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Influence of Soil Management on Water Retention from Saturation to Oven Dryness and Dominant Soil Water States in a Vertisol under Crop Rotation

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Unique water transfer and retention properties of Vertisols strongly affect their use in rainfed agriculture in water-limited environments. Despite the agricultural importance of the hydraulic properties of those soils, water retention data dryer than the wilting point are generally scarce, mainly as a result of practical constraints of traditional water retention measurement methods. In this work we provide a detailed description of regionalized water retention data from saturation to oven dryness, obtained from 54 minimally disturbed topsoil (0-0.05m) samples collected at a 3.5-ha experimental field in SW Spain where conventional tillage (CT) and direct drilling (DD) is compared in a wheat-sunflower-legume crop rotation on a Vertisol.

Water retention was measured from saturation to oven dryness using sand and sand-kaolin boxes, a pressure plate apparatus and a dew point psychrometer, respectively. A common shape of the water retention curve (WRC) was observed in both tillage systems, with a strong discontinuity in its slope near -0.4 MPa and a decreasing spread from the wet to the dry end. A continuous function, consisting of the sum of a double exponential model (Dexter et al, 2008) and the Groenevelt and Grant (2004) model could be fitted successfully to the data. Two inflection points in the WRC were interpreted as boundaries between the structural and the textural pore spaces and between the textural and the intra-clay aggregate pore spaces.

Water retention was significantly higher in DD ($p<0.05$) for pressure heads ranging from -0.006 to -0.32 MPa, and from -1.8 to -3.3 MPa. The magnitude of these differences ranged from 0.006 to 0.015 kg kg-1. The differential water capacity and associated equivalent pore-size distribution showed that these differences could be attributed to a combined effect of tillage and compaction, increasing and decreasing the amount of the largest pores in CT and DD, respectively, but resulting in a proportionally larger pore space with relevant pore-sizes for water dynamics and agronomic performance. Significant differences in water retention and equivalent pore-sizes at the dry end of the WRC could be associated with the higher organic matter content found in DD.

These results explain the superior performance of DD over CT in satisfying high crop water demands, especially at the end of spring when atmospheric water demands become very high, resulting in an extension of the growing period under DD. The results provide also an explanation for the observed soil water dynamics pattern in the field, with rapid transitions between persistent wet and dry water content states.

References

Dexter, A.R., E.A. Czyż, G. Richard, A. Reszkowska, 2008. A user-friendly water retention function that takes account of the textural and structural pore spaces in soil. Geoderma, 143:243-253.

Groenevelt, P.A., C.D. Grant, 2004. A new model for the soil-water retention curve that solves the problem of residual water contents. Eur. J. Soil Sci. 55:479-485.