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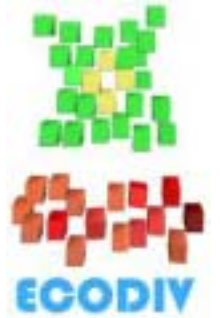
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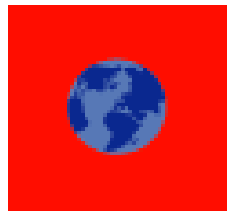


Enzymatic activities in crop and grassland soils - Impact of copper addition

**Isabelle Trinsoutrot-Gattin, Marthe Vinceslas-Akpa,
Caroline Bailleul, Agathe Brault, Christian Mougin and
Karine Laval**



A D E M E



Introduction

- **Soil : non-renewable resource essential for life**
- **Several functions :**
 - Physical and cultural environment for humankind
 - Food and biomass production
 - Storing, filtering and transformation of organic matter
 - Habitat and gene pool of living organisms...
- **Pressures : agricultural production, urban and industrial development, transport networks, leisure activities...**
- **Necessity to guaranty the protection and sustainable use of the soil**
 - ↳ **Project of European policy 2006.**

Context

- **Current tools in agronomic practices : physical and chemical properties**
- **Soil organisms responsible for biogeochemical cycles, ...**
- **This study is a part of a vast project intending to elaborate an index of the biological state of soil.**
 - ↳ **microbial, fungal and bacterial biomass**
 - ↳ **Enzymatic activities**
- **Enzymatic activities :**
 - **Soil functioning**
 - **Scientifically recognized**
 - **Integrative tool : pedological characteristics, climate, soil management**

Objectives

- ✓ **Impact of copper on soil enzymatic activities**
- ✓ **Considering the natural variations of the enzymatic activities in our referenced agricultural systems (grassland and crop plots)**

Material and Methods

Enzymatic activities assessed

Enzymes	Substrate	pH
Dehydrogenase	1,3,5-triphenyltetrazolium chloride (TTC)	7
Acid Phosphatase	p-nitrophenyl phosphate (PNP)	6,5
Alkaline Phosphatase	p-nitrophenyl phosphate (PNP)	11
β -glucosidase	p-nitrophenyl b-glucoside (PNP)	6
N-acetyl glucosaminidase	p-nitrophenyl acetyl glucosaminide (PNP)	6
Urease	urea	7

Dick et al. (1996)

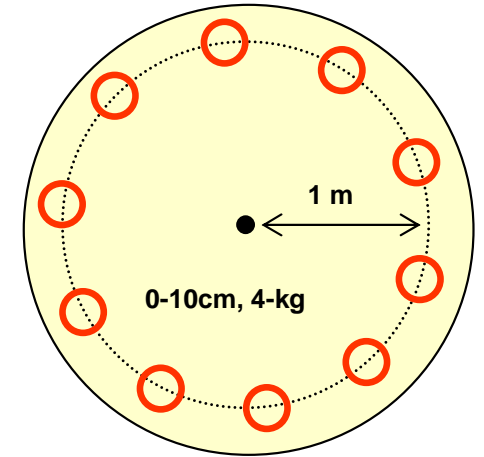
Material and Methods - Field plots

Two sites, located in the North West of France

20 samples per plot



Yvetot



April, June, October



Saint Georges sur
Fontaine



Material and Methods

Cosme experimentation



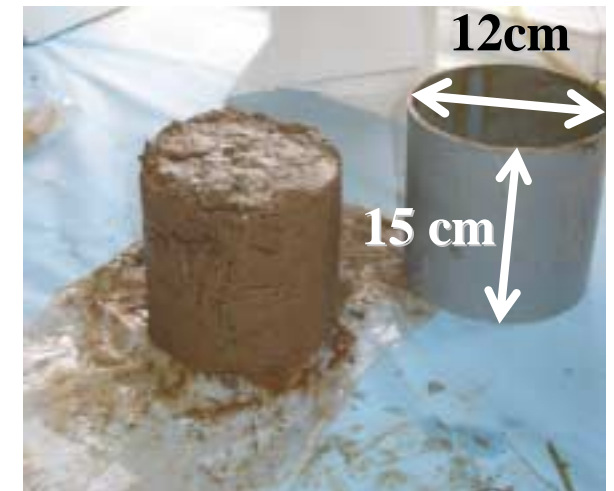
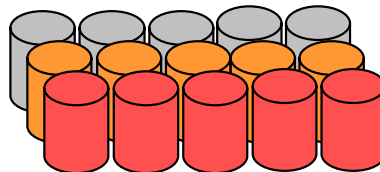
Undisturbed cosmes sampled from Yvetot grassland and crop plots.

5 cosmes for each model

4 dates: 0, 7, 35 and 70 days

Incubation in field conditions

Models : Control
2 ppm Cu
200 ppm Cu



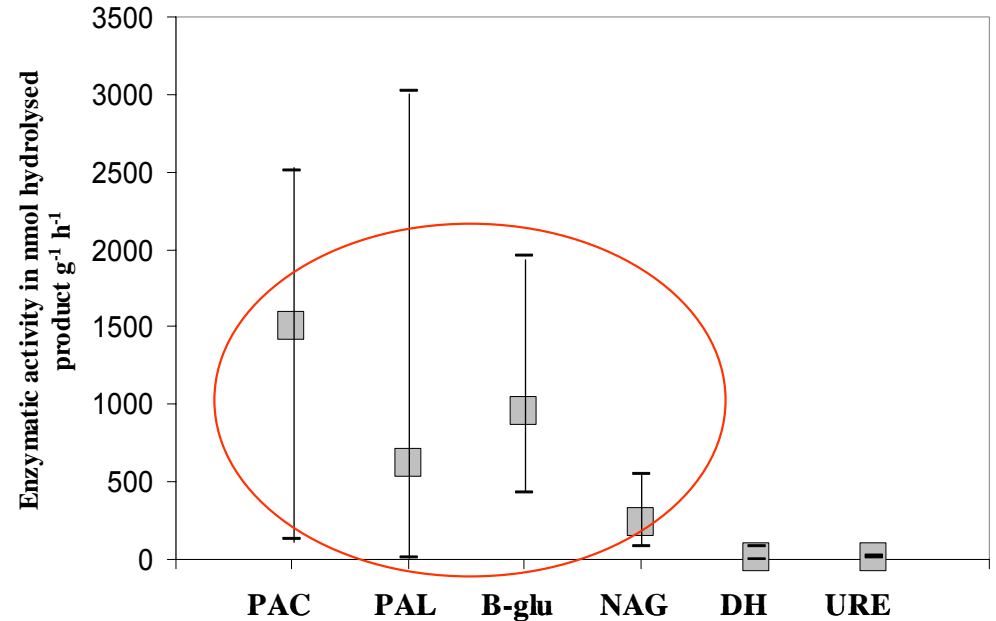
Results

Temporal and spatial variations for enzymatic activities

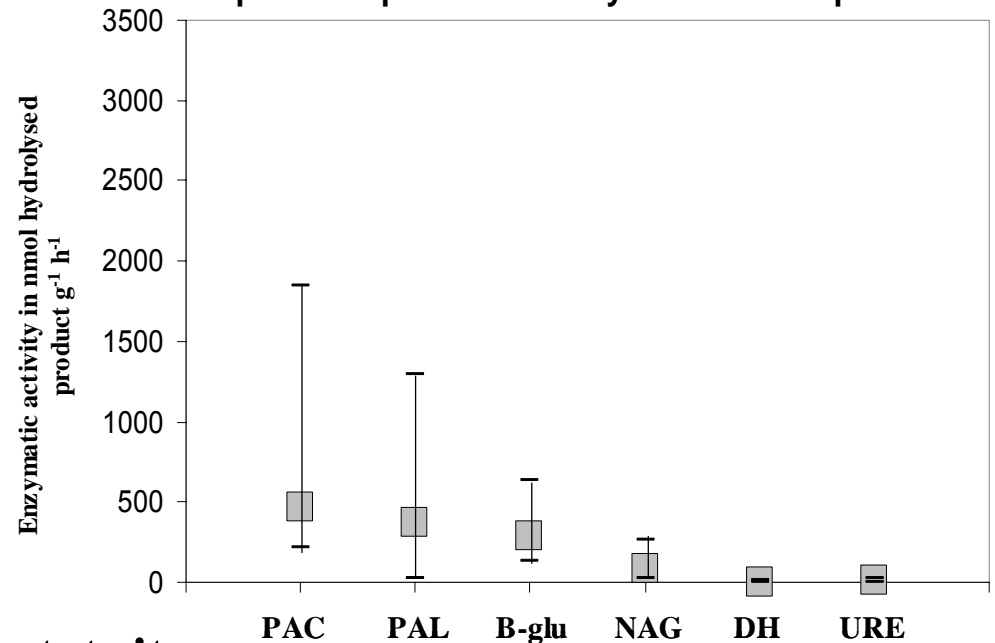
Acidic, alkaline phosphatases and b-glucosidase activities exhibit a great variability

The level of activities is higher in grassland than in crop plots

Spatio temporal variability in Yvetot meadow soils

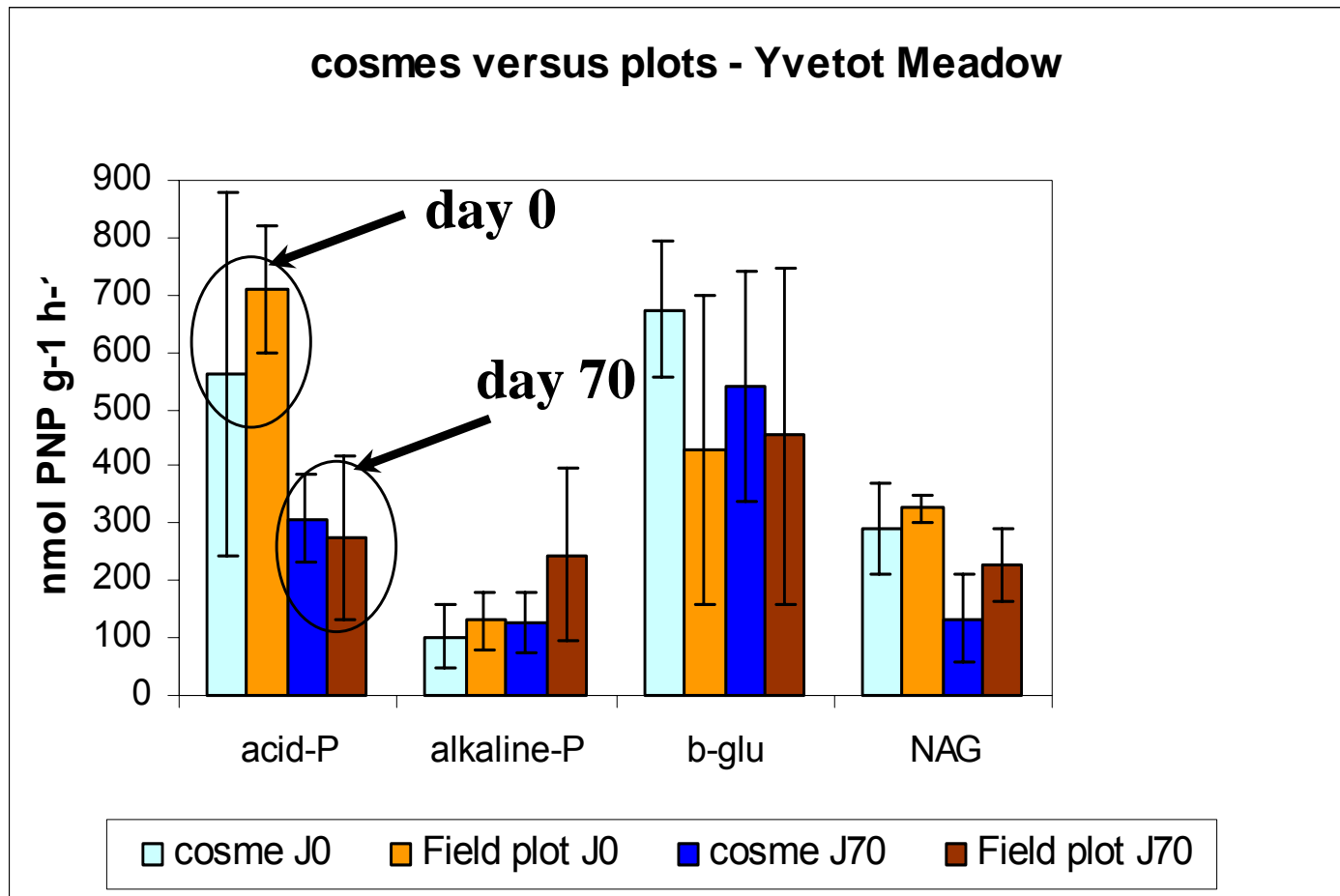


Spatio temporal variability in Yvetot crop soils



Yvetot site

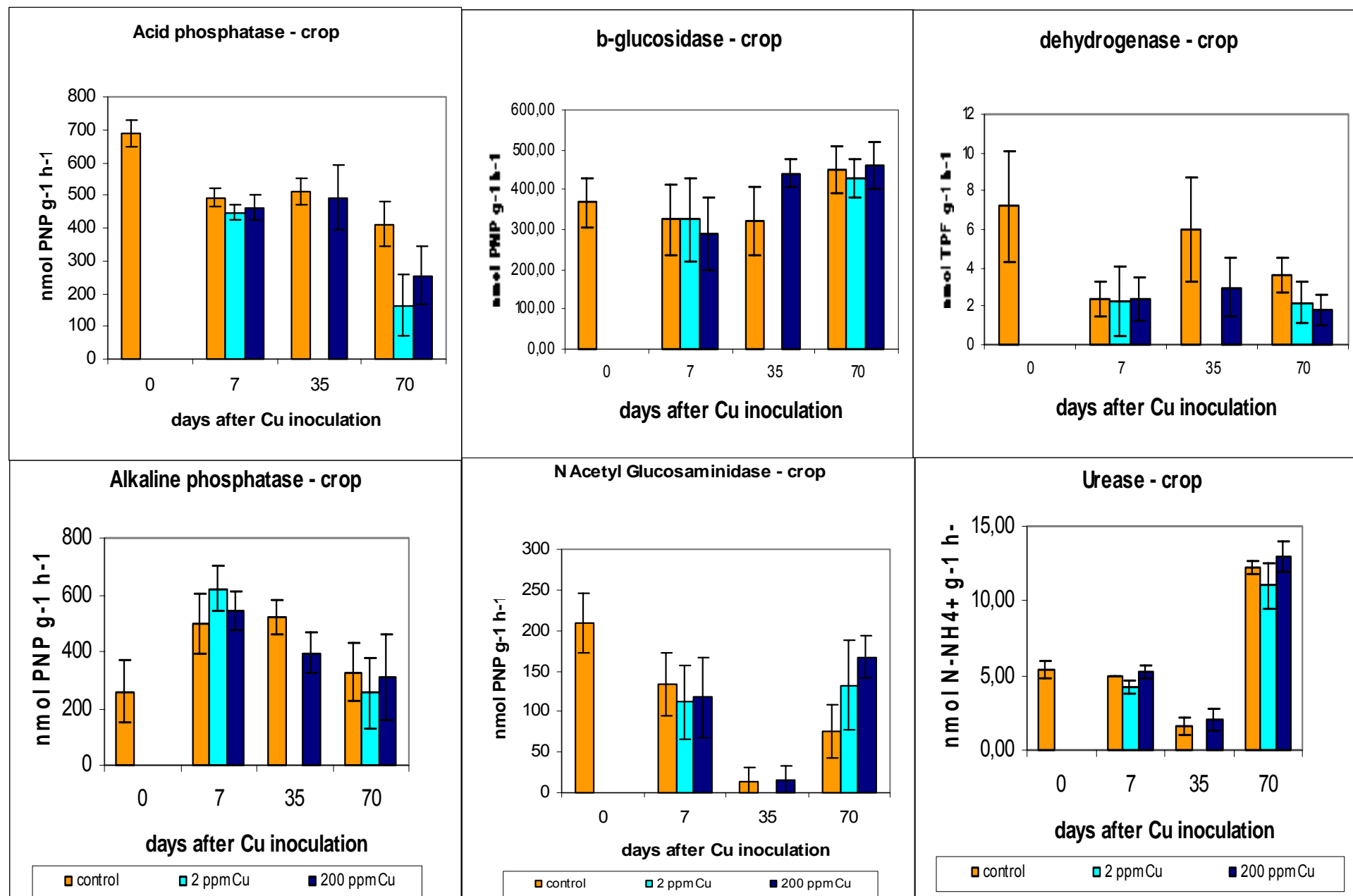
Enzymatic activities in Yvetot plots and in cosmes



Enzymatic activities are similar in plots and control cosmes

⇒ Validation of our undisturbed cosmes approach

Impact of the two copper concentrations on enzymatic activities in crop cosmes



Impact of Cu on enzymatic activities : Literature controversy

✓ Differences in experimental conditions

↪ Sieved soil vs undisturbed cosmes

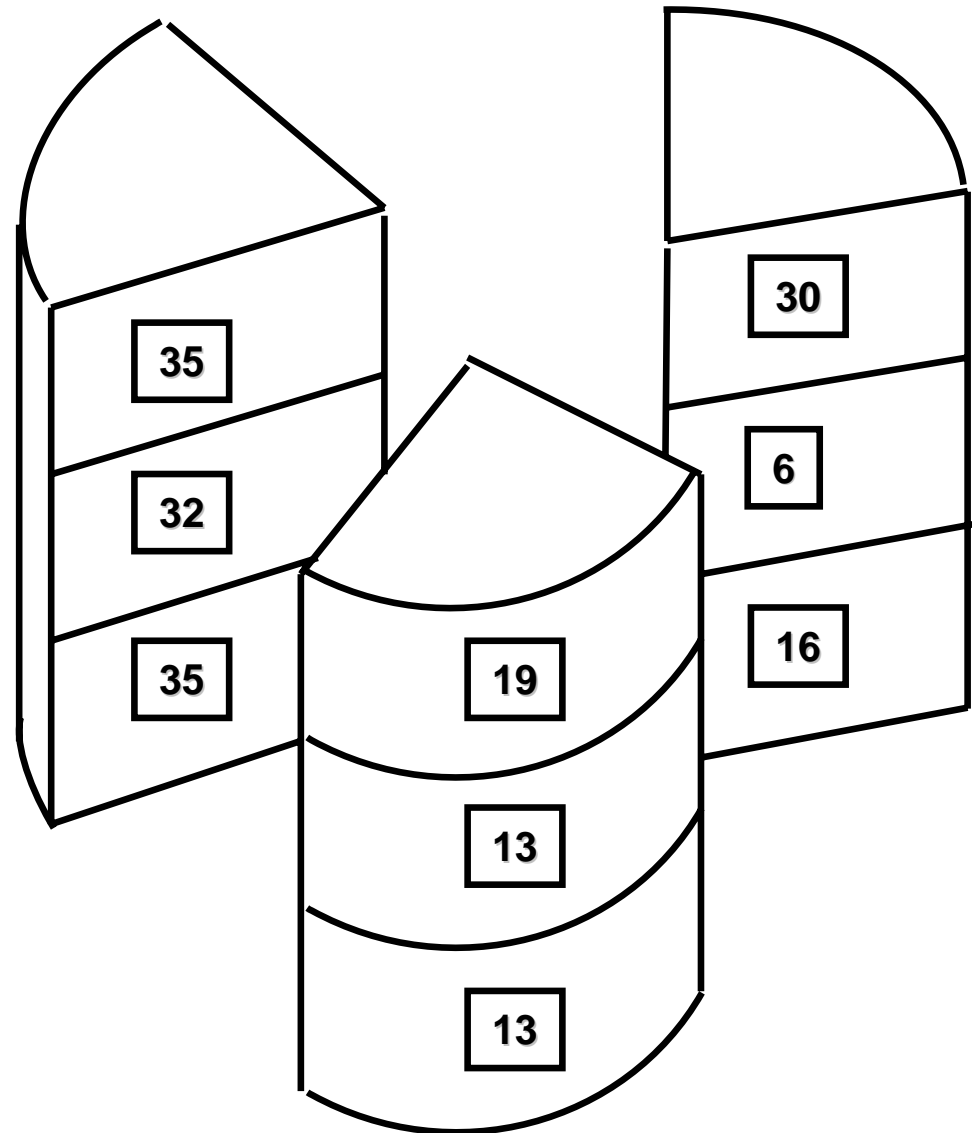
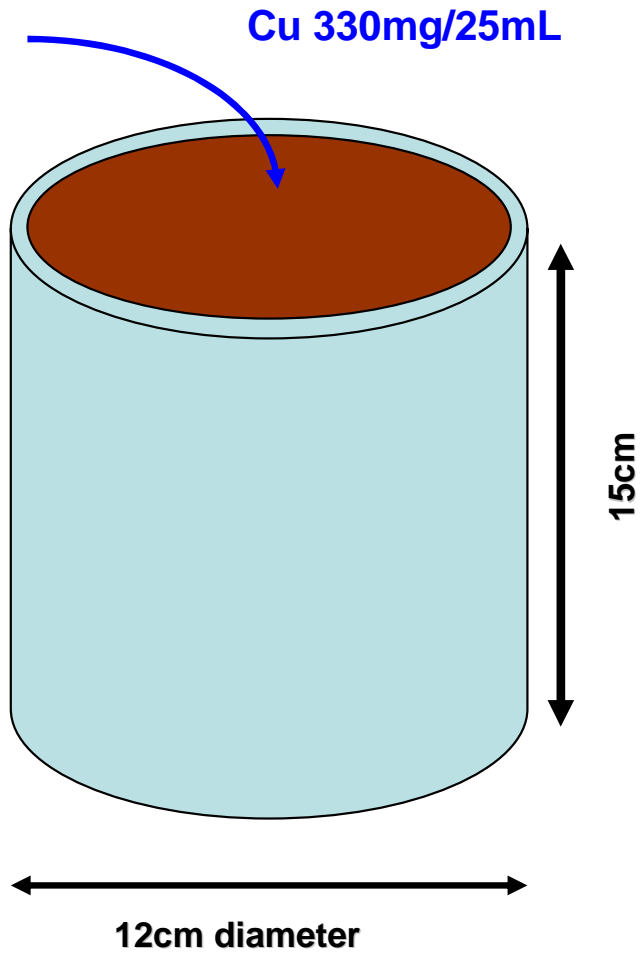
- . microbial physiological status**
- . physical protection on soil microorganisms**
- . availability of copper**

↪ High Cu concentration vs agronomic reality

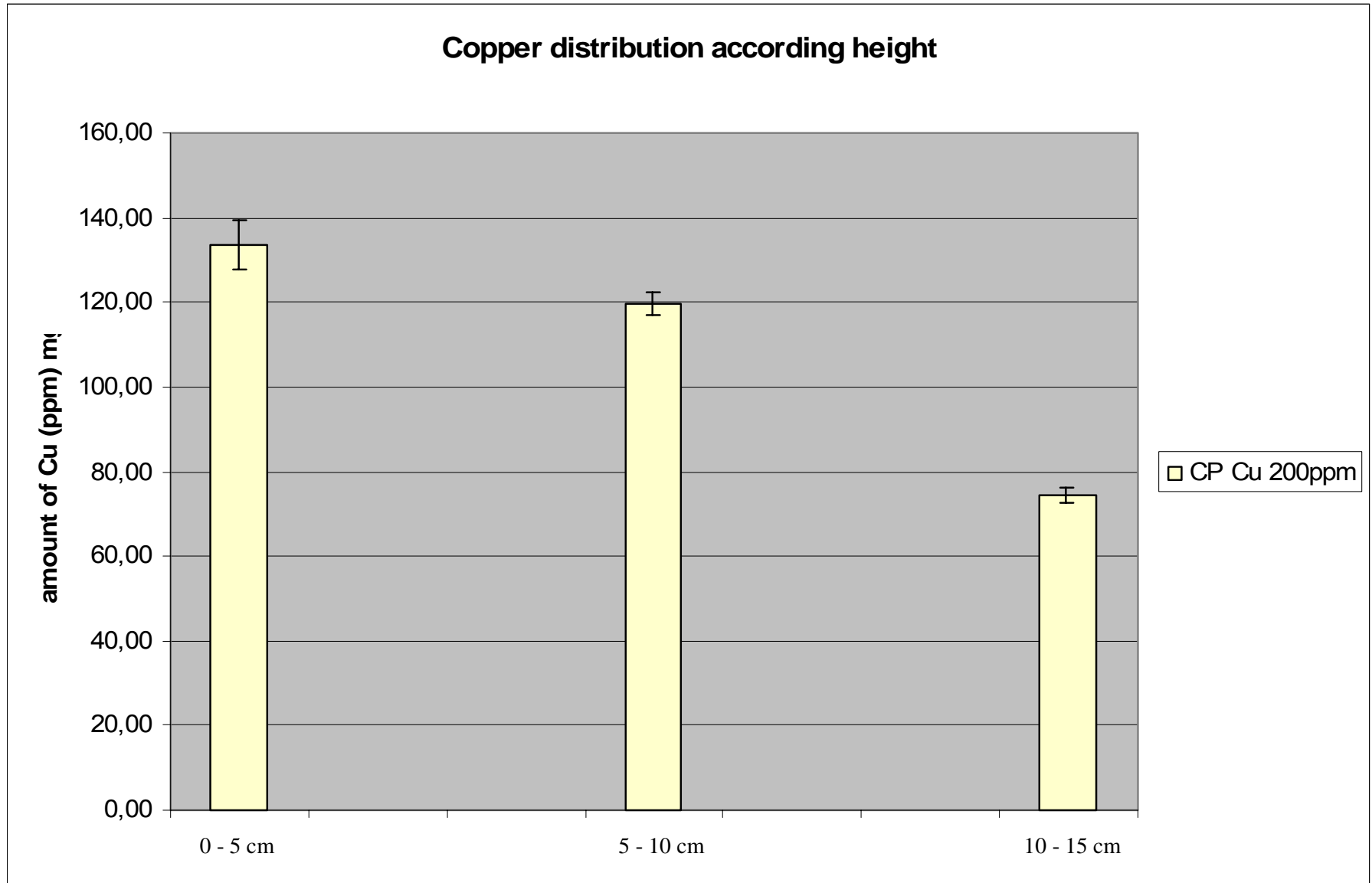
- . Status of copper**
- . Distribution of copper**

Distribution of inoculated copper in microcosms

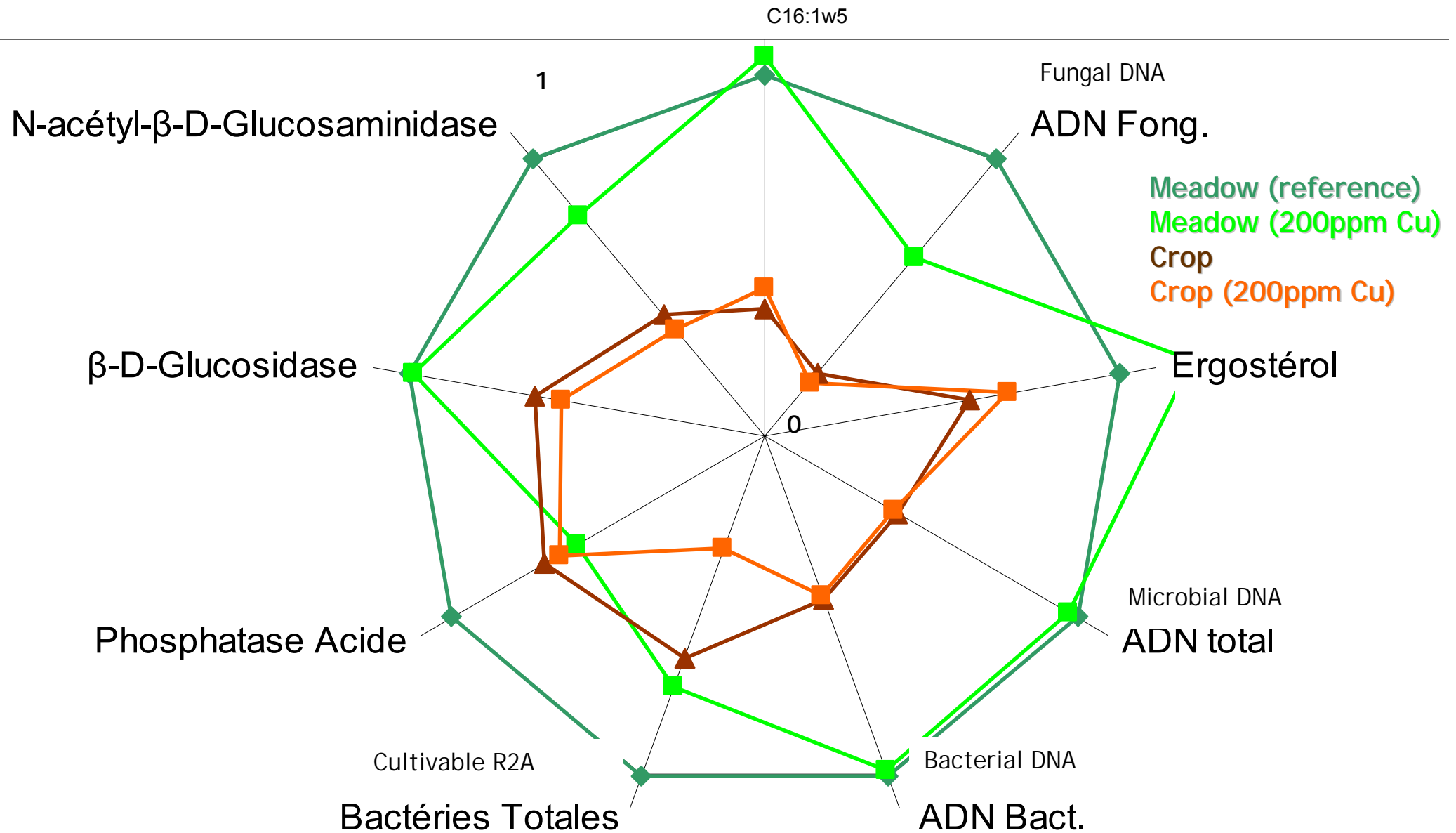
Content (mg) after equilibration



Cu distribution in cosmes



Evaluation of the copper impact on the descriptors of the microbial communities



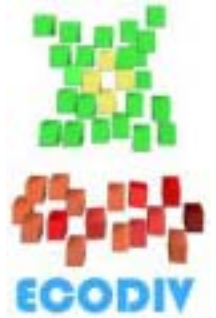
Results at T₁

Conclusion

- ✓ **Spatiotemporal variability of enzymatic activities ranged from 6 to 95 % in referenced systems**
- ✓ **Total enzymatic activities are higher in meadow related to soil biomass increase**
- ✓ **Anova analysis shows :**
 - ↪ **Agricultural practices**
 - ↪ **Sampling date (including season and plant cover)**
 - ↪ **No copper effect**

Conclusion

- ✓ **Enzymatic activities as indicator of soil « quality »?**
- ✓ **Links between microbial communities structure and functional diversity?**
- ✓ **Enzymatic activity of interest ?**
 - ↳ **stage of organic matter decomposition ?**
- ✓ **Methodological strategies for Soil Science :**
 - ↳ **pH?**
 - ↳ **Substrate?**
 - ↳ **spectrophotometry versus fluorimetry?**
 - ↳ **Units?**
- ✓ **Agronomic decision tools?**



Thank you for your attention



ADEME

