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Characterization of field compaction using shrinkage analysis and visual soil examination

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Visual field examination of soil structure can be very useful in extension work, because it is easy to perform, does not require equipment or lab analyses and the result is immediately available. The main limitations of visual methods are subjectivity and variation with field conditions. To provide reliable reference information, methods for objective and quantitative assessment of soil structure quality are still necessary. Soil shrinkage analysis (ShA) (Braudeau et al., 2004) provides relevant parameters for soil functions that allow precise and accurate assessment of soil compaction. To test it, we applied ShA to samples taken from a soil structure observatory (SSO) set up in 2014 on a loamy soil in Zurich, Switzerland to quantify the structural recovery of compacted agricultural soil. The objective in this presentation is to compare the ability of a visual examination method and ShA to assess soil compaction and structural recovery on the SSO field plots.

Eighteen undisturbed soil samples were taken in the topsoil (5-10 cm) and 9 samples in the subsoil (30-35 cm) of compacted plots and control. Each sample went through ShA, followed by a visual examination of the sample and analysis of soil organic carbon and texture. ShA combines simultaneous shrinkage with water retention measurements and, in addition to soil properties such as bulk density, coarse and fine porosity, also provides information on hydrostructural stability and plasma and structural porosity. For visual examination the VESS method of Ball et al. (2007) was adapted to core samples previously equilibrated at -100 hPa matric potential. The samples were randomly and anonymously scored to avoid subjectivity and were equilibrated to insure comparable conditions.

Compaction decreased the total specific volume, as well as air and water content at all matric potentials. Structural porosity was reduced, while plasma porosity remained unchanged. Compaction also changed the shape of the shrinkage curve: (i) With compaction the sigmoidal shape characterizing a well-structured soil disappeared, and (ii) the basic slope became steeper, indicating lower hydrostructural stability. VESS scores were significantly different between compacted and uncompacted soil and strongly correlated with ShA properties. Based on these relationships, we propose a model characterizing the recovery potential of compacted soil structure.

The good agreement between visual examinations and ShA indicates that both methods are well suited for the assessment of soil compaction. ShA is more elaborate, but also more precise and has the advantage to provide valuable addi¬tional quantitative information on the state of physical degradation.

References

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