

EFFECT OF TILLAGE AND FERTILIZATION ON SOIL MICROBIAL DIVERSITY IN SOYBEAN CROPS

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INTRODUCTION

A maize: soybean cropping system established on a 26 yr experimental site at l'Acadie (Quebec, Canada) was studied to determine the effect of soil tillage (mouldboard plowing and no-till) and mineral N fertilization rates on soil microbial (bacteria, fungi, protista, metazoa) diversity. Results [1] obtained 12 to 20 yr after initiation of the study indicated that no-till enhanced total C and total N, organic C accumulation, NO₃-N availability, microbial biomass and activity in the clay loam soil 0-20 cm layer, likely due to soil stratification effect by leaving crop residues at the soil surface. The N fertilization had no significant effect on the soil microbial biomass and activity. Our hypothesis was that after 26 yr, the stratification effect of no-till and increase total C and total N in soil upper layer can still modify the soil bacterial, fungal and protista richness and taxonomic composition diversity.

MATERIALS & METHODS

- The statistical design is a split-plot replicated 4 times with main plots: conventional tillage using mouldboard plough to 20 cm (CT) and no-tillage (NT), while N fertilizer rates: 0, 80, 160 kg N ha⁻¹ are randomly assigned to 24 subplots of 25 m x 4,6 m.
- Four (6 cm x 20 cm) clay-loam soil cores sampled and manually homogenized per each soya plot. Soil DNA extracted using FastDNA Spin kit for Soil (MPBiomedicals).
- Microbial diversity assessment targeting 16SrRNA (V6-V8 region) for bacteria and 18SrRNA for protista, metazoa, and fungi [2]. Bio-informatic treatment: QIIME platform [3] and R with DADA2 [4] for filtration. Taxonomic assignments with Greengenes13.8 [5] and PR2 [6] databases.
- Other variables: Total C, Total N, Microbial respiration after 3 days.

CONCLUSION

We were able to demonstrate significant effect of soil tillage on total C, total N, microbial respiration and the composition of bacteria, fungi and protista. Moreover, after 26 years, the stratification effect already observed at the level of total C and total N of the microbial biomass (BMN), is also observed for microbial composition of fungal and protista communities for either no-till and conventional soil tillage while for bacteria this effect was observed only in no-till soil. The N fertilization rates had increased maize yield but had no effect on soybean yield.

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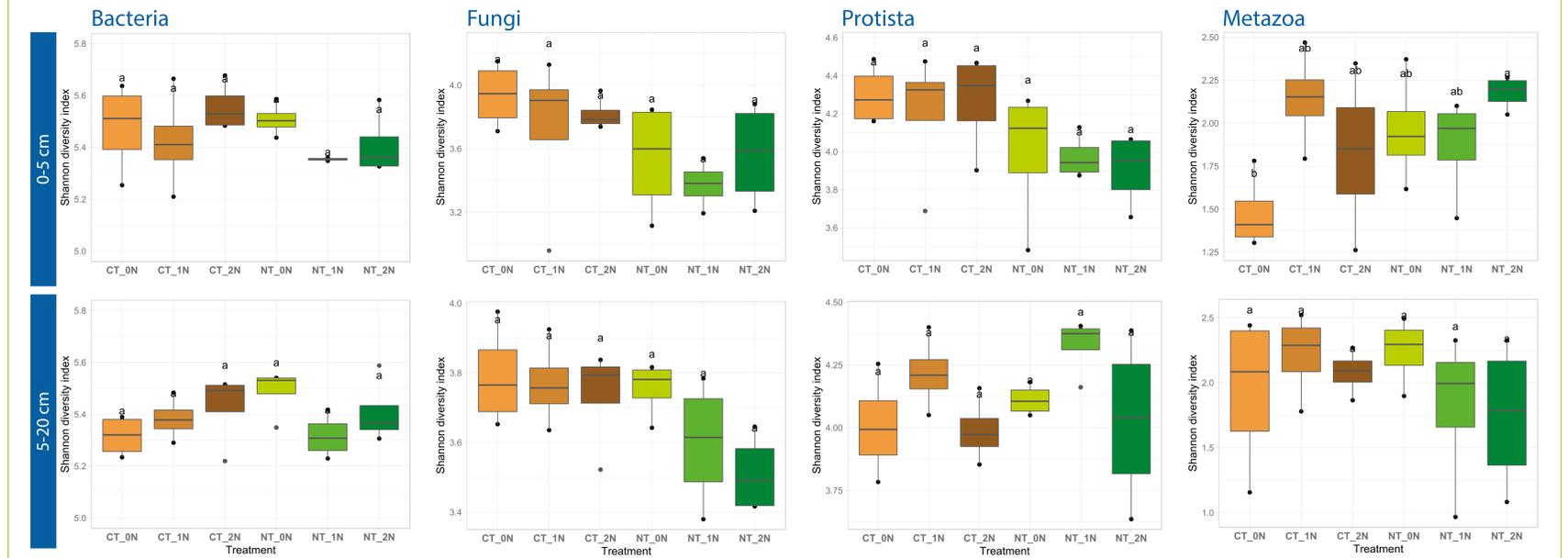


Figure 1: Shannon diversity index for bacteria, fungi, protista and metazoa according to soil tillage and N fertilisation.

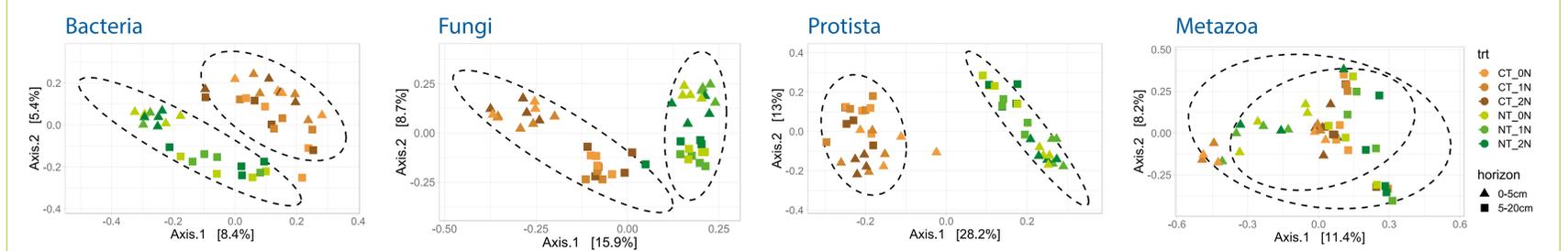


Figure 2: Principal coordinate analysis (PCoA) based on Bray & Curtis distance matrix for bacteria, fungi, protista and metazoa according to soil tillage and N fertilisation.

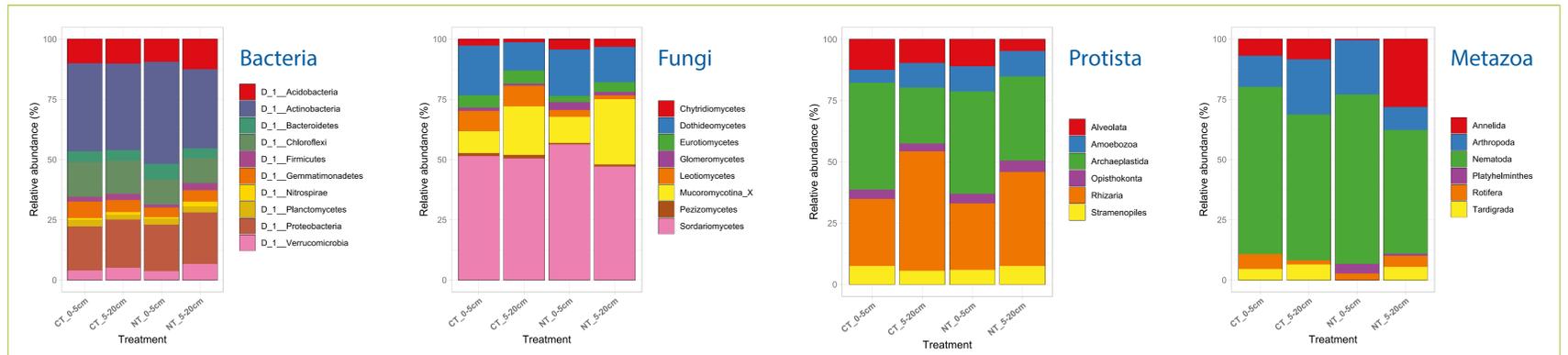


Figure 3: Taxonomic profiles for bacteria, fungi, protista and metazoa according to soil tillage.

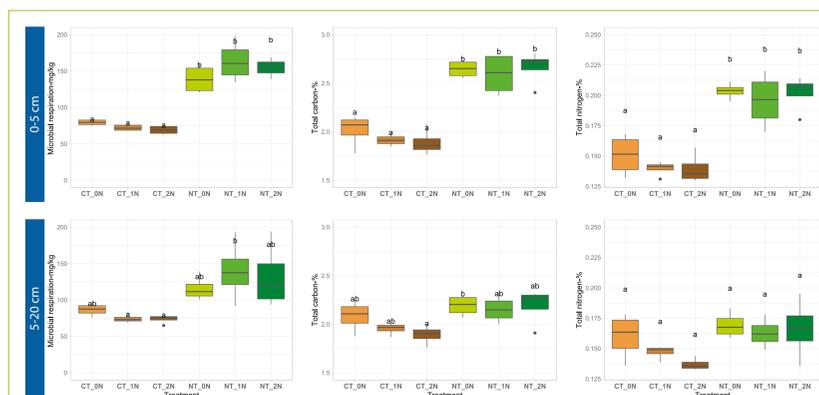


Figure 4: Microbial respiration over a period of 3 days, total C and total N determined according to soil tillage and N fertilisation.

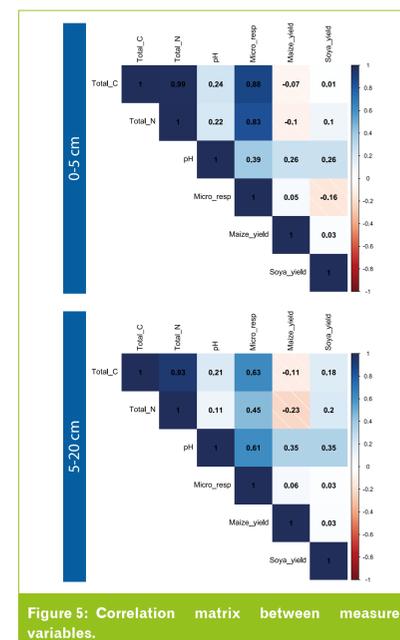


Figure 5: Correlation matrix between measured variables.

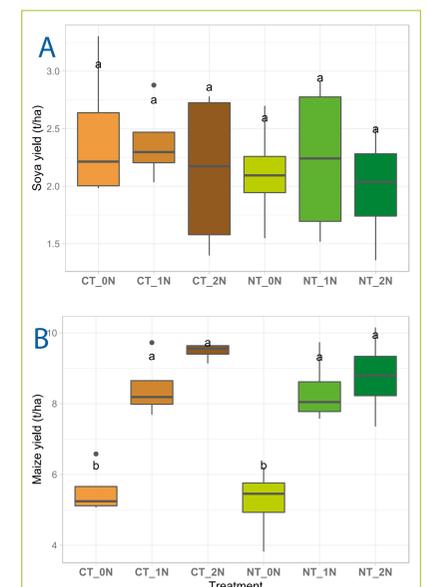


Figure 6: Soya yield (A) and maize yield of previous year (B).