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Role of organic matter on aggregate stability and related mechanisms through organic amendments

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To date, only a few studies have tried to simultaneously compare the role of neutral and uronic sugars and lipids on soil structural stability. Moreover, evidence for the mechanisms involved has often been established following wetting of moist aggregates after various pre-treatments thus altering aggregate structure and resulting in manipulations on altered aggregates on which the rapid wetting process may not be involved anymore. To the best of our knowledge, the objective of this work was to study the role of neutral and uronic sugars and lipids in affecting key mechanisms (swelling rate, pressure evolution) involved in the stabilization of soil structure. A long-term incubation study (48-wk) was performed on a clay loam and a silty-clay loam amended with de-inking-secondary sludge mix at three rates (8, 16 and 24 Mg dry matter ha-1), primary-secondary sludge mix at one rate (18 Mg oven-dry ha-1) and composted de-inking sludge at one rate (24 Mg ha-1). Different structural stability indices (stability of moist and dry aggregates, the amount of dispersible clay and loss of soil material following sudden wetting) were measured on a regular basis during the incubation, along with CO2 evolved, neutral and uronic sugar, and lipid contents. During the course of the incubations, significant increases in all stability indices were measured for both soil types. In general, the improvements in stability were proportional to the amount of C added as organic amendments. These improvements were linked to a very intense phase of C mineralization and associated with increases in neutral and uronic sugars as well as lipid contents. The statistical relationships found between the different carbonaceous fractions and stability indices were all highly significant and indicated no clear superiority of one fraction over another. Paper sludge amendments also resulted in significant decreases in maximum internal pressure of aggregate and aggregate swelling following immersion in water, two mechanisms affecting structural stability. Overall, the results suggest that reduction in maximum internal pressure induced by organic amendments most likely resulted from increases in pore surface roughness and pore occlusion rather than by increase in surface wetting angles. This study also supports the view of a non specific action of the lipids, neutral and uronic sugars on aggregate stability to rapid wetting.

Key words: soil aggregate stability, polysaccharides, lipids, mechanisms, organic matter