SEL Research 不同凋落物特性对草地土壤微生物多样性及碳氮释放的调控作用

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不同凋落物特性对草地土壤微生物多样性及碳氮释放的调控作用。论文标题：Divergent effects of root and leaf litter on soil microbial diversity decouple soil C-N release

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Divergent effects of root and leaf litter on soil microbial diversity decouple soil C-N release

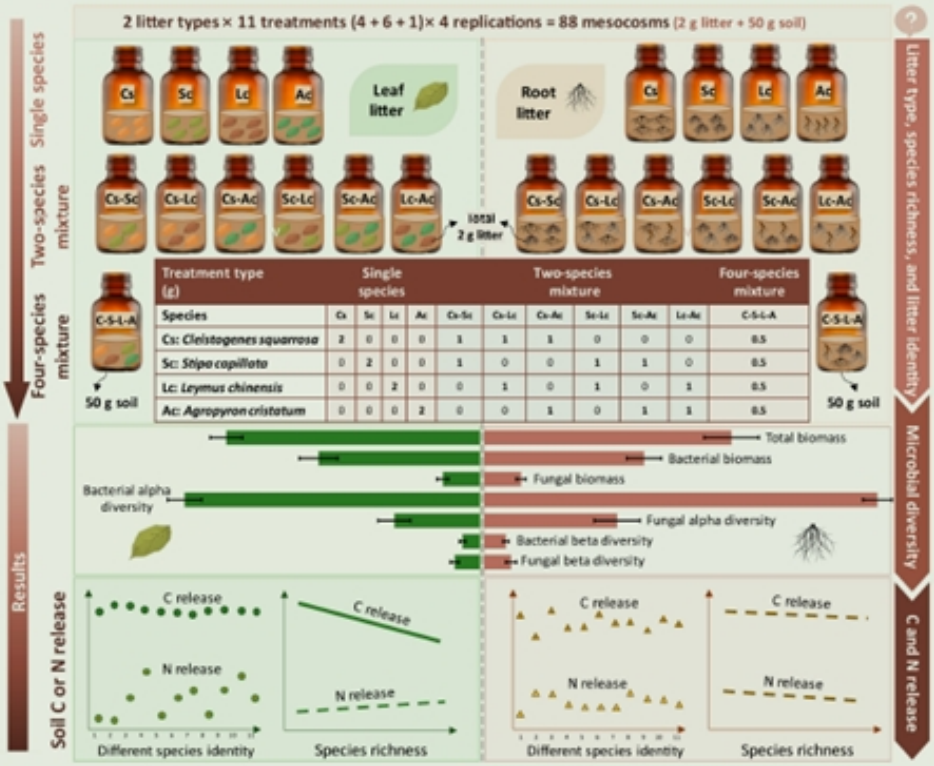
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ABSTRACT

- Root litter boosts bacterial diversity but reduces microbial biomass vs. leaf litter.
- Litter identity outweighs richness in shaping microbial communities and C-N release.
- Leaf litter richness suppresses CO_2 emissions, while root traits control N retention.
- Root recalcitrance sustains fungal beta diversity, whereas leaf chemistry drives bacterial convergence.
- Integrated leaf-root management balances grassland C sequestration and nutrient cycling.



Litter decomposition drives grassland biogeochemical cycles, yet the distinct roles of leaf and root litter identity, richness, and functional traits in regulating soil microbial diversity and decomposition remain poorly resolved. Using a 120-day mesocosm experiment with leaf and root litter of the dominant species in Inner Mongolia grassland, we assessed how litter type (leaf vs. root), richness (1, 2, 4 species), and identity (root or leaf litter of 4 dominant species) modulate microbial diversity and soil carbon (C) and nitrogen (N) release. We found that litter type and identity more strongly influenced microbial biomass than species richness, and root litter supported higher bacterial alpha diversity but lower microbial biomass and fungal beta diversity compared to leaf litter. Root litter identity primarily affected the overall beta diversity patterns of both bacterial and fungal communities, while greater leaf litter richness significantly suppressed soil C release. Mechanistically, root litter identity associated with the resource-conservative strategy directly controlled soil C release and indirectly regulated N retention via bacterial beta diversity. Conversely, leaf litter type characterized by the resource-acquisitive strategy primarily affected soil C release by altering

本研究选取内蒙古典型草原4种优势物种 (糙隐子草、针茅、羊草和冰草)的叶片凋落物和根系凋落物作为研究对象，通过添加不同叶片或根系凋落物，探究凋落物类型、丰富度及特性对土壤微生物多样性及碳氮释放的影响。结果表明，与叶片凋落物相比，根系凋落物增加土壤细菌但是降低土壤微生物生物量；相较于物种多样性，凋落物类型和特性在调控微生物群落组成和碳氮释放中起着更为关键作用；增加叶片凋落物多样性显著降低土壤碳矿化速率。

植物凋落物分解是草地生态系统物质循环的核心过程，但长期以来叶片与根系凋落物在调控土壤微生物多样性及碳氮释放中的差异化机制尚不明确。本研究基于内蒙古草原4种优势植物(糙隐子草、针茅、羊草和冰草)的凋落物开展为期120天的室内培养实验，系统解析凋落物类型（叶/根）、物种丰富度（1/2/4种）及凋落物特性对土壤微生物生物量、多样性及土壤碳氮释放的调控。

研究发现，相较于物种丰富度，凋落物的类型与特性对土壤微生物生物量的影响更为显著。与叶片凋落物相比，根系凋落物促进增加细菌Alpha多样性(香农指数)但降低土壤微生物量和真菌Beta多样性(Bray-Curtis dissimilarity)。根系凋落物的特性是决定细菌与真菌群落Beta多样性的主要因素，而叶片凋落物的物种丰富度显著抑制了土壤碳释放。从机制上看，具有资源保守型策略的根系凋落物通过影响细菌Beta多样性间接调节氮保留，并直接控制土壤碳释放；而叶片凋落物则表现出资源获取型策略，主要通过提高微生物Alpha多样性来促进碳释放，同时还能通过增加微生物生物量直接促进氮释放。

综上，本研究强调了凋落物类型、多样性与凋落物特性对土壤微生物多样性及碳氮释放的显著调控作用，表明在草地恢复中可通过优化凋落物组成（如增加叶片凋落物多样性）来增强土壤碳汇潜力，并调控氮循环过程。

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专题征稿

城市土壤生态与同一健康

Call for papers: Urban Soil Ecology and One Health

Urban landscapes are complex incubators for emerging public health threats, including the persistence and spread of zoonotic pathogens that jeopardize the integrated health of humans, animals, plants, and environments—a nexus addressed by the One Health framework. Within these ecosystems, soil biodiversity is a keystone component that underpins critical ecosystem functions, yet it persists as one of the least understood elements of urban ecosystems.

Aligned with the World Soil Day 2025 theme, "Healthy soils for healthy cities," this special issue calls for research to address this knowledge gap. We seek submissions that illuminate the distribution patterns and functional contributions of urban soil biota, particularly under pressures from human activity and climate change. We are also interested in studies exploring how harnessing urban soil biodiversity can lead to nature-

based solutions for mitigating biodiversity loss, adapting to climate change, and reducing the urban burden of disease. We particularly encourage studies proposing frameworks for embedding soil biodiversity into urban governance and policy to directly enhance One Health outcomes.

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