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# 3D fluorescence-based characterization of dissolved organic matter components and their impact on soil-structure stability indices

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Stable soil aggregates and structure are usually associated with increased levels of soil organic matter. A significant fraction of the latter is comprised of humic substances (HS). Opposing findings on the contribution of HS to both stabilization and increased dispersivity of soil aggregates have been reported; these findings could be related to the heterogeneity in the chemical composition of the HS. The objectives of this research were: (i) to characterize the compositional heterogeneity of HS and dissolved organic matter (DOM) in soil solutions, (ii) to evaluate the relations between general soil properties (e.g., organic matter, clay and calcium carbonate content, cation exchange capacity) and concentration and composition of DOM and HS in soil solution, and (iii) to examine the relationships between properties associated with soil structure such as aggregate stability and hydraulic conductivity and the composition of DOM and HS.

The composition of HS and DOM in aqueous extracts, obtained from samples collected from cultivated fields of four Israeli soils (loamy sand, loam, sandy clay and clay), was characterized and quantified using 3D fluorescence (and UV-absorption) spectroscopy together with parallel factor analysis (PARAFAC) supported by dissolved organic carbon (DOC) measurements. Variability in the HS/DOM composition was obtained by including soils with a different history of irrigation, i.e. irrigated by fresh water and by treated wastewater. PARAFAC analysis provided scores proportional to concentrations of three major fluorescent DOM components, two were considered to represent HS and the third to represent proteinous matter (containing tryptophan). Soil structure had been characterized by saturated hydraulic conductivity and an index for aggregate stability. PARAFAC analysis demonstrated that concentrations of fluorescent DOM components in aqueous extracts were influenced by the type of water used for irrigation. This influence was distinctly affected by soil type. In clayey soils, samples irrigated with treated wastewater yielded smaller concentrations of extractable HS components compared with samples irrigated with fresh water. In the loamy sand and loam, concentrations of HS and proteinous matter in samples irrigated with treated wastewater were greater than those from samples irrigated with freshwater. These differences suggest that some interactions between soil clay and the effluent-borne OM may occur leading to reduced extractability of organic components in the clayey soils. The structural stability determinants of soils studied correlated significantly (at the $p<0.05$ level) with the concentrations of the three fluorescent DOM components but not with DOC concentration. In the clayey soils, the decrease in soil stability indices correlated with the decrease in concentrations of the extractable HS components, both induced by irrigation with treated wastewater. Our results suggest that changes in soil indices representing soil structure and stability, induced by changes in irrigation water quality, could be associated with changes in the concentration of HS components.