Carbon sequestration and stabilization in a 40-year agronomic long-term experiment

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Soils contain more carbon (C) in the form of organic matter (soil organic matter = SOM) than the entire atmosphere and global vegetation put together. They are thus a central component of the global C cycle and its largest dynamic reservoir. On the one hand, intelligent agricultural practices are discussed as a way of mitigating climate change because they can increase the amount of SOM and thus actively remove C from the atmosphere. On the other hand, all intensively used soils lose C in the long term. Central questions in this context revolve around the extent and dynamics of storage, the stabilisation mechanisms involved and the impact of agricultural use on the C budget.

The DOK experiment is an agronomic long-term experiment near Basel (Switzerland), which has been comparing biodynamic, organic and conventional management systems for 40 years (six crop rotation cycles) and has an extensive soil sample archive covering the entire period. As part of the "DynaCarb" project, we are investigating how SOM behaves in different soil fractions during the 40-year test period in the systems. We compare an unfertilized control, a purely mineral one, a purely organic one and a combined fertilized, mineral-organic variant (four replicas each) in 1982, 1989, 1996, 2003, 2010 and 2017. Using physical fractionation (density and particle sizes) and CN analyses, SOM is separated into particulate and mineral-associated fractions and their development is quantitatively investigated during six crop rotation cycles. We use solid-state ^{13}C NMR spectroscopy, N_2 gas adsorption and radiocarbon dating to estimate the C sequestration potential of soils, their saturation and the dynamics of C storage.

"DynaCarb" investigates the medium- and long-term effects of different agricultural systems on SOM. These results are of great importance for the evaluation of the C-sequestration potentials of agricultural soils and for the identification of suitable utilization and fertilization strategies.