

# Effect of grassland restoration in crop rotation on the organic matters dynamic, and on microbial biodiversity

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## Abstract

The composition of organic matters and microbial communities of a series of ageing grassland soils have been analysed in order to measure the impact of this practice.

For each parcel, different forms of organic carbon, total carbon, and particulate organic matter (POM) have been analysed. In parallel microbial population quantity (microbial biomass and total DNA) and diversity (genetic and metabolic profiles) have been studied. The results enable us to observe an increase (i) in total organic and particulate organic matter (ii) in microbial biomass and (iii) in functional diversities (Biolog system), according to the time of setting out to meadow of the parcel.

## Introduction

For a long time, restoration of grassland in crop rotation is supposed to have had positive repercussions on organic matters dynamic (1, 3), which is essentially controlled by microbial activities. Therefore, we analysed some relevant fractions of organic matter concurrently to microbial communities, in order to appreciate the effect of grassland restoration. Evaluating the biodiversity of microbial communities remains an elusive task because of taxonomic and methodological difficulties. In fact, 1g of soil can contain from  $10^8$  to  $10^{10}$  bacteria divided into 4000 bacterial species (5) ; an alternative for the study of these communities consists in observing components of the biodiversity likely to give comparable patterns (genetic and metabolic) that are biologically meaningful.

## Study site

The study focuses on silty grassland of the lycée agricole d'Yvetôt, Pays de Caux, which is located in Northwest of France in Haute Normandie. The silt constitutes the major geologic formation in the Pays de Caux and depends on the formation of clay and flint. The grain size analysis indicates the average texture of Yvetôt's soil as silty (15% clay, 65% silt, 20% sand). The region is dominated by an oceanic and temperate climate characterised by an abundance of rainfall (between 800 and 900mm per year), the midness of temperatures and the low level of seasonal ranges. Grasslands were all planted with ray-grass and clover. Cultivated parcels were used as references.

## Grassland management history

P1 : 2000/2001 Grassland, 1990/2000 cultivated

P3 : 1998/2001 Grassland, 1990/1998 cultivated

P6 : 1995/2001 Grassland, 1990/1995 cultivated

P7 : 1994/2001 Grassland, 1990/1994 cultivated

P33 : grassland for 33 years

## Cultivated soils

PC2 : 1999/2001 cultivated, 1993/1999 Grassland

Réf : 1994/2001 cultivated

## Material and method

The total organic carbon and “unstable” fraction like the POM (defined as fraction ranging between 50µm and 2 mm) were quantified. Microbial biomass was also estimated with fumigation/extraction method (4), quantification of total DNA (Fastprep DNA kit BIO101 extraction method), and cultivable bacteria on R2A agar medium (20°C, 48h).

In parallel, the microbial diversity in these different parcels was analysed. On the one hand, the functional diversity was observed thanks to the Biolog system. BIOLOG is an

identification system which can be used to draw up metabolic profiles based on the capacity of micro-organisms to consume different carbon sources. In those experiments, ECO microplates composed with 31 carbon sources were used. On the other hand, genetic diversity was examined from amplified ribosomal DNA restriction analysis (ARDRA).

#### Results and discussion

The results show that the longer the land is set out to meadow, the higher the content of total carbon and particulate organic matter is. The POM can constitute a relevant reference of the organic states of the parcels on account of their fast turn over, as they fast react to agricultural management changes. Microbial parameters, such as microbial biomass and total DNA, are clearly higher in the case of the 33 year-old grassland. Concerning the functional diversity analysis, we can notice a contrast between cultivated soils and grasslands, as in the BIOLOG ECO plates which were inoculated with the cultivated soils, 48% of the wells are positive whereas in those inoculated with 6, 7 and 33 year-old grassland soils, 68% of the wells are positive. Influence of the chronological meadow on micro-organisms diversity is not clearly demonstrated.

#### conclusion

We underline that the meadow restores the organic matter and microbial biomass, which guaranties the structure stability and the soil fertility. Moreover, the longer the setting out to meadow is, the higher the biodiversity, as regards metabolic activities, seems to be. The ARDRA analysis is still under way today. The whole studies is carried out annually and will be repeated in March 2002.

These complementary approach (quantitative and qualitative) measures can give further information on the interactions between the microbial populations and the dynamic of the organic matters in order to look for indicators of soil quality.

#### Acknowledgements

The authors would like to thank the lycée agricole of Yvetot to have let us the free access to the parcels.

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