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RELATIONSHIP BETWEEN INITIAL SOIL MICROBIAL DIVERSITY AND THE QUALITY OF EXOGENOUS ORGANIC MATTER

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Context

Global climate change is an environmental problem due to the increase of atmospheric CO₂ and other greenhouse gases emissions. Another societal challenge nowadays is the waste management. Thus, some cultural practices are used to limit these problems such as no tillage, culture conversion to grassland and organic amendment. Exogenous organic matter inputs can indeed be a way of carbon sequestration in agricultural soils and waste management. The aim of our work was to study the relationship between soil microbial diversity and the evolution of different Organic Waste Products (OWP) inputs. Our hypothesis was to see if different OWP affect the composition and evolution of the microbial compartment.

Material and methods

In our experiment, four different OWP were chemically and thermally characterized (Table 1). Their degradation was studied in two contrasted agricultural soils in Normandy (France): Permanent Grassland (PG) and Conventional Cropping (CC), used as experimental control. These soils have different microbial diversities (Plassard *et al.*, 2008), as well as different total C (26 and 11 g.kg⁻¹ for PG and CC soils, respectively) and total N contents (2.5 and 1.1g.kg⁻¹ for PG and CC soils, respectively).

OWP initial characterization (Table 1)

Organic Waste Products (OWP)	C/N	ISMO*	Weight loss % at 900 °C (TGA [§])
Green Waste Compost (GWC)	11.5	81.5	29.5
Mature Cattle Manure (CM)	9.9	64.0	54.3
Green Waste-Sludge Compost (GWSC)	9.7	78.2	38.5
Sewage Sludge (SS)	6.4	42.6	84.8

*ISMO: Organic Matter Stability Index = 44,5 + 0,5*SOL-0,2*CEL+0,7*LIC-2,3*CEL3 soluble in boiling water + reagent NDF (SOL); lignin equivalent + cutin (LIC); cellulose equivalent (CEL)

§ TGA : Thermal Gravimetric Analysis

Experimental conditions

- OWP dried at 35°C and finely grind (1 mm)
- 6 months incubation of OWP in microcosms (triplicates) with each fresh soil, at 20°C.
- All OWP incubated with constant organic carbon value (4g C.kg⁻¹ dry soil).

Biological measures

- Abundance** : Total DNA quantification
- Function** :
 - Enzymatic assays (Cellulase, Xylanase, Alkaline phosphatase, Lipase).
 - Potential metabolic activity by Biolog® analysis (AWCD : Average well color development).

Results and discussion

1. Effect of time incubation

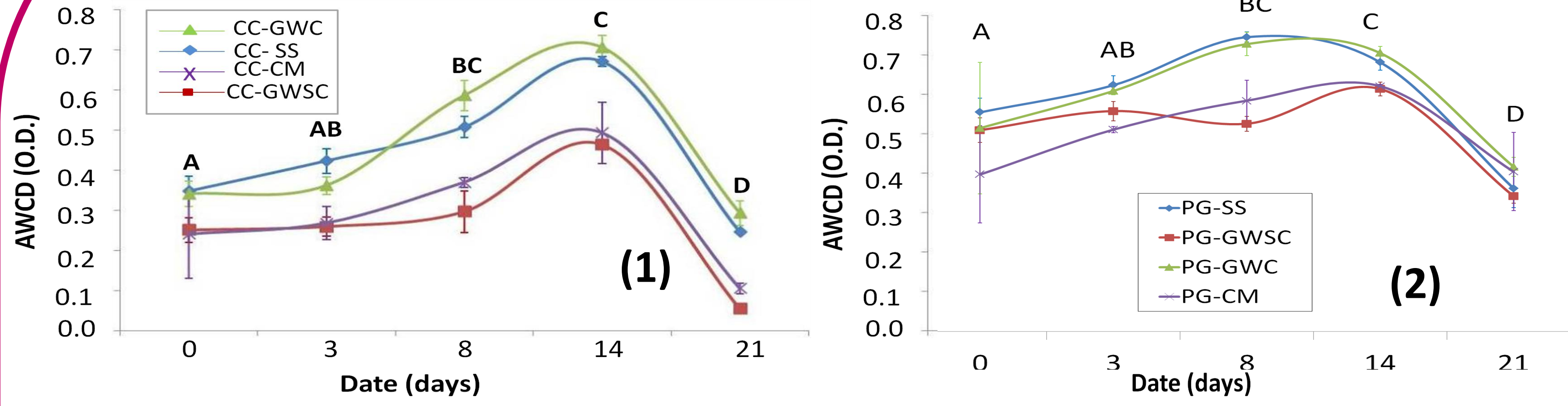


Figure 1: Evolution of AWCD over time for the different OWP in CC soil (1) and PG soil (2).

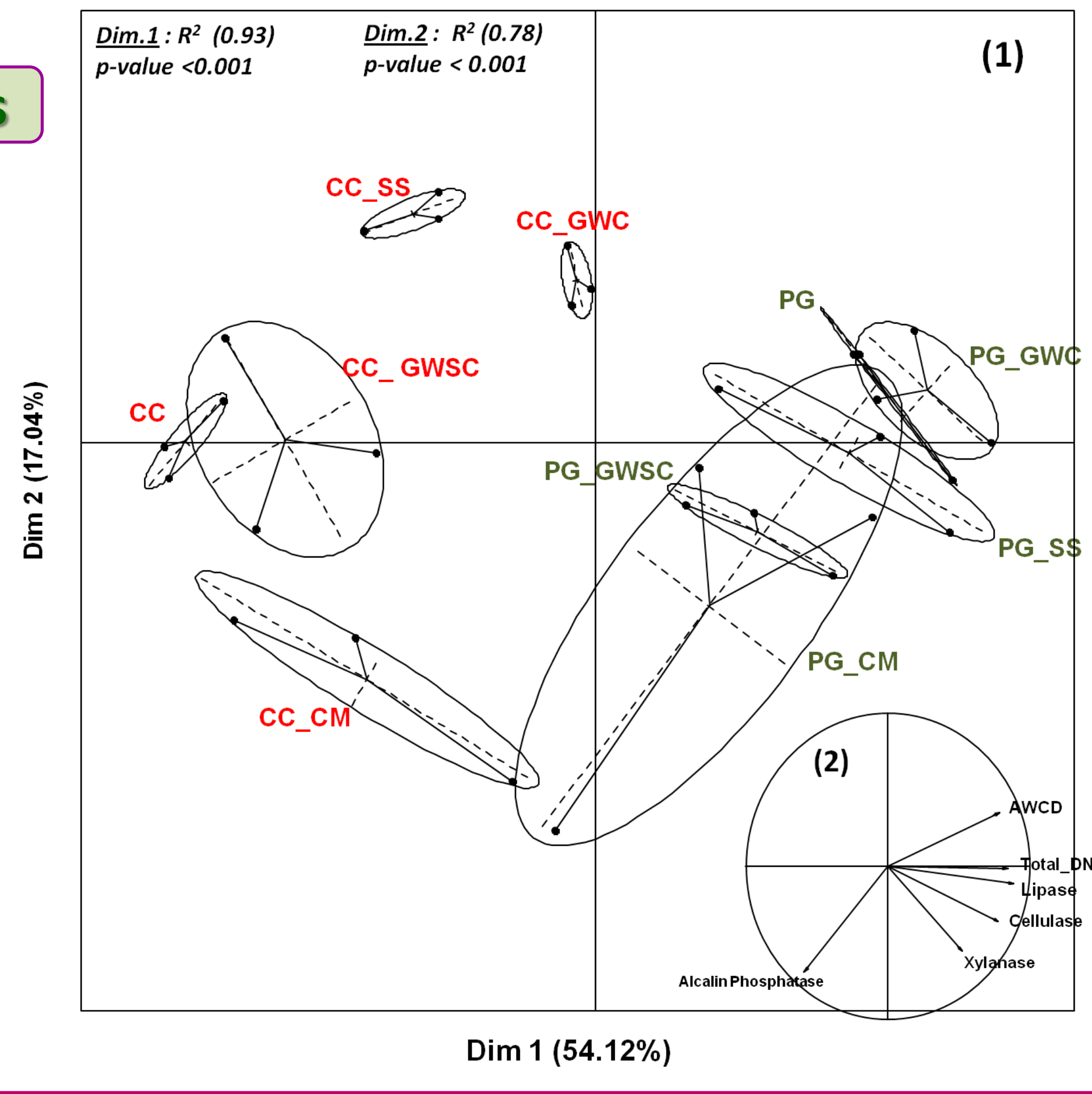
Time effect: Different letters represent a significant differences during incubation period (p-value < 0.05).

- Same evolution of AWCD in PG and CC soils in time.
- Whatever the soil, AWCD was different depending on the OWP input: (GWC=SS) > (CM=GWSC).

2. Global analysis of biological parameters

Figure 2: Principal Components Analysis (PCA) of the biological data (DNA, Enzymes, Biolog®), according to OWP inputs at 14 days.

(1) Projection on factorial axes 1-2, (2) Circle of correlation



- Effect of OWP on microbial diversity according to soil.
- Global lower impact of the OWP on the PG diversity.
- More influence of the OWP on the biological parameters in CC soil.
- > In a way, PG diversity seems to hide inputs effects.

Conclusions

- In two soils, the metabolic activity varies according to the biochemical characteristics of the OWP.
- Structural and functional parameters of the microbial compartment are different between soils (control), and soils with OWP inputs.
- CC soil diversity seems to be more impacted by the addition of OWP than PG's.

Behaviour of microorganisms in Permanent Grassland appears to be more resilient than in conventional cropping when anthropogenic factors such as organic matter inputs of different biochemical composition are brought to soils (as previously shown in literature in the presence of other factors (Riah *et al.*, 2014)).

What Perspectives ?

How far would the differences in initial soil diversities impact the OWP degradation kinetics and carbon stability in soils ?