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Stability of soil aggregates in differently managed croplands – a methodological comparison

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Soil aggregation is an important characteristic of soil structure and has been studied for a long time. During the last decade, soil aggregation reached increasing attention as key factor determining organic matter (OM) stabilization and erosion processes. The vulnerability to aggregate breakdown, thus a potential release of OM and the susceptibility to soil crusting and erosion is often inferred from measurements of aggregate stability. Several methods for measuring aggregate stability are available considering different breakdown mechanisms and different scales at which stability can be determined [1,2]. The numerous methods used with different disruptive forces complicate the comparability among aggregate stability data and hamper interpretation. On that account, we compared three common different aggregate stability methods using the same soil samples. Our research has been carried out in the Central Loess Hill region of Saxony. Soil samples were taken from the upper layer (0-5 cm) along a hillslope at four positions under Conventional Tillage (CT), Direct Sowing (DS) and two no-turning Mulching managements with a shallow and deep cultivation to 15 cm (Ms) and 30 cm depth (Md), respectively. Cultivation impact declined in the following order: CT >Md > Ms > DS. Aggregate size distribution was det ermined by dry sieving. We tested three different aggregate stability tests on the aggregate size class 2-4 mm: (1) the single sieve (< 250 μm) wet sieving method with Eijkelkamp wet sieving apparatus to measure water stable aggregates, (2) the methods proposed by Le Bissonnais (1996) and (3) the ultrasonic dispersion method in combination with fragment size distribution measurement via laser diffraction. Overall, the three different methodologies tested to measure aggregate stability revealed similar results. However, the wet sieving method with Eijkelkamp apparatus is a very fast method, but only gives an overview about aggregate stability and does not allow detecting smaller differences. The method of Le Bissonnais is appropriate in studies where the different mechanisms of aggregate breakdown play a major role, especially in erosion studies. However, this approach is laborious and time consuming. Ultrasonic application in combination with laser diffraction to measure the particle sizes after disintegration of aggregates seems to be very precise measurement of aggregate stability whereby least amounts of soil material is necessary.

[1] Amézketa, E. 1999. Soil Aggregate Stability: A Review. Journal of Sustainable Agriculture 14:83-151.
[2] Le Bissonnais, Y. 1996. Aggregate stability and assessment of soil crustability and erodibility: I. Theory and methodology. European Journal of Soil Science 47:425-437.