

荧光假单胞菌接种可通过改变叶际微生物群落促进旱柳的生长，超越施用氮肥的效果

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摘要:【目的】土壤施肥和微生物接种促进植物生长涉及不同的机制，特别是通过改变叶际微生物群的组成。【方法】本研究调查了氮肥、荧光假单胞菌 R124 菌株接种及其组合对不同年龄的旱柳扦插苗的影响。我们重点评估了叶际微生物群落、植物生长参数和土壤养分动态的变化。【结果】结果表明，接种荧光假单胞菌比单独施用氮肥更有效，可显著促进生物量、植物组织养分吸收、土壤养分改善和根系发育。特别是，接种显著改变了叶际微生物群落的 β 多样性，K-策略真菌显著增强了植物的固氮作用，从而促进了生长。幼龄和中龄扦插苗的响应各不相同，中龄扦插苗的生长更为强劲。这种变化与叶际真菌的不同影响有关，特别是幼龄中 Myriangiales 目和中龄扦插苗中 Capnodiales 目相对丰度的显著增加，对于增强叶际稳定性和植物健康有重要作用。【结论】这些结果强调了微生物接种在通过调节叶际微生物群落促进植物生长方面优于氮肥的效果，并为不同发育阶段旱柳人工林的可持续管理提供了见解。

关键词: 氮添加；微生物接种剂；柳树；叶际微生物群落；植物-土壤反馈；林龄

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Pseudomonas fluorescens inoculation enhances *Salix matsudana* growth by modifying phyllosphere microbiomes, surpassing nitrogen fertilization

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Abstract: 【Objective】The enhancement of plant growth by soil fertilization and microbial inoculation involves different mechanisms, in particular by altering the phyllosphere microbiome. 【Method】This study investigated the effects of nitrogen (N) fertilization, *Pseudomonas fluorescens* strain R124 inoculation and their combination on *Salix matsudana* cuttings of different ages. We focused on assessing changes in the phyllosphere microbial community, plant growth parameters and soil nutrient dynamics. 【Result】The results showed that *P. fluorescens* inoculation was more effective than N fertilization alone, promoting significant increases in biomass, plant tissue nutrient uptake, soil nutrient improvement and root development. In particular, inoculation significantly shifted the beta-diversity of the phyllosphere microbial community, with K-strategy fungi significantly enhancing plant N fixation and consequently growth. Responses varied between cuttings from young and middle-aged forests, with those from middle-aged forests showing more robust growth. This variation was linked to differential effects on phyllosphere fungi, particularly the relative abundance of Myriangiales in young and Capnodiales in middle-aged cuttings, which may enhance phyllosphere stability and plant health. 【Conclusion】These results highlight the superior efficacy of microbial inoculation over N fertilization in promoting plant growth through modulation of phyllosphere microbial communities, and provide insights for sustainable management of willow plantations at different developmental stages.

Key words: Nitrogen addition; microbial agents; willow; phyllosphere microbiomes; plant-soil-feedback; forest age.