Does soil biological state influence C and N mineralization of organic waste during laboratory incubation?

Bennegadi-Laurent, N.[1], Houot, S.[2], Castel, L.[1], Dubois, C. [1], Ailhas, J.[1], Laval, K.[1], Trinsoutrot-Gattin, I.[1]

[1]*Institut Polytchnique LaSalle-Esitpa, campus Rouen, research unit Agroecology Hydrogeochemistry Environment and Ressources (AGHYLE), 3 Rue du Tronquet - F-76130 Rouen Cedex, France ;* [2] *INRA, UMR 1091 Environnement et Grandes Cultures (EGC), 78850 Grignon, France*

nadia.laurent@unilasalle.fr

Introduction

- Application of exogenous organic matter (EOMs) in soil provides available nitrogen for crops and increase soil carbon stocks
- EOM decomposition is followed by C and N mineralization, and can be evaluated by French standard laboratory incubation approach **XPU 44-163** (AFNOR, 2009)
- In this approach, the collected soil can be stored during 1 year at 4°C
- **Objective : i)** Characterize the evolution of initial microbial status of soil during cold storage, and **ii)** evaluate C and N mineralization changes according to the presence of EOM

Materials and Methods

- **Sampling :** soil was collected in the North of France, during the spring. Soil was maintained bare and without any organic or mineral inputs

- **Storage :** Soil was stored at 4°C during 7 days (C0), 1 (C1), 6 (C6) and 12 months (C12)
- **EOMs :** Urban sludge (C/N = 6,1) and mature cow manure (C/N=12,5) were dried at 38°C and ground (1 mm)

- **Microbial community measures :**

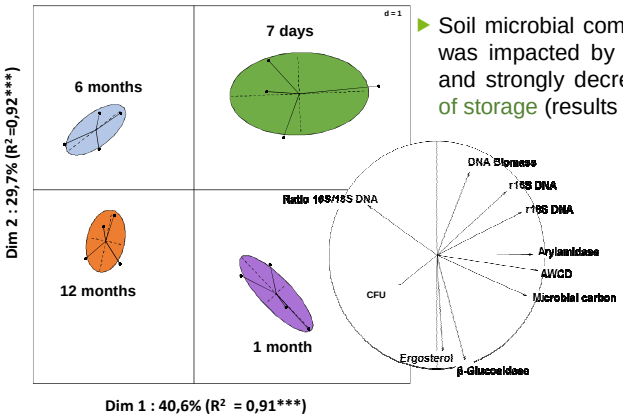
Abundance (microbial biomass carbon, total, bacterial and fungal DNA, total ergosterol) ; **Potential metabolic activity** (Biolog® analysis- CFU, AWCD) ; **Enzyme assays** for C cycle (β-Glucosidase) and N cycle (Arylamidase)

- **Soil incubation :** at 28°C during 175 days, with 4 replicates for control (Soil), control+urban sludge and control+cow manure (AFNOR, 2009)

C mineralization : continuous measurement of CO_2 release using NaOH trapping (1, 3, 5, 7, 10, 14, 21, 28, 49, 70, 91, 112, 133, 154, 175 days)

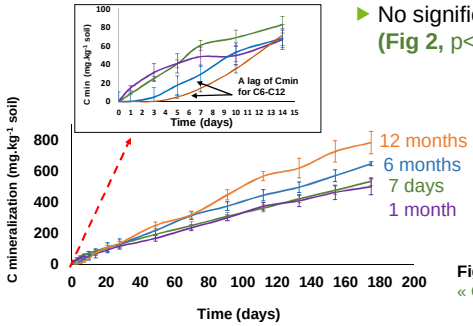
N mineralization : mineral N amount evolution in soil (KCl extraction) (0, 3, 7, 14, 28, 49, 91, 175 days)

Results



- Soil microbial communities' composition was impacted by cold storage **(Fig 1)**, and strongly decreased after 6 months of storage (results not shown).

Fig 1. PCA analysis of biological parameters related to the duration of soil storage à 4°C. **(a):** Diagramme of eigenvalue ; **(b)** : Circle of correlation ; *** *: p value < 0.001*



- No significant changes for mineralized C until C6 **(Fig 2, p<0.05).**
- C mineralization for C12: was lower (first 0-15 days), then it reversed and was higher at the end (at d175 : C0 and C1 < C12, p<0,01)

Fig 2. Cummulative CO_2 mineralization of soil « Control » related to the duration of storage at 4°C

- Organic inputs increase C mineralization **(Fig 3)** and reduce the difference between C0 and C12 observed in the control **(Fig 2)**

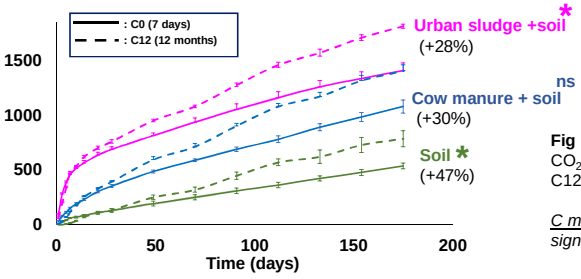


Fig 3. Comparaison of cummulative CO_2 mineralization between C0 and C12 for soil with or without EOM

*C min at 175 d. : * : p<0,05 ; ns : no significant*

- Regarding kinetic and rate of N mineralization in soil, they were lower at C1 and C6, Whereas they were similar between C0 and C12 (results not shown)

Conclusions

- Cold soil storage affects microbial abundance and functions especially from **6 months storage.**
- These changes have limited consequences on the C mineralization estimation of EOM, probably due to high functional redundancy of soil microbes
- N mineralization prediction seems to be more affected and would require further investigations
- **Advice:** Follow-up of C and N mineralization on soil retained less than 6 months

AFNOR. 2009. French standard XPU 44-163. Organic soil improvers and growing media - determination of potentially mineralisable carbon and nitrogen - method of incubation under controlled conditions. AFNOR, Paris, France

This work was supported by the National Research Programme of French Environment & Energy Managment Agency (ADEME)