

不同覆盖类型城市绿地土壤核心细菌群落决定土壤多功能性并表现出广泛的环境适应性

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摘要:【目的】城市绿地支持多种生态系统功能,其中许多功能是由土壤核心微生物群落所驱动的。然而,城市绿地土壤核心细菌群落的生物地理分布及其变化机制仍未得到充分研究。本文综合探究了不同覆盖类型的城市绿地中,土壤核心细菌群落对土壤理化性质及土壤多功能性变化的响应机制。【方法】我们采集了 90 个土壤样本,利用高通量扩增子测序技术和多元统计分析方法,探究了不同覆盖类型的城市绿地,包括草地、灌木丛和乔木林地。【结果】研究发现大部分土壤理化性质和土壤多功能性在乔木林地中达到最高值。而且,草地土壤核心细菌群落的 α 多样性显著低于灌木丛和乔木林地,土壤核心细菌群落结构受土地覆盖类型的影响较大。在生物地理分布方面,土壤核心细菌群落的地理距离-衰减模式比土壤理化性质-衰减模式更加平缓,同时,这一结果被核心细菌群落与土壤理化性质之间的密切相关性所证实。在群落构建方面,整体而言随机性过程对核心细菌群落的贡献较小,但对草地中核心细菌群落的贡献大于对其他覆盖类型中的群落。我们还发现,土壤总碳是影响土壤核心细菌群落结构的主要土壤理化性质,且土壤多功能性主要受核心细菌群落 α 多样性的影响。值得注意的是,土壤理化性质决定了土壤核心细菌群落结构的变化,而土壤核心细菌群落则显示出更加广泛的环境适应性。【结论】总体而言,这些结果极大地深化了我们对城市绿地土壤核心细菌群落形成机制的理解,这对于管理城市环境健康和支持可持续化的城市发展至关重要。

关键词: 核心细菌群落; 生物地理分布; 群落构建机制; 土地覆盖类型; 城市绿地

Core bacterial communities determine soil multifunctionality and display broader environmental adaptation under different land cover types in urban greenspaces

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Abstract: 【Objective】Urban greenspaces support multiple ecosystem functions, many of which are particularly driven by soil core microbial communities. However, the biogeographic distributions and mechanisms underlying altered soil core bacterial communities in urban greenspaces remain largely unexplored. Here, the responses of soil core bacterial communities to variation in edaphic properties and soil multifunctionality were comprehensively characterized under the effects of different land cover types in urban greenspaces. 【Method】We collected 90 soil samples and utilized sequencing and multiple statistical analyses to conduct our investigation. The different land cover types included grassland, shrubland, and arborland in urban greenspaces. 【Result】Most edaphic properties and soil multifunctionality significantly reached the highest values in arborland. Alpha diversity of soil core bacterial communities was significantly lower in grassland than shrubland and arborland, and the composition of soil core communities was profoundly affected by land cover type. Subsequently, soil core bacterial communities had flattened geographic d

istance-decay relationships than edaphic decay patterns, confirmed by intimate correlations between core communities and edaphic properties. Stochastic processes were lower in core bacterial communities, but contributed more in grassland than other land cover types. Soil total carbon was the dominant edaphic property regulating the composition of soil core bacterial communities. Meanwhile, soil multifunctionality was mainly determined by the alpha diversity of core communities. Notably, edaphic properties explained more variation in the composition of soil core bacterial communities, which displayed substantially broader environmental adaptation. **【Conclusion】** Overall, these results considerably expand our understanding of the mechanisms shaping soil core bacterial communities in urban greenspaces, which is integral to managing the health of urban environments and supporting sustainable urbanization development.

Key words: Core bacterial community; Biogeographic distribution; Community assembly; Land cover; Urban greenspaces