Geophysical Research Abstracts
Vol. 12, EGU2010-4367, 2010
EGU General Assembly 2010

No tillage effect on water retention characteristics of soil aggregates in rainfed semiarid conditions.

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The evaluation of changes in soil moisture retention characteristics associated to alterations in soil structure is of great interest in tillage studies. Most of these studies have evaluated soil properties in samples of total soil but not in individual aggregates. However, soil behavior at a macroscale level depends on the aggregate properties. A better knowledge of aggregate characteristics, as the water retention properties, will help to explain, for example, the response of soil to tillage, compaction and crop growth, and hence, to plan adequate soil management practices. In this study we determine the water retention curve of soil aggregates of different sizes from a soil under two tillage systems (conventional and no tillage).

The study was carried out in a silty clay loam soil of semiarid Aragon (NE Spain). Two tillage systems were compared: no tillage (NT) and conventional tillage with mouldboard plough (CT). Water retention curves (WRC) were determined for soil surface aggregates (0-5 cm) of three different sizes (8-4, 4-2 and 2-1 mm in diameter) by using the TDR-pressure cell (*Moret et al. 2008. Soil Till. Res, 100, 114-119*). The TDR-pressure cell is a non-destructive method which permits determining WRC with the only one and same soil sample. Thus, the pressure cell was filled with aggregates up to 4 cm height, weighted and wetted to saturation from the bottom. Pressure steps were sequentially applied at -0.5, -1.5, -3, -5, -10, -33, -100, -300 kPa, and water content of each aggregate sample was measured gravimetrically and by TDR 24 h after starting each pressure head step. The volume of the sample within the cell was also determined at this moment in order to obtain the bulk density and thus calculate the volumetric water content.

A good relationship was obtained between the volumetric water content calculated from the gravimetric water content and the corresponding values measured by TDR (r^2=0.907; $p \leq 0.05$). Within the same tillage treatment, no significant differences in WRC were found among soil aggregate sizes. Soil aggregates under CT retained more water at lower pressure heads in all aggregate sizes; in contrast the retention was more effective in those from NT at high pressure level. The extensive structural degradation of the CT aggregates observed during wetting with the consequent decrease in the soil volume within the transparent cell, can help to explain the different behaviour of both soils. The CT aggregates were probably disintegrated by slaking, causing a reduction in water drainage and, therefore, an increase in soil water content at low pressure heads. This idea was also confirmed with the application of the double exponential function proposed by Dexter et al. (2008. *Geoderma 173, 243-253*). The WRC curves measured by TDR were successfully fitted to the theoretical model proposed by Dexter (r^2=0.986; $p \leq 0.05$). Thus, the model estimated that the large porosity between aggregates retain slightly more water under CT (0.36-0.39 m^3 m^{-3}) than under NT (0.31-0.35 m^3 m^{-3}). On the contrary, pores inside the aggregates tend to storage more water in NT (0.16-0.20 m^3 m^{-3}vs. 0.13-0.17 m^3 m^{-3} in CT). These results show the suitability of NT to reduce the risk of soil crusting and compaction in agricultural lands of Aragón.