High levels of enzymatic activities are measured in soils managed under no-tillage leading to acidification and increased bioavailability of toxic metals

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HIGH LEVELS OF ENZYMATIC ACTIVITIES ARE MEASURED IN SOILS MANAGED UNDER NO-TILLAGE LEADING TO ACIDIFICATION AND INCREASED BIOAVAILABILITY OF TOXIC METALS

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Rationale / objectives

- Enzymatic activities are typically used to assess the impacts on pollutants on soil functioning.
- As a consequence, they are often described as relevant indicators for soil ecotoxicity assessment.

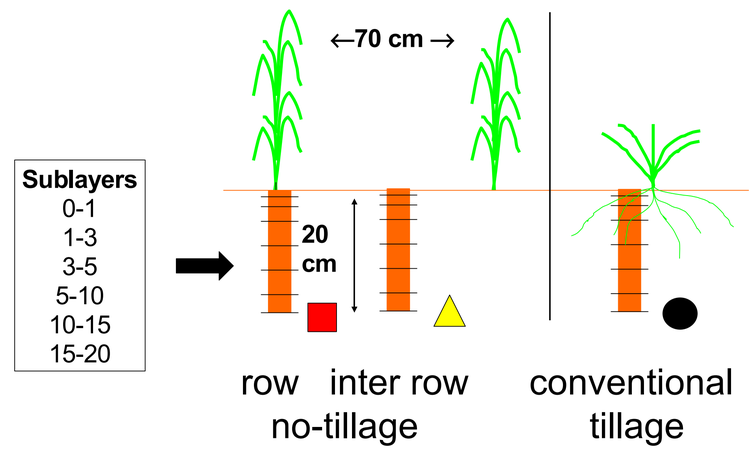
► Our objectives are i) to assess the variations of the physicochemical and biological parameters of the soil according to the practices and the depth , ii) to link the biological responses to physicochemical and chemical stressors.

Experimental

►A long-term experiment was set-up since 1974 in a field near Paris. It alterns maize and wheat rotations on plots submitted to conventional tillage or no-tillage. All agronomic practices (fertilizers, pesticides…) are identical whatever the tillage status.

►Soil was sampled after 32 years. Cores were divided into 6 sub-layers prior to parameters determination. Soil physicochemical parameters were measured using normalized protocols. Enzymatic activities were measured using classical spectrophotometric assays.

►The soil is a Hapludalf developed on loess laid in calcareous substratum. The original topsoil (0-28 cm) contains 22% clay, 76% fine and coarse silt and 2% sand.

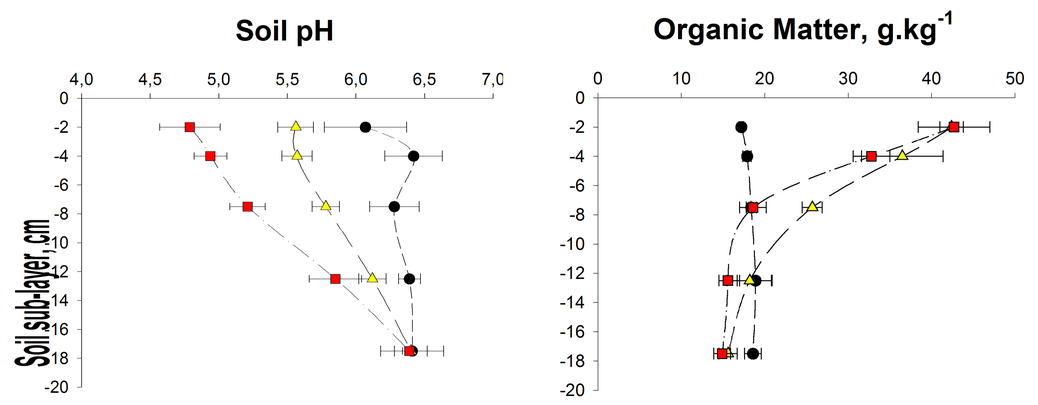


triplicates x 3 measurements

No-tillage leads to the acidification of the soil

►Long-term no-tillage induce vertical gradients in the soils

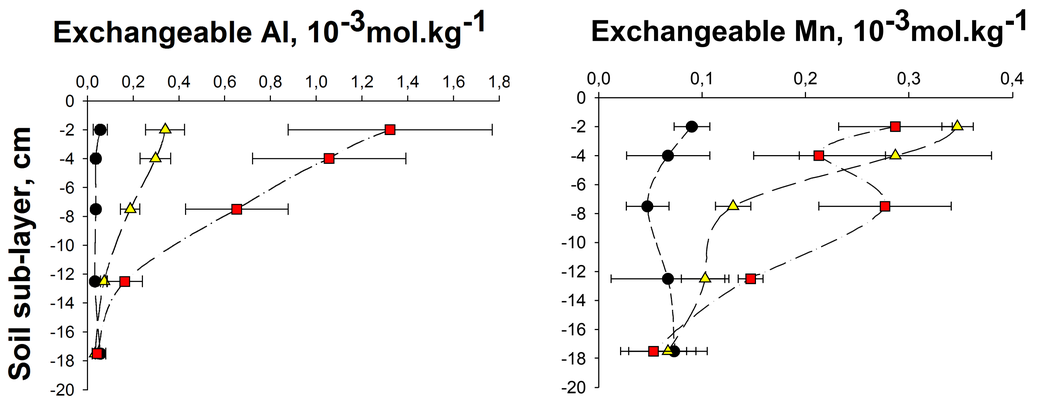
- the pH strongly decreases at the surface
- it is negatively related to organic matter breakdown
- other soil parameters are less affected (moisture content, CEC…)



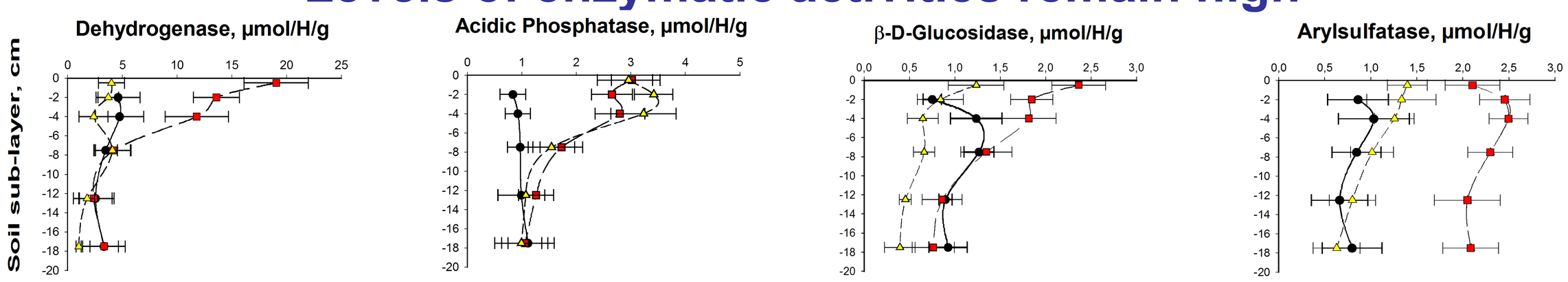
Toxic metals are released at the surface

►Long-term no-tillage modify cation bioavailability in the soils

- toxic metals (Al, Mn) are more released at the surface
- other cations have distinct behaviors: the bioavailability of Ca and Mg decreases, this of K increases, this of Na is unaffected



Levels of enzymatic activities remain high



►Enzymatic activities remains in most cases the highest under no-tillage situations.

Statistical analysis shows the high significance of the relationships between: 1) pH, dehydrogenase and phosphatase activities,
2) Al and Mn contents, the two previous activities, as well as glucosidase.

Conclusions

1) No-tillage performed during a long period of time results in the degradation of the physico-chemical properties of the soils.
2) These changes are associated with modifications of the status of chemical contaminants in the soils.
3) Enzymatic activities are not pertinent biomarkers to assess the soil functioning in that context of multiple stressors.

► We will now study the dynamics and the impacts of organic compounds (pesticides…) taking into account these soil physico-chemical properties.

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