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Soil microaggregates reveal different physical structure, microbial diversity, and organic matter composition depending on clay content and isolation method

Daniel Uteau Puschmann (1), Vincent J.M.N.L. Felde (1), Steffen A. Schweizer (2), Danh Biesgen (3), Angela Ulbrich (1), Claudia Knief (3), Markus Graf-Rosenfellner (4), Ingrid Kögel-Knabner (2,5)

(1) Department of Soil Science, Kassel University, Germany , (2) Soil Science, Department of Ecology and Ecosystem Management, Technical University of Munich, Germany , (3) Molecular Biology of the Rhizosphere, Institute of Crop Science and Resource Conservation, Universität Bonn, Germany, (4) Soil Ecology, Institute of Forest Sciences, Faculty of Environment and Natural Resources, University of Freiburg, Germany, (5) Institute for Advanced Study, Technical University of Munich, Germany

Most of our knowledge about the aggregation of soil components into larger structures is derived from analyzing wet-sieved samples, which impedes the quantification of mechanical aggregate stability. Here, we present a dry method to isolate soil microaggregates ($< 250\ \mu$m) by uniaxial crushing with the goal to preserve their natural structure. To understand how soil texture governs soil microaggregation, we investigated topsoil samples of an agricultural plot in Scheyern (Germany) with clay contents of 19, 24, and 34 %. Microscopic and tomographic observations revealed fine particle microaggregates in the clayey soils, whereas the dry-crushed aggregates in the sandy loam soil included sand grains. These dry-crushed sandy microaggregates showed a high variability when measuring their uniaxial mechanical stability in a loading frame. We compared the dry-crushed microaggregates with wet-sieved ones and found that wet-sieved aggregates had a lower and less variable mechanical stability indicating a more homogeneous structure and fewer occluded sand grains. The more heterogeneous arrangements of dry-crushed aggregates also revealed a higher microbial diversity than the wet-sieved ones. In the dry-crushed aggregates the microbial community composition differed between clay contents, whereas it was similar between small (20-53 μm) and large (53-250 μm) microaggregates. When dispersing the dry-crushed aggregates in water we found mostly aggregates sized approximately 25 μm in diameter. The distribution of such fine particle microaggregates was related with higher concentrations of organic matter in aggregates. Within the dry-crushed microaggregates, the larger size fraction retained more organic matter that was less decomposed than in the smaller size fractions. Our study reveals that dry-crushing enables the isolation of sandy microaggregates, whereas water-stable fine particle microaggregates governed the distribution of organic matter.