



HYPOTHESES

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Application of filamentous phages in environment: A tectonic shift in the science and practice of ecorestoration

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Abstract

Theories in soil biology, such as plant-microbe interactions and microbial cooperation and antagonism, have guided the practice of ecological restoration (ecorestoration). Below-ground biodiversity (bacteria, fungi, invertebrates, etc.) influences the development of above-ground biodiversity (vegetation structure). The role of rhizosphere bacteria in plant growth has been largely investigated but the role of phages (bacterial viruses) has received a little attention. Below the ground, phages govern the ecology and evolution of microbial communities by affecting genetic diversity, host fitness, population dynamics, community composition, and nutrient cycling. However, few restoration efforts take into account the interactions between bacteria and phages. Unlike other phages, filamentous phages are highly specific, nonlethal, and influence host fitness in several ways, which make them useful as target bacterial inocula. Also, the ease with which filamentous phages can be genetically manipulated to express a desired peptide to track and control pathogens and contaminants makes them useful in biosensing. Based on ecology and biology of filamentous phages, we developed a hypothesis on the application of phages in environment to derive benefits at different levels of biological organization ranging from individual bacteria to ecosystem for ecorestoration. We examined the potential applications of filamentous phages in improving bacterial inocula to restore vegetation and to monitor changes in habitat during ecorestoration and, based on our results, recommend a reorientation of the existing framework of using microbial inocula for such restoration and monitoring. Because bacterial inocula and biomonitoring tools based on filamentous phages are likely to prove useful in developing cost-effective methods of restoring vegetation, we propose that filamentous phages be incorporated into nature-based restoration efforts and that the tripartite relationship between phages, bacteria, and plants be explored further. Possible impacts of filamentous phages on native microflora are discussed and future areas of research are suggested to preclude any potential risks associated with such an approach.

KEYWORDS

bioremediation, biosensors, ecological theory, filamentous phages, microbial ecology and fitness, restoration ecology

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