

EGU21-9489, updated on 04 Jul 2022

<https://doi.org/10.5194/egusphere-egu21-9489>

EGU General Assembly 2021

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Indicators of soil functioning in conventional, conservation and organic agriculture

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Sustainable management of agricultural systems is a major challenge for ensuring food security of the growing world population. Organic farming and reduced tillage are assumed to be sustainable agricultural practices improving soil quality relative to conventional management strategies. However, assessment of soil quality is often restrained to either physical, chemical or biological parameters. Soil organic carbon (SOC) is the most widely used indicator of soil quality, but it is not necessarily reactive to change, nor representative of the functioning of soil systems, in particular in relation to the realization of soil microbial processes, as it is composed of fractions with different availability for microbial activity and decomposition.

The objective of this study was to assess the influence of three major cropping systems: organic agriculture and conservation agriculture (no/reduced-tillage) vs. conventional agriculture on SOC fractions and microbial processes related to C and N cycling and to establish relationships between carbon fractions and microbial processes in order to identify the most relevant indicator of soil functioning. We hypothesized that 1) organic farming and conservation agriculture would improve soil functioning, 2) labile organic fractions would be better indicators of soil functioning.

We measured C and N in physical and chemical fractions (bulk, <20 µm, 20-2000µm, dissolved organic C, hot water extractable C, water soluble C, K₂SO₄ extractable C, microbial biomass C) and microbial processes (respiration potential, net N mineralization, metabolic diversity of soil bacteria) in 16 cropland sites in Wallonia, south Belgium (CARBIOSOL project).

Preliminary data analyses indicate improved soil functioning in organic managed sites relative to sites under conventional and conservation management and reveal hot water extractable carbon as a promising proxy for monitoring changes in soil functioning in response to agricultural practices. Final detailed data analyses will be presented.