A high-throughput method for evaluating bacterial dispersal on hyphal networks

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In complex and heterogeneous environments, the hyphae of filamentous fungi and fungal-like Oomycetes are known to provide a support for the dispersal of other microorganisms. The use of these “fungal highways” is regulated by the interplay of both physical and biological constraints. Therefore, the ability of different species to establish fungal highways must be verified experimentally. Several experimental devices that can test specific pairings exist. However, these methods are time consuming and cannot be applied at a large scale and high-throughput format. Today, three-dimensional (3D) printing offers fast translation between digital design and a finished product, allowing the testing of intricate designs with greater reproducibility, and faster production times. In this study, we used 3D printing to develop an experimental tool to allow fast and high-throughput evaluation of bacterial dispersal on hyphal networks. Different materials and designs were tested to produce a “crossing bridge”, which the fungal-bacterial couples can use to traverse to the opposite well. The design allows for the simultaneous testing of multiple species and the inclusion of any culturing media.

The devices were evaluated with several fungal and bacterial species and the performance of designs was compared. The optimal topology was selected to evaluate the effect of multi-trophic conditions on the effectiveness of the transport. The comparison of a high- and low-nutrient media showed that bacterial transport is more effective under low-nutrient conditions, despite the fact that fungal growth was slower. This study provides an easy-to-implement approach for evaluating the effective transport of bacteria by fungi and fungi-like hyphal networks.