Elasto-Plastic Behaviour of Soil Aggregates and the Soil Matrix as a Function of Physical Properties in three Soils of Central Chile

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Abstract

This study assessed the elasto-plastic behaviour of soil aggregates and of the soil matrix in three soils of central Chile in terms of their structural development, clay content and internal tension. Soil samples (cores and aggregates) were collected from 2 Mollisols and 1 Vertisol at untilled and conventionally tilled sites. Unconfined consolidation tests were conducted on soil cores and on aggregates equilibrated to field capacity and air-dried, in order to determine bearing capacity and tensile strength.

For the air-dried samples there was a positive and direct relationship between soil mechanical properties (tensile strength and bearing capacity) and clay content, particularly in untilled soil, because of the non-degraded structure, while at -33 kPa the relationship was reverse, at least for the aggregates. Under wet conditions, soil management became more important and under no tillage we detected higher soil stability, irrespective of organic matter content. In both wet and dry conditions, preloading affected the resistance of the samples to deformation. Overall, the elasto-plastic behaviour of soil aggregates was significantly different from that of the soil matrix and the differences increased with increasing degree of soil structural development.

Keywords: Tensile strength, bearing capacity, aggregates, soil physical properties.

Introduction

Soil structure is defined as a three-phase material, which consists of solid mineral particles, water and air, as well as organic material. The solid mineral particles are not susceptible to compression under application of normal loads (rectangular stresses), but the soil pore volume is changed, particularly the pore size distribution and the proportion of inter-aggregate pores with the largest diameter (Hallett et al., 2000). Thus, the properties of bulk soil (undisturbed and disturbed samples) are studied more frequently than individual aggregates, although the latter do not have the same porosity as the matrix, in terms of e.g.

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