Dear Dr. Lessard,

Please find attached our manuscript “Time will tell: the temporal and demographic contexts of plant-soil microbe interactions” submitted as a Concept & Synthesis article to Ecological Monographs.

There is an increasing recognition that interactions between plants and soil microbes, often studied under the framework of plant-soil feedback (PSF), influence the structure and dynamics of plant communities. Although there is now evidence that soil microbes affect plant performance and species interactions across almost every terrestrial ecosystem, our ability to translate results from short-term PSF experiments into predictions of long-term plant dynamics in the field remains limited. We argue that accounting for the natural temporal and demographic contexts of plant-soil microbe interactions can help bridge this gap.

In our manuscript, we begin by using model simulations to show the consequences of overlooking the temporal and demographic details of microbial effects. For the temporal dimension, we synthesize the current understanding of how plants and soil communities change over time during the conditioning and response phases of the classic PSF experimental design, with a novel focus on the temporal gap between the two phases. For the demographic dimension, we highlight microbial effects on different plant demographic transitions, which are often ignored in PSF studies that focus solely on microbial impact on plant biomass. Finally, we argue that the current theoretical paradigm makes it difficult to incorporate the temporal and demographic dimensions of plant-soil microbe interactions. We propose two new avenues for theoretical studies to better integrate this complexity. Throughout the manuscript, we offer perspectives for experiments and theoretical frameworks to enable more nuanced predictions of the long-term consequences of plant-soil microbe interactions in nature.

We believe this study would interest the broad range of readership of Ecological Monographs. Our manuscript summarizes the temporal aspects of PSF experiments in the literature, thereby demystifying the experimental decisions associated with quantifying microbial effects for newcomers to the field. For empirical studies, our synthesis highlights the necessity of considering the natural temporal context when designing experiments and interpreting results. For theoretical studies, we demonstrate how patch occupancy models and demographically explicit models can be applied to study plant-soil microbe interactions. The feedback loop between empirical and theoretical approaches, as exemplified in our Concept & Synthesis article, provides an exciting avenue to understand the influence of soil microbes on plant communities.

This manuscript has been posted on EcoEvoRxiv (DOI: 10.32942/X2PS5N) but is not under consideration elsewhere. Thank you for considering our submission.

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Sincerely, Po-Ju Ke, Gaurav Kandlikar, Suzanne Ou, Gen-Chang Hsu, Joe Wan, Meghna Krishnadas