DOC trial: soil organic matter quality and soil aggregate stability in organic and conventional soils

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Introduction

Organic farming systems comprise management practices that change the cycling processes of soil organic matter. Investigations on decomposition and mineralisation in soils suggest a higher importance of soil organisms in organic systems. When a larger number of soil biota are more active in organic soils, we suspect that this is reflected in the composition of soil organic matter in the long-term.

Material and methods

Soils from bio-dynamic (DYN), bio-organic (ORG) and conventional (CON) field plots were compared by using physical and chemical fractionation techniques as well as ^{13}C nuclear magnetic resonance to evaluate the distribution and composition of soil organic C and N. The exclusively minerally fertilized conventional plots (MIN), and the ones that remained unfertilized (NON) from the beginning of the trial were also included.

Results and Discussion

Total soil organic matter in the bio-dynamic field plots (16 mg C_{org} g^{-1} soil) was 20 —30 % higher than in any of the other land use systems. C-distribution among particle-size classes showed that this difference was caused by higher concentration in silt and sand but not in the clay fraction. Earlier investigations showed that sand associated organic matter can be subdivided into fractions one of which consists of young plant or manure material (light fraction). The light fraction material is decreasing with increasing organic matter content of the whole soil. Older sand associated material (heavy fraction) however was positively correlated with total C_{org} (Flie§bach *et al.*, 2000). Humus fractionation by wet chemistry resulted in the fulvic acid and humic acid fractions not being affected by the systems, whereas the residual humin fraction in the bio-dynamic system was approximately 50 % higher than in the other soils of the study. The most recalcitrant humus fraction therefore accounts for most of the difference in total C_{org}. C/N ratios of the particle size classes and the wet chemical fractions showed similar values for the different systems, indicating the functional character of the fractions. The chemical composition of soil organic matter, as assessed by solid state ^{13}C-NMR, did not show any significant effects of the systems.

Soil aggregate stability —an important factor with respect to soil erosion —was affected by the farming systems, with high stability in the manured systems and low stability in the unmanured. We found that the recommended drying prior to the measurement heavily reduced the amount of stable aggregates which supports the idea that microbial cells and microbial excreta are important factors in aggregate formation and stability.

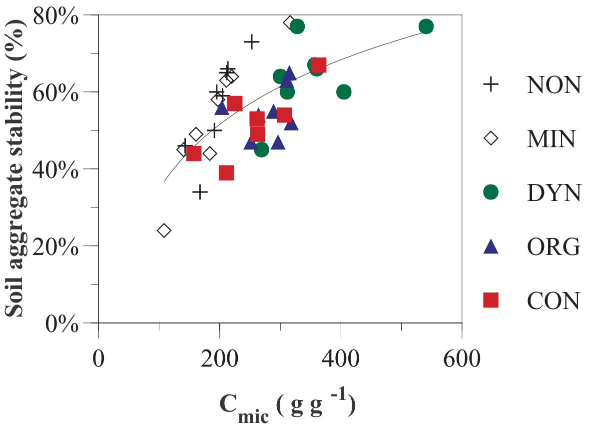

Fig 1: Aggregate stability as a function of microbial biomass

Conclusions

Soil organic matter quality is affected by the agricultural systems of the DOC trial. System effects on the chemical composition, however, were smaller than those on the living organisms in soil and their functions. A close correlation was found between soil structure and microbial biomass indicating that microbes are playing an important role in soil structural stability.

References:

Flie§bach A., M der P. (2000) Microbial biomass and size-density factions differ between soils of organic and conventional agricultural systems. *Soil Biol Biochem* **32**, 757-768. Flie§bach A., M der P., Niggli U. (2000) Mineralization and microbial assimilation of ^{14}C-labeled straw in soils of organic and conventional agricultural systems. *Soil Biol Biochem* **32**, 1131-1139