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Fungal and bacterial predator-prey systems influence soil aggregate formation and stabilisation

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Soil aggregates are micro- to millimetre sized organo-mineral associations considered as the building bricks of soil structure. It is acknowledged that soil bacteria and fungi influence their formation and stabilisation, but to date most experimental evidences account for these effects in isolation. As soil microorganisms are embedded in complex foodwebs, prompting us to investigate how trophic interactions modulate soil aggregate formation and stabilisation.
We focused on: (i) a bacterial-based system comprising Amoebae (Acanthamoeba castellanii) grazing on free-living bacteria (Pseudomonas fluorescens), and (ii) a fungal-based system comprising Collembola (Heteromurus nitidus) grazing on saprophytic fungi (Chaetomium globosum). Soil organisms were incubated in mesocosms during 7 weeks on sterilized soil previously sieved to 1 mm to destroy larger aggregates. Soil aggregate formation was assessed by dry sieving (10 mm, 5 mm, 3 mm, 2 mm, 250 μm, 50 μm) and soil aggregate stabilization was assessed by capillarity re-wetting of macroaggregates (3 to 5 mm), followed by dry sieving (2 mm, 1 mm, 500 μm, 200 μm, 100 μm, 50 μm).
We found that soil aggregate formation and stabilisation were significantly enhanced by fungi inoculation, resulting in larger diameter aggregates resisting more dispersion in water. The addition of Collembola negatively modulated these effects, by suppressing the positive effect of fungi on aggregate formation and by reducing the stabilising effect of fungi when incubated alone. The inoculation of bacteria alone did not affect of aggregate formation, but had a significant stabilising effect on soil aggregates. Adding amoebae significantly increased aggregate formation, resulting in the formation of larger diameter aggregates. By contrast, amoebae suppressed the stabilising effect of bacteria on soil aggregates. To our knowledge, this study provides the first evidence that predators significantly modify the effects of soil microbes on soil aggregate formation and stabilisation.