Researchers offer new and novel paradigm for advancing research on beneficial microbes

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While beneficial microbes are becoming a more common tool in agriculture, their effectiveness in the field is severely blunted thanks to real-world environmental stressors like heat and drought, competition with other microbes, and interactions with the host plant. Such factors can reduce the treatment's effectiveness or even drive the microbe to extinction.

Adding to these challenges: the development of new beneficial microbes and microbiome-related treatments has been slow. Because the pool of microbial taxa found in the soil is so large and diverse, it is hard to isolate the most beneficial ones for study.

Through a new *Phytobiomes* journal review paper, titled "Translating Phytobiomes from Theory to Practice: Ecological and Evolutionary Considerations," Drs. Christine Hawkes and Elise Connor in the Department of Integrative Biology at the University of Texas propose applying ecological theories to improve the process of microbial technology development.

"Most plant microbiome studies in agriculture are divorced from ecological mechanisms," says Hawkes. "We argue that if we can identify the underlying ecological mechanisms, these can provide a roadmap to improve the development and application of successful microbiome treatments."

Using endophytic fungi to illustrate, Hawkes and Connor discuss the integration of ecological and evolutionary niche theory in plant microbiome studies to help with the development and implementation of microbiome treatments. They specifically discuss:

- Applying processes such as niche partitioning to limit competitive interactions and maximize persistence, priority effects to allow establishment before resident taxa, storage effects that take advantage of temporal variation in niche availability, and others.
- How these niche processes can serve as both impediments or opportunities for the establishment and persistence of microbiome treatments in the field.
- The barriers to implementing niche-based microbiome treatments, including the potential role for neutral processes, technological issues, and scaling of inoculum production.

"By considering the niche when designing treatments, we can increase treatment effectiveness and persistence," said Hawkes. "Ideally, identification of the most important mechanisms will allow us to assemble treatment communities that are robust, difficult to invade, and provide consistent benefits despite environmental fluctuations."

Hawkes also points out a major benefit of research on microbiome treatments: They may one day help move growers toward more sustainable, low-input agriculture by using plant-microbe interactions as opposed to chemical additives.

"We are entering a new era of microbiome discovery that has the potential to change the way we grow crops for food and fuel," said Hawkes. "This article provides a new perspective on how to do that, considering microbial ecological interactions with the host, other microbes, and the environment."

More information: Christine V. Hawkes et al, Translating Phytobiomes from Theory to Practice: Ecological and Evolutionary Considerations, *Phytobiomes* (2017). DOI: 10.1094/PBIOMES-05-17-0019-RVW