

### Effect of the type of contamination and land use on soil enzymatic activities. Results of the French "Bioindicator program"

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# Effect of the type of contamination and land use on soil enzymatic activities: results of the french « Bioindicators program »

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# Abstract

Since many decades, enzymatic activities are used to assess the effects of land use changes, agricultural practices and soil contamination on soil functioning. A lot of studies point out contradictory results depending notably on the methodology used, as well as soil characteristics...

To overcome the lack of consensus concerning indicators available to assess soil quality and functioning, the national research program "Bioindicators" (overseen by ADEME) was set up in France to develop and assay biological indicators (2006–2012). We aimed at standardizing and emphasizing the number of biochemical measurements, and developed miniaturized colorimetric methods to obtain a great enzymatic dataset. Thirteen activities (from three laboratories) were measured within this programme, in 47 modalities of 13 experimental sites differing in terms of land use (Corine land cover), contamination type – Polycyclic Aromatic Hydrocarbures or metals – and pollution levels (Vibrisse 8<sup>th</sup> decile). This dataset allows an analysis of the effect of atmospheric or added contamination gradients on the enzymatic activities. Our objectives are to point out the sensitivity of enzymes for each type of pollution and land use, to offer the most appropriate panel for a sensible analysis. Data were analysed for the all datasets, each site and each land use. Our main conclusions are as follows: enzymes are more sensitive to metallic contamination than to organic ones; enzymes are good indicators of metal bioavailability; alkaline phosphatase and arylamidase are the most relevant enzymes to assess the effect of soil contamination.

# **OBJECTIVES**

-Calibrate the bioindicators on the basis of referential values -Provide relevant biological tools (sensibility, accessibility, cost, ...) depending on the purpose :

- soil monitoring
- characterization
- risk assessment

Transfer the tools to stakeholders (policy makers, farmers, technical advisers...)

Identify enzyme or group of enzyme with high potential of indication









Grassland

Grassland

sensitive to

contaminants

P2au

P1yv



					A BARY ST.
			E.C.		and the second s
	Enzymes	Codes	number	Substrates (buffer pH and concentration)	References
<u>Global</u>					
activities					
	Dehydrogenase	DEH	1.1.1.1	2,3,5 triphenyltetrazolium chloride ((pH 7; 0.12M)	Schaefer et al, 963
	Fluorescein diacetate	FDA	209.877.6	Fluorescein diacetate (pH 7.6; 1000 µg.mL-1)	Adam & Duncan, 2001
0 availa					
<u>C cycle</u>	Linco	LID	2112	n ND nolmitate (nH 6.5:1 mM)	Gupta at al. 2002
	Collulase		3.1.1.3	p-NP-paimitate (ph 0.5, 1 mivi)	Gupta et al. 2002
	Cellulase	CEL	3.2.1.4	p-NP-p-D-cellobioside (pH 6, 10 min)	Trapetal, 2012
	Galactosidase	GAL	3.2.1.23	p-NP-B-D-galactopyranoside (pH 7; 0.02 M)	Elvazi & Labatabal, 1988
	N-acetyl glucosaminidase	NAG	3.2.1.30	p-NP-N-acetylglucosaminide (pH6; 10 mM)	Trap et al, 2012
	Xylanase	XYL	2.8.1.8	Xylan (pH 5.5, 12 g.L <sup>-1</sup> )	Schinner & von Mersi, 1990
	β-glucosidase	GLU	3.2.1.21	p-NP-β-D-glucopyranoside (pH 6; 50 mM)	Eivazi & Tabatabai, 1988
Scycle					
<u>o oroic</u>	Arvisulfatase	ARYLS	3.1.6.1	p-NP-sulfate (pH7: 25 mM)	Tabatabai & Bremner, 1970
					,
<u>N cycle</u>					
	Urease	URE	3.5.1.5	Urea (pH 7; 0,05 mM)	Sinsabaugh et al, 2000
	Arylamidase	ARYLN	3.4.11.2	L-leucine b-naphtylamide (pH 8; 2 mM)	Martinez & Tabatabai, 2000
Davida					
PCVCIE	Acid phosphatasa	ACD	2122	n NR nhaanhata (nH 5: 50 mM)	Trap at al. 2012
	Alleling all gan bates	ACP	3.1.3.2	p-NF-phosphate (pH 5, 50 mW)	Trap et al. 2012
	Aikaine phosphatase	AKP	3.1.3.2	p-INP-phosphate (pH 9; 50 mNI)	Trapletal, 2012
	NP: nitrophenyl				

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