Responses of microbial degradation patterns of soil organic matter to a gradient of anthropogenic pressure on agrosystems

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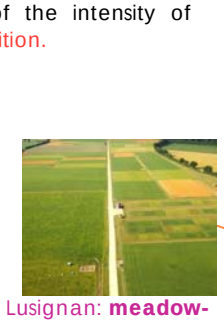
Context and Objective

Soil microbial functions involved in nitrogen (N) recycling and carbon (C) storage are shaped by human operations such as soil and crop managements and N fertilization. We aimed at characterizing the effects of the intensity of anthropogenic pressure on the microbial patterns of soil organic matter decomposition.

Gradient of anthropogenic pressure

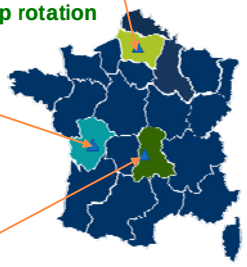
Crop system	Treatment	
Crop rotations (6 years)	tillage, N+	Mons (T1)	1
	tillage, N-	Mons (T4)	2
	reduced tillage, residues recycled	Mons (T2)	3
	reduced tillage, residues exported	Mons (T3)	4
	tillage, N+	Lusignan (T1)	5
Crop (3 years)-meadow rotations	meadow 3 years, N+, mowed	Lusignan (T2)	6
	meadow 6 years, N+, mowed	Lusignan (T3)	7
	meadow 6 years, N-, mowed	Lusignan (T4)	8
	meadow 6 years, N+, mowed	Lusignan (TL3)	9
	meadow 6 years, legumes, grazed	Lusignan (TL6)	10
Permanent grassland	NPK, mowed	Theix (ID13)	11
	N-, mowed	Theix (ID11)	12
	NPK, mowed	Theix (ID20)	13
	N-, mowed	Theix (ID18)	14
	N+,1 livestock unit	Laqueuille (Int)	15
	N-,0.5 livestock unit	Laqueuille (Ext)	16



Lusignan: **meadow-crop rotation**

Estrées-Mons: **crop rotation**

Theix-Laqueuille: **permanent grassland**



Long Term Ecological Research (LTER) network France

Experimental approach

16 soils sampled *in situ* from the gradient

Mineral N (net mineralization)

Chemical composition of litter

Bacteria + archae (16S rRNA), fungi (18S rRNA) (pyrosequencing)

Respiration CO_2, ^{13}C-CO_2, Priming effect

→ Metabolic quotient (qCO_2)

→ C-use efficiency (CUE)

Microbial-C,-^{13}C (fumigation – extraction)

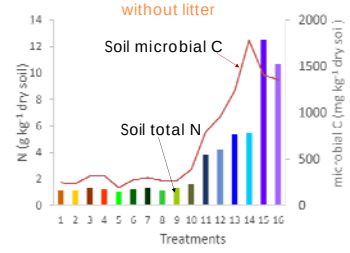
+ ^{13}C-labelled wheat straw  and without litter

Incubation 15°C, topsoil (0-10cm), 3 g C added / microcosm

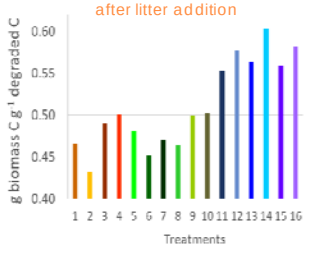
Determinations after 0, 2, 6, 14, 30 days

Results and discussion

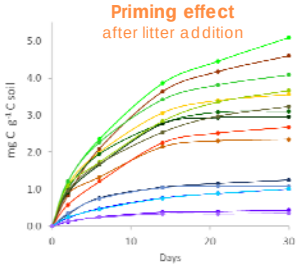
Soil total N and microbial C
without litter



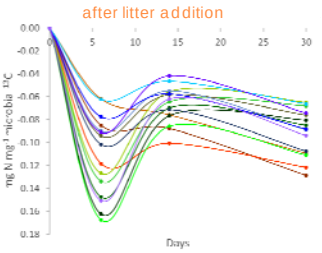
Microbial C-use efficiency (CUE)
after litter addition



Priming effect
after litter addition



Immobilized N / microbial C
after litter addition



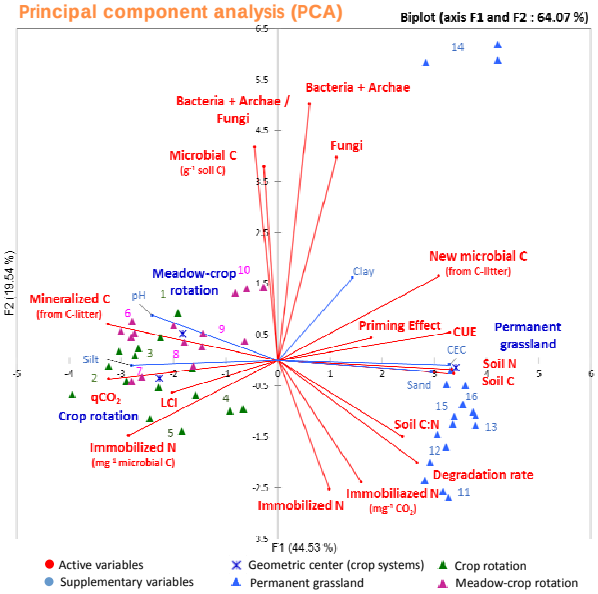
A marked gradient in soil C, N, C:N, microbial C was observed.

CUE was the highest in permanent grassland.

Priming effect per unit of soil C was the highest in meadow-crop and crop rotations.

The amount of N immobilized per unit of new microbial C from litter was the highest in meadow-crop rotation.

Principal component analysis (PCA)



Permanent grassland: microorganisms had the lowest rate of soil C mineralization and of priming effect per unit of soil C, and the highest production of litter-derived microbial C (CUE), i.e. a pattern of strong potential to stabilize C.

Meadow-crop rotation: microorganisms had the ratio soil-N immobilized-to-litter-derived microbial C the lowest, and caused the highest priming effect per unit of soil C, suggesting higher nitrogen requirements, and less stability of microbial communities.

The bacteria+archae-to-fungi ratio did not correlate with the anthropogenic gradient. However this gradient of anthropogenic pressure had a strong influence of soil organic matter degradation functions.

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