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Fate of organic carbon from different waste materials in cropland soils

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Organic amendments are widely used to enhance the fertility of cropland soils. However, there is only scarce knowledge about the long term impact of added organic matter (OM) on the soil organic carbon (SOC) pool. Therefore, we analyzed a long-term field experiment in Feucherolles (France), which regularly received three different composts (home sorted bio-waste mixed with green waste (BIO), municipal solid waste (MSW) and a mixture of green waste and sewage sludge (GWS) and cattle manure since 1998. With these organic materials approximately 4 Mg total OC were added to the soil in two year intervals. The experiment was fully randomized with 4 replicates for each amendment.

In September 2013 we took samples from the surface soil (0-5 cm of Ap horizon) of all 4 treatments and the unamended control. To study the chemical alteration and the fate of the added OC into different soil compartments, we fractionated the soils by physical means using a combined density and particle size protocol. Carbon and N content were determined in bulk soils, amendments as well as in size fractions (fPOM, oPOM <20μm and oPOM >20μm, sand, silt and a combined fine silt-clay fraction). Chemical composition was determined by solid-state 13C CPMAS NMR spectroscopy.

We found significant higher C contents for the oPOM small and sand fraction of BIO treated soil and for the clay fraction of GWS treated soils ($p<0.05$). Nitrogen contents were significantly higher for BIO treated soils in bulk soil, fPOM, oPOM small and for GWS treated soils in bulk soil, fPOM and oPOM. The NMR measurements revealed that only the chemical composition of the fPOM differed according to the treatment; towards the more altered fractions as the oPOM small, the compositional differences leveled out and became almost homogeneous. Furthermore, the NMR measurements indicate a similar OC composition within the independent field replicates regarding the different amendments and fractions.

As previously shown, N was found to be concentrated in the clay fractions, but interestingly we were able to show this also for the oPOM small. Proteins and peptides, as indicated by the broad resonance between 30 and 55 ppm, clearly point to the presence of microbial products and residues in this fraction.