Stabilization of soil aggregates along a plant community succession: indirect positive effects of root biomass and root heterogeneity

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Abstract

Soil aggregate stability is a major component of soil functioning. This research aimed at tracking variations of soil aggregate stability along succession and to unravel how root characteristics contribute to drive these variations. Forty-eight plant communities on embankments along roadsides were selected in the French Mediterranean region, aged from 6 to 69 years-old, and ranging from gramino'id dominated plant communities to shrub/trees dominated communities. From methodological perspective, we measured soil aggregate stability and several soil and plant community characteristics, focusing on root characteristics (*e.g.* root morphology, root chemistry and mass density). Beyond the usual community average root traits, we adapted methods generally used for aboveground traits to calculate root morphological heterogeneity. The results show that soil aggregate stability varied significantly along the successional gradient, from unstable in early successional communities to very stable in late successional ones. Along the gradient, the accumulation of soil organic carbon, related to plant community dynamic, appeared as the major factor driving the stabilization of soil aggregates. Structural equation models revealed that the increase in root mass density and root morphological heterogeneity along the succession contributed equally to the accumulation of soil organic carbon, stabilizing soil aggregates. Finally, the research reveals that root compartment appeared as central to indirectly drive soil aggregate stabilization along the succession.

Keywords: root traits, mass ratio hypothesis, plant diversity, soil formation, soil erosion, mediterranean region

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