**Mycelia as hot spots for horizontal gene transfer of bacteria**

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Bacteria have the ability to exchange genes via horizontal gene transfer (HGT), which enables soil bacteria to adapt to changing environments by acquiring new genetic traits such as degradative pathways or resistance to antibiotics. Conjugation is believed to be the most important mechanism of bacterial adaptation in soil, involving the transfer of plasmids via direct cell-to-cell contact. Yet, soil bacteria typically live in isolated surface-associated colonies. Hence, HGT between them requires cell movement in soil water or along surfaces, which however are typically discontinuous in nature.

We studied the effects of bacterial dispersal along mycelial networks to investigate (I) if mycelial networks can help bacteria to overcome spatial isolation and (II) how these networks influence bacterial HGT in general.

Using laboratory-scale microcosms, we applied a bacterial reporter system for HGT events consisting of two Pseudomonas putida strains. The recipient strain and the plasmid donor strain, carrying the TOL plasmid pWW0, were labeled with distinct fluorescent proteins. Resulting transconjugants were indicated by an emerging third fluorescence signal. Successful conjugation events along the hyphae were both quantified with flow cytometry and visualized by fluorescence microscopy. To obtain more generic, spatio-temporal information on the role of mycelial networks for HGT in heterogeneous habitats, an individual-based simulation model was employed.

Our Results show that (I) mycelial networks can help bacteria to overcome spatial isolation and (II) that mycelial structures promote bacterial HGT by providing a transport network and confined aqueous films in which bacterial contacts are more frequent, leading to a significant increase in transconjugant cells. Individual-based simulations supported these observations and revealed that the tendency of bacteria to concentrate around mycelial networks, resulting in high bacterial densities along hyphae, has a more pronounced effect on HGT than the promotion of bacterial dispersal by the mycelium.

Our study shows the beneficial role of the mycosphere on bacterial HGT by providing transport networks that facilitate cell-to-cell contact, leading to significantly increased gene transfer. Such knowledge may be highly relevant for the design of novel knowledge-driven bioremediation strategies or the chemical risk assessment as HGT is a driver of the expansion of the microbial gene pool involved in the biodegradation of emerging contaminants.