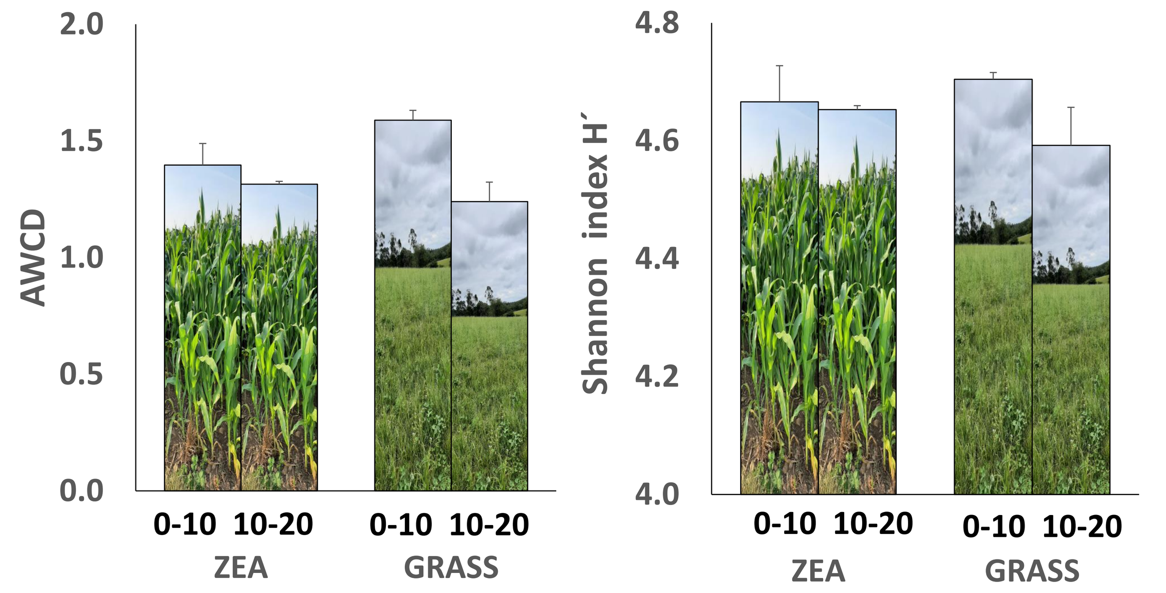
The land-use change induced a reduction of both organic C and total N contents, more pronounced in the 0-10 cm than in the 10-20 cm layer of the loamy soil studied. Microbial biomass and respiration dramatically decreased in the 0-10 cm layer of the soil converted to maize cropland, while the global metabolic activity of the microbial communities (average well colour development AWCD in EcoPlates) decreased in the surface layer. However, the functional diversity (Shannon diversity index) did not significantly change. Regarding microbial CLPPs, the cultivation had a negative impact on the degradation of polymers in both soil layers, but improved the degradation of amines in the 5-10 layer. At more specific level, the modifications were generally more evident in the 10-20 cm depth with increases in the degradation of β-methyl-D-glucoside, D-xylose, i-erythritol, Tween 80, phenylethylamine and putrescine and decreases in the degradation of D-cellobiose, α-D-lactose, D-galacturonic acid and L-arginine).
The rapid loss of organic matter and associated decrease in microbial biomass and activity, as well as, the more pronounced alteration of CLPPs in the subsurface soil layer can be attributed to the removal of the grass cover, to the decomposition of the remains of the vegetation buried after tillage and to the fertilisation applied. Further research will study the evolution of the changes detected.

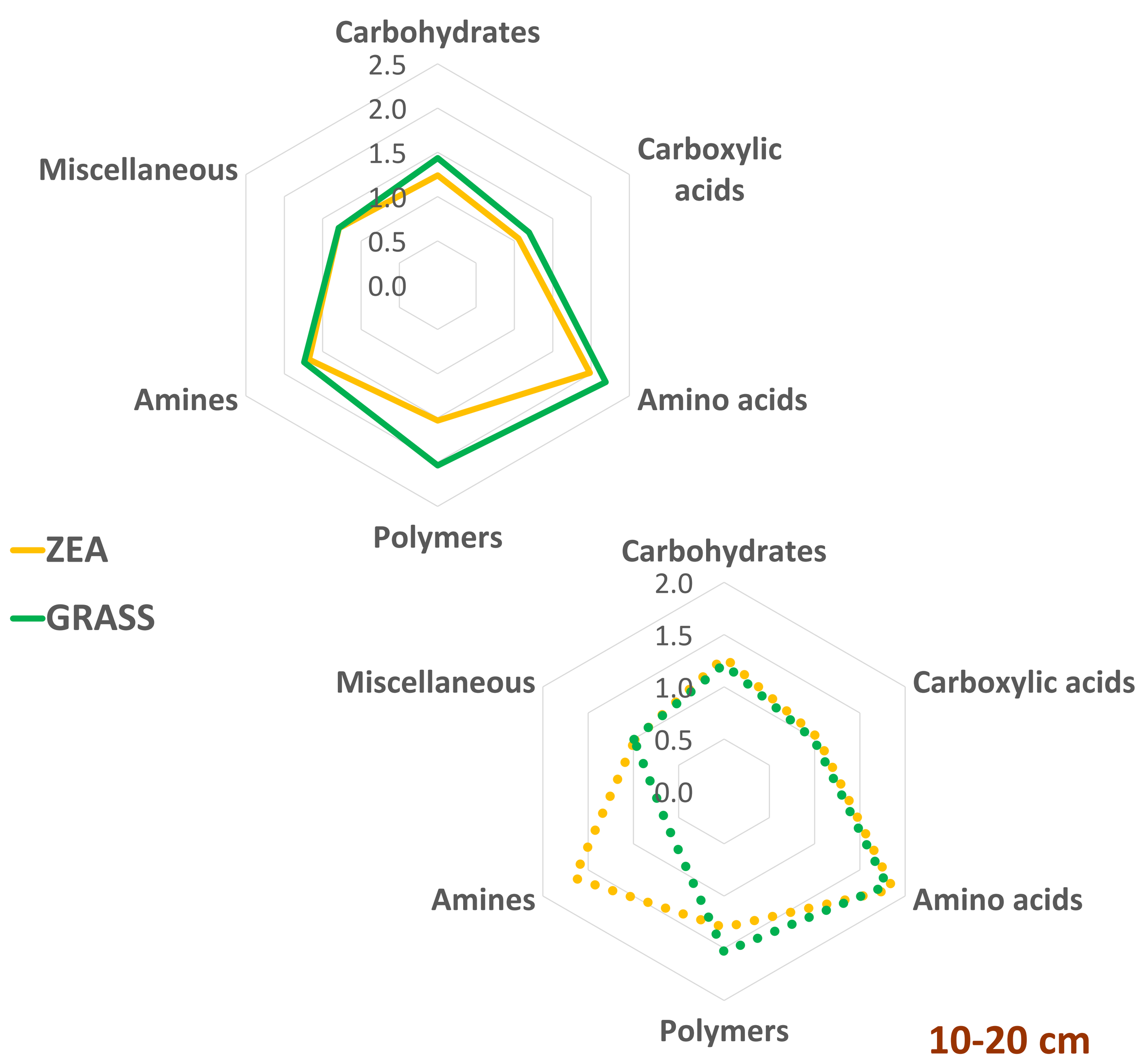
Table 1. Main physico-chemical properties of the soils

Soil	Maize		Meadow	
Depth	0-10 cm	10-20 cm	0-10 cm	10-20 cm
pH KCl	4.46±0.32	4.21±0.12	4.21±0.11	4.08±0.04
Total C (%)	3.72±0.25	4.21±0.67	8.08±0.58	5.62±0.35
Total N (%)	0.39±0.02	0.43±0.05	0.69±0.04	0.51±0.04
C/N	10	10	12	11









Degradation of different C substrate types (AWCD) by microbial communities in maize and meadow soils

CONCLUSIONS

The conversion of meadow into a maize field induces a strong decrease of the soil organic matter content and early modifications in diverse parameters related to soil functionality. Further analysis in successive cropping seasons are necessary to adequately evaluate the transformations of soil properties caused by the land use change.

REFERENCES

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