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Effect of dispersal networks on bacterial dispersal and biodegradation at varying water potentials

Anja Worrich (1,2), Matthias Kästner (2), Anja Miltner (2), and Lukas Y. Wick (1)

(1) Helmholtz Centre for Environmental Research, Department of Environmental Microbiology, Leipzig, Germany, (2) Helmholtz Centre for Environmental Research, Department of Environmental Biotechnology, Leipzig, Germany

In porous media the matric and the osmotic potential contribute to the availability of water to microbes and decisively influence important microbial ecosystem services such as biodegradation. Bacterial motility is considered as a key driver for biodegradation and fungal mycelia have been shown to serve as effective dispersal networks thereby increasing bacterial movement in water unsaturated environments. However, poor knowledge exists on the beneficial effects of mycelia at varying water potentials (Ψw). We therefore established experimental microcosms to investigate the effect of mycelia-like dispersal networks on the dispersal and growth of Pseudomonas putida KT2440-gfp at given osmotic and matric potentials and determined their benefit for the biodegradation of benzoate. Using either NaCl or polyethylene glycol 8000 the Ψw of agar was modified between ΔΨw 0 - -1.5 MPa (i.e. water potentials representing completely saturated or plant permanent wilting point conditions). We found that dispersal, growth and biodegradation rates dropped noticeably below ΔΨw -0.5 MPa in osmotically stressed systems. However, in matric stress treatments this decline occurred at ΔΨw -0.25 MPa due to a complete repression of bacterial movement at this Ψw. The presence of dispersal networks effectively defused the negative effects of lowered matric potentials by enhancing bacterial dispersal. No benefical network effect was observed in the osmotically stressed systems, likely due to NaCl toxicity rather than the water depriviation effects. We propose that dispersal networks act as an important buffer mechanism and hence may increase the microbial ecosystem's functional resistance to matric stress.