

青钱柳嫩枝扦插的生根过程中内源激素变化及其转录组分析

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摘 要: 植物的扦插繁殖关键在于不定根的形成, 植物激素可以对不定根的形成进行调控, 植物激素是影响不定根形成的重要因素之一。青钱柳(*Cyclocarya paliurus* (Batalin) Iljinsk.)是具有多种利用价值的多功能珍贵树种, 但生根困难的问题导致青钱柳优良品种的繁殖面临瓶颈。本研究通过设计 10 个激素配方处理, 找出促进青钱柳嫩枝扦插不定根形成的最佳激素配方, 并探讨其激素调控机制。(1) 不同激素配方对青钱柳嫩枝扦插生根过程和生根参数均有显著影响 ($p < 0.05$), 其中 H3 配方 (SR3:IR3 = 1:1) 的生根率 (93%) 和根系质量指数最高。(2) 在不定根形成的不同阶段取样的插穗中, 检测到的植物激素浓度及其比值存在显著差异 ($p < 0.05$), 并且在不定根形成期间, 每种植物激素的含量变化很大。(3) 转录组分析结果表明在青钱柳扦插生根过程中共鉴定出 12028 个差异表达基因, KEGG 富集分析表明, 在所有对照样品中, 共有 19 个 KEGG 通路显著富集, 其中 253 个差异表达基因与植物激素信号转导有关。本研究进一步筛选出了 45 个参与生长素信号转导的差异基因, 25 个细胞分裂素信号通路的差异基因, 20 个脱落酸信号通路的差异基因, 以及 7 个赤霉素信号通路的差异基因。本研究结果不仅优化了青钱柳扦插生根的激素配方, 还揭示了青钱柳扦插不定根形成过程中的激素调控机制。

关键词: 青钱柳; 激素配方; 嫩枝扦插; 生根参数

Changes of endogenous hormones during rooting of softwood cuttings of *Cyclocarya paliurus* and their transcriptome analysis

Abstract: *Cyclocarya paliurus* (Batalin) Iljinsk. is a multifunctional and valuable tree species with various uses, but the difficulty in rooting poses a bottleneck for the propagation of superior varieties of *Cyclocarya paliurus*. This study aims to identify the optimal hormone formula to promote the formation of adventitious roots in *Cyclocarya paliurus* cuttings by designing 10 different hormone treatments and to explore the hormonal regulation mechanism. Different hormone treatments significantly affected the rooting process and rooting parameters of *Cyclocarya paliurus* cuttings ($p < 0.05$). Among them, the H3 formula (SR3:IR3 = 1:1) showed the highest rooting rate (93%) and root quality index. Significant differences ($p < 0.05$) in plant hormone concentrations and their ratios were detected in cuttings sampled at different stages of adventitious root formation, and the content of each plant hormone varied greatly during the formation of adventitious roots. Transcriptome analysis identified a total of 12,028 differentially expressed genes during the rooting process of *Cyclocarya paliurus* cuttings. KEGG enrichment analysis revealed 19 significantly enriched KEGG pathways across all control samples, with 253 differentially expressed genes related to plant hormone signal transduction. This study further screened out 45 differentially expressed ge

nes involved in auxin signal transduction, 25 in cytokinin signal transduction, 20 in abscisic acid signal transduction, and 7 in gibberellin signal transduction. The results of this study not only optimized the hormone formula for the rooting of *Cyclocarya paliurus* cuttings but also revealed the hormonal regulation mechanisms during the formation of adventitious roots in *Cyclocarya paliurus* cuttings.

Keywords: *Cyclocarya paliurus*; Hormone formula; Softwood Cuttings; Rooting parameters