Chemical contamination versus non chemical stressors: the case study of agricultural soils

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Agricultural soils, and especially cropped soils, constitute ecosystems highly disturbed by human activities. Because these soils are submitted to multiple (i.e. physical) stresses due to agricultural practices, it remains difficult to assess the real impact of chemical contamination. In that context, our objectives are to define the equilibrium state of the soil that could be used as a reference state to assess the real impact of pollutants. In a second time, we attempt to develop tools describing that state.

For that purpose, we measured the variability of 40 physical, physical-chemical and biological quantitative descriptors in soils from cropped and meadow plots during two years. Whatever the spatial variability observed, ranging from 10 to 80%, we highlighted that the descriptors of the microbial compartment gave the highest values in meadow soils.

Agricultural practices constituted the main factors affecting total microbial DNA, all fungal descriptors, and 16S rDNA, a structural descriptor of the bacterial communities. By contrast, the sampling date (integrating the season, soil management, climate...) was the main factor affecting cultivable amounts of bacteria, as well as their metabolic potential. Both agricultural practices and sampling date affected soil enzyme activities.

Then, we developed microcosms fitted with columns of undisturbed soil from the previous fields to assess the ecotoxicity of chemical pollutants. Using that unusual setup, we were unable to evidence any effect of copper (200 ppm) on the micro-organisms of the soil, whereas toxic effects of the metal are often reported using air-dried, sieved and homogenized soils. So, the hypothesis is that soil preparation for measurements greatly enhances the response of micro-organisms to soil chemical contamination.

Finally, using long-term experiments in the field, we showed also that developing practices such as no-tillage greatly affected soil physical-chemical and biological properties.

We conclude that agricultural practices strongly modify the physical-chemical properties of the soil, and that the resulting changes have greater impacts on its functioning than chemical contamination. However these changes may then modify both the dynamics and impacts of chemicals such as pesticides by comparison with conventional tillage.