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Hydraulic and mechanical properties of soil aggregates under organic and conventional soil management

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Variation in hydraulic and mechanical properties of soil aggregates is an important factor affecting water storage and infiltration because the large inter-aggregate pores are dewatered first and the transport of water and solutes is influenced by the properties of the individual aggregates and contacts between them. A high mechanical stability of soil aggregates is fundamental for the maintenance of proper tilth and provides stable traction for farm implements, but limit root growth inside aggregates. The aggregate properties are largely influenced by soil management practices. Our objective was to compare the effects of organic and conventional soil management on hydraulic and mechanical properties of soil aggregates.

Experimental fields subjected to long-term organic (14 years) and conventional managements were located on loamy soil at the Institute of Soil Science and Plant Cultivation - National Research Institute in Pulawy, Poland. Soil samples were collected from two soil depths (0-10 cm and 10-20 cm). After air-drying, two size fractions of soil aggregates (15-20 and 30-35 mm) were manually selected and kept in the dried state in a dessicator in order to provide the same boundary conditions.

Following properties of the aggregates were determined: porosity (%) using standard wax method, cumulative infiltration Q ($mm^3\ s^{-1}$) and sorptivity S ($mm\ s^{-1/2}$) of water and ethanol using a tube with a sponge inserted at the tip, wettability (by comparison of sorptivity of water and ethanol) using repellency index R, crushing strength q (MPa) using strength testing device (Zwick/Roell) and calculated by Dexter's formula. All properties were determined in 15 replicates for each treatment, aggregates size and depth.

Organic management decreased porosity of soil aggregates and ethanol infiltration. All aggregates revealed rather limited wettability (high repellency index). In most cases the aggregate wettability was lower under conventional than organic soil management. Crushing strength was higher for aggregates from organic managed field, especially for 30-35 mm aggregates.