10.17521/cjpe.2025.0153-S1
刘润洪, 阳柳蓉, 梁慧婷, 申卫军 **(2026). 丛枝菌根和外生菌根植物磷获取与利用策略研究进展与展望. 植物生态学报, 50, 566-583. DOI: 10.17521/cjpe.2025.0153**
Liu RH, Yang LR, Liang HT, Shen WJ (2026). Research progress and prospect on phosphorus acquisition and utilization strategies of arbuscular mycorrhizal and ectomycorrhizal plants. *Chinese Journal of Plant Ecology*, 50, 566-583. DOI: 10.17521/cjpe.2025.0153
http://www.plant-ecology.com/CN/10.17521/cjpe.2025.0153

附录　丛枝菌根和外生菌根植物磷获取与利用策略比较

Supplement　Comparison on phosphorus acquisition and utilization strategies between arbuscular mycorrhizal and ectomycorrhizal associated plants

特点 Characteristics	丛枝菌根物种 Arbuscular mycorrhizal species	外生菌根物种 Ectomycorrhizal species	参考文献 Reference
细根生物量 Fine root biomass	通常丛枝菌根物种的细根生物量较外生菌根物种高, 但也存在争议 The fine root biomass of arbuscular mycorrhizal species is generally higher than that of ectomycorrhizal species, but this is a controversial topic		Withington et al., 2006; Zhang et al., 2023
根系形态与构型 Root morphology and architecture	通常具有较粗的直径和较低的分支强度 Generally characterized by thicker diameter and lower branching intensity	通常具有较细的直径和较高的分支强度 Generally characterized by smaller diameter and higher branching intensity	Comas et al., 2014; Liu et al., 2015; Chen et al., 2016; Liese et al., 2018; Yan et al., 2022
根系分泌物释放速率 Root exudate release rate	尚存争议 Still controversial		Phillips & Fahey, 2005; Phillips et al., 2013; Yin et al., 2014; Sun et al., 2017; Wurzburger & Brookshire, 2017; Keller et al., 2021; Jiang et al., 2022; Liang et al., 2025
根系质子释放 Root proton release	通常较弱 Usually weaker	通常较强 Usually stronger	Hinsinger, 2001
根系有机酸释放 Root organic acid release	通常较弱 Usually weaker	通常较强 Usually stronger	Grayston et al., 1997; Taylor et al., 2009; Phillips et al., 2013
根系胞外酶分泌 Extracellular enzyme secretion ability	通常缺乏分泌胞外酶的能力 Usually lacks the ability to secrete extracellular enzymes	通常能分泌胞外酶 Usually has the ability to secrete extracellular enzymes	Schüβler et al., 2001; Phillips et al., 2013; Kohler et al., 2015; Brundrett & Tedersoo, 2018; Frey, 2019; Miyauchi et al., 2020
土壤 pH Soil pH	通常较高 Usually higher	通常较低 Usually lower	Phillips & Fahey, 2006; Phillips et al., 2013; Chen et al., 2018; Lin et al., 2022; Qi et al., 2022; Yuan et al., 2023; Zhang et al., 2023
菌丝拓展范围 Mycelium expansion range	通常菌丝生物量较小, 探索范围有限; 孢子较大, 扩散范围较远 Mycelial biomass is typically small with limited exploratory range, whereas spores are larger, enabling greater dispersal potential	通常菌丝生物量较大, 探索范围广; 孢子较小, 扩散能力较强, 但常受限于宿主植物的分布, 导致扩散范围较近 Mycelial biomass is typically large and has an extensive exploration range; spores are smaller and have a higher dispersal capacity, but are often restricted by the distribution of the host plant, resulting in a limited dispersal range	Agerer, 2001; Chagnon et al., 2013; Tedersoo & Bahram, 2019

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特点 Characteristics	丛枝菌根物种 Arbuscular mycorrhizal species	外生菌根物种 Ectomycorrhizal species	参考文献 Reference
菌丝周转 Mycelium turnover	通常较快，平均 5−6 天 Usually faster, average 5–6 days	通常较慢，平均 0.3−1.1 个月 Usually slower, average 0.3–1.1 months	Staddon et al., 2003; See et al., 2022
菌丝构建成本 Mycelium construction costs	通常能量需求较小，构建成本较低，需要植物光合作用固定碳的 1%–22%，平均为 6.2% Typically requires 1%–22% of the carbon fixed by plant photosynthesis, averaging 6.2%, with low energy requirements and construction costs	通常能量需求较大，构建成本较高，需要植物光合作用固定碳的 4%–20%，平均为 13.1% Typically requires 4%–20% of the carbon fixed by plant photosynthesis, averaging 13.1%, with higher energy requirements and construction costs	van der Heijden et al., 2015; Tedersoo & Bahram, 2019; Tedersoo et al., 2020
招募微生物类群 Recruited microbial taxa	通常以细菌为主 Usually dominated by bacteria	通常以外生菌根真菌和腐生真菌为主 Usually dominated by ectomycorrhizal and saprophytic fungi	Phillips et al., 2013; Yang et al., 2022
与腐生微生物竞争磷的强度 The intensity of competition with saprophytic microorganisms for phosphorus	通常较弱 Usually weaker	通常较强 Usually stronger	Averill et al., 2014; Taylor et al., 2016
磷形态吸收偏好 Phosphorus form uptake preferences	主要吸收无机磷，也能吸收一些简单的有机磷 Mainly absorb inorganic phosphorus, but also can absorb some simple organic phosphorus	无机和有机磷均可吸收，且能够吸收复杂有机磷 Inorganic phosphorus and organic phosphorus can be absorbed, including complex organic forms	Rosling et al., 2016; Liu et al., 2018; Liang et al., 2024
磷重吸收效率 Phosphorus resorption efficiency	尚存争议 Still controversial		Zhang et al., 2018; Deng et al., 2023
磷循环 Phosphorus cycle	通常以无机磷周转过程为主，磷循环较迅速和开放 Phosphorus cycle is typically dominated by inorganic phosphorus turnover processes, and it is faster and more open	通常以有机磷周转过程为主，磷循环较缓慢和封闭 Phosphorus cycle is usually dominated by organic phosphorus turnover processes, and it is slow and closed	Phillips et al., 2013; Averill et al., 2014, 2019; Frey, 2019; Tedersoo & Bahram, 2019; Yu et al., 2023

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