Microbial ecological memory of recurrent drought enhances host stress tolerance through enrichment of plant-beneficial bacteria

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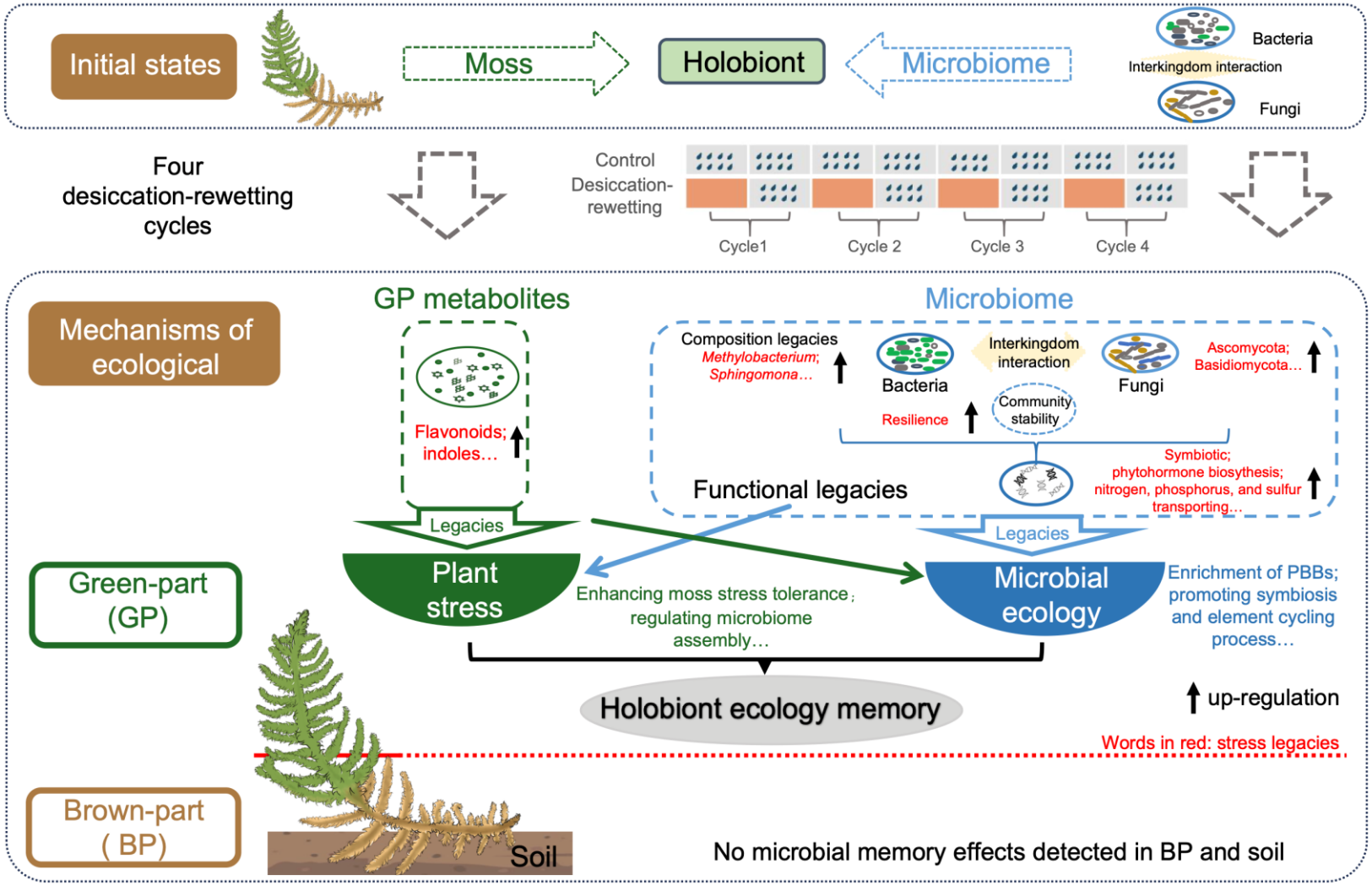
Introduction



Under recurrent drought-rewetting stress, a niche-specific ecological memory emerges in the microbiome of *Calohypnum plumiforme*. This memory enhances host stress tolerance through the enrichment of plant-beneficial bacteria and substantiates the “holobiont ecological memory” framework.

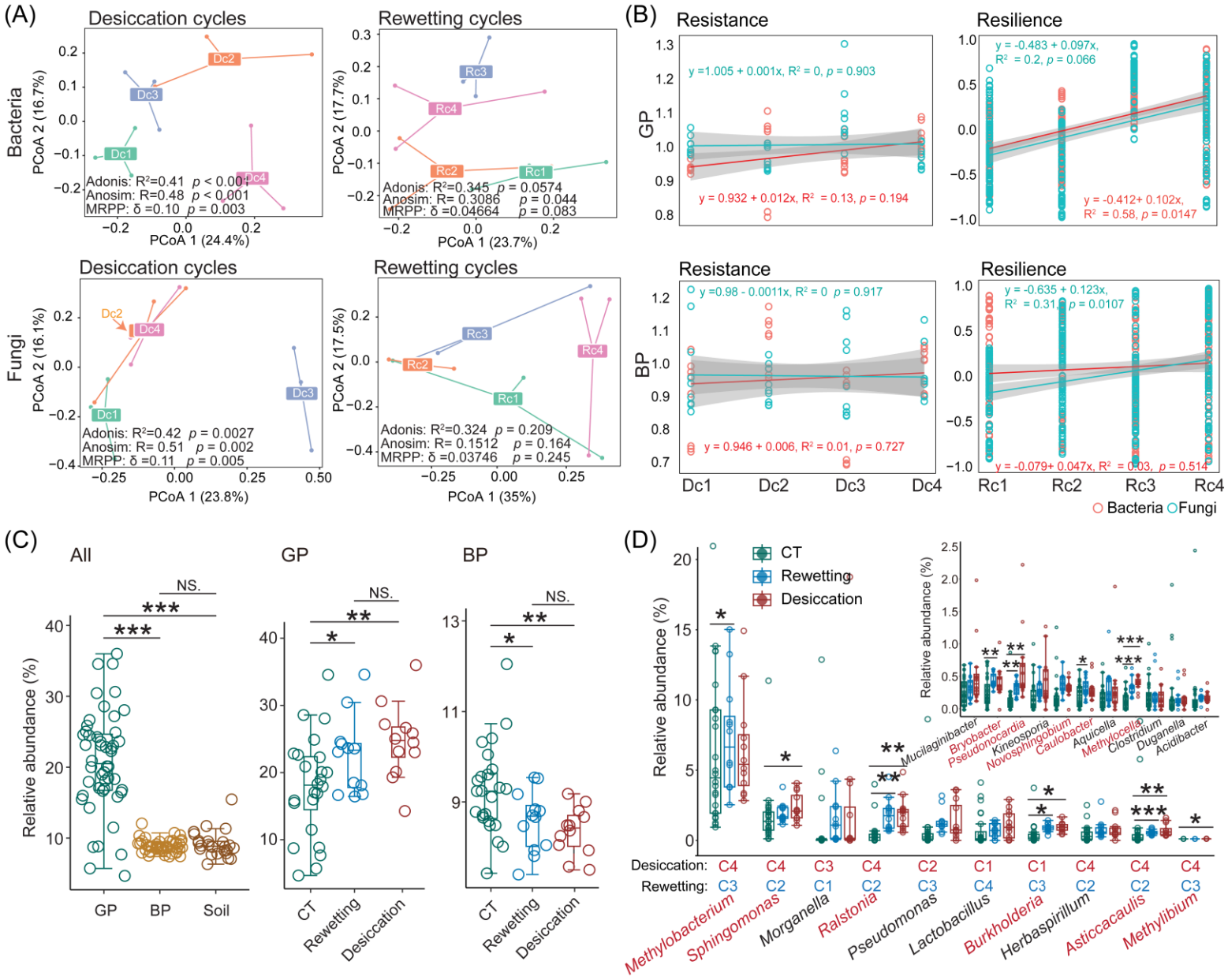
Highlights

1. Microbial ecological memory exhibits strong niche specificity, manifesting as a stable legacy through deterministic assembly exclusively in the metabolically active green parts (GP), with negligible responses observed in senescent tissues (brown part, BP) and soil.

2. Plant-beneficial bacteria (PBBs) serve as the core biotic carriers of this memory, wherein the significant enrichment of *Methylobacterium* and *Sphingomonas*, coupled with the upregulation of functional genes, confers enhanced host stress tolerance.

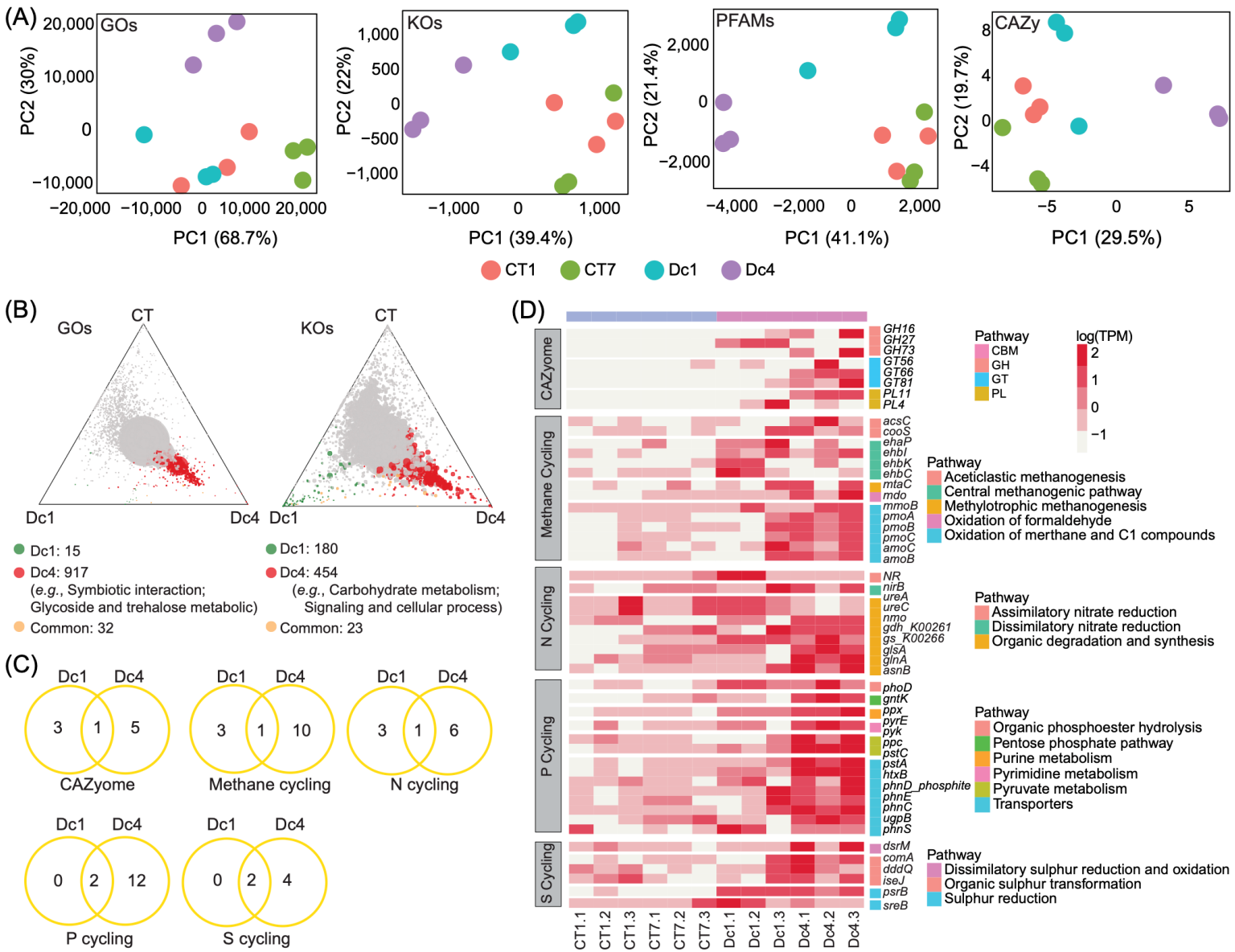
3. Microbial functional restructuring and host metabolic reprogramming converge to substantiate the “holobiont ecological memory” framework.

Results



Recurrent drought generates a niche-specific microbial ecological memory and enriches plant-beneficial bacteria in GP of *C. plumiforme.*

Results



Functional and host-associated shifts support a holobiont-scale stress-memory framework under recurrent drought.

Summary

- Recurrent drought-rewetting induces niche-specific microbial ecological memory in the moss phyllosphere.
- This memory is driven by enhanced community stability, the enrichment of plant-beneficial bacteria, and coordinated functional-metabolic restructuring.
- This study proposes a “holobiont ecological memory” framework, extending ecological memory from soil systems to plant aerial microbiomes and highlighting its potential role in host stress resilience.

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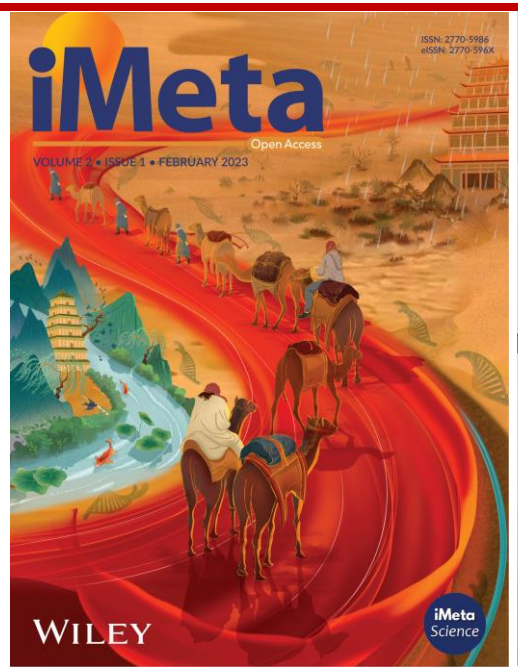

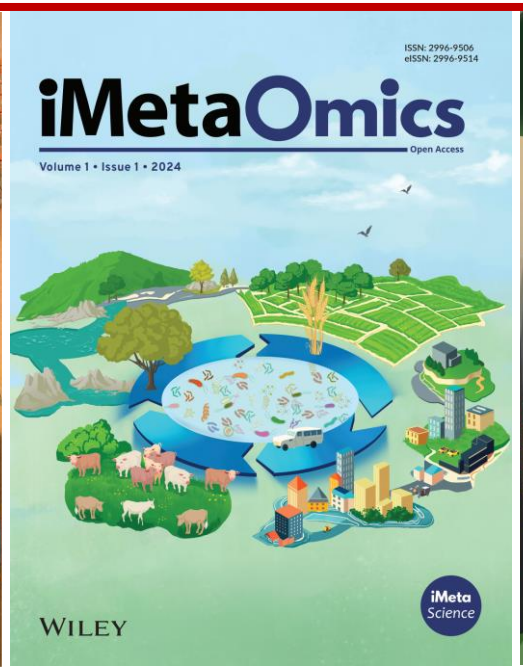

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