

杨树对氮素的响应存在性别差异

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摘 要: 近年来, 全球人为的氮排放极大增加了氮沉积, 中国的大片森林承担着相对较高的氮负荷。杨树作为主要的造林树种, 其生长速度快, 对氮肥具有较高需求。前期研究表明, 在正常状态下, 杨树雄株长势较雌株好; 在高氮状态下, 这种现象出现了反转, 但这种变化背后的生理和分子机制却很少被探索。

在此, 我们研究了在正常和模拟氮沉降条件下雌雄杨树对氮素响应的差异。结果表明, 在高氮状态下, 雌株在株高、叶面积等表型上均优于雄株, 这可能与具有较高的光合作用能力相关。此外, 转录组分析表明, 氮素处理下仅在雌株体内差异表达基因数目和表达水平远高于雄株杨树, 这其中包含了大量与氮吸收、转运、利用相关的基因以及与生长相关的基因等。同时, 高氮条件下雌性杨树的苯丙烷代谢和植物激素信号转导等途径被激活, 而雄性杨树中被抑制, 这可能是氮处理下相关核心基因在雌雄杨树中的表达水平波动导致的。总的来说, 这种变化可能与雌雄杨树中氮素应答基因所形成的共表达网络相关。这些结果揭示了杨树对氮肥的响应与性别有关, 对高氮环境的生理和转录协调响应赋予了雌性比雄性更好的氮同化和利用能力。研究结果将为理解和预测氮沉降持续加剧背景下相关栖息地的雌雄异株植物自然种群的动态和性别组成的生态后果提供新的知识。

关键词: 杨树; 性别差异; 氮素; 转录调控

There are gender differences in the response of poplars to nitrogen

Abstract: In recent years, global man-made nitrogen emissions have greatly increased nitrogen deposition, and large forests in China bear a relatively high nitrogen load. As the main afforestation tree species, poplar grows fast and has a high demand for nitrogen fertilizer. Previous studies have shown that under normal conditions, the growth of male poplar plants is better than that of female plants; under the condition of high nitrogen, this phenomenon is reversed, but the physiological and molecular mechanism behind this change is rarely explored.

Here, we studied the difference of response to nitrogen between male and female poplars under normal and simulated nitrogen deposition conditions. The results showed that under the condition of high nitrogen, the phenotype of female plant was better than that of male plant in plant height and leaf area, which may be related to its higher photosynthetic ability. In addition, transcriptome analysis showed that the number and expression level of differentially expressed genes in female plants were much higher than those in male poplars under nitrogen treatment, which included a large number of genes related to nitrogen uptake, transport, utilization and growth. At the same time, phenylpropane metabolism and plant hormone signal transduction were activated in female poplars under high nitrogen conditions, and inhibited in m

ale poplars, which may be caused by fluctuations in the expression level of related core genes in male and female poplars under nitrogen treatment. In general, this change may be related to the co-expression network formed by nitrogen response genes in male and female poplars. These results revealed that the response of poplar to nitrogen fertilizer was related to sex, and the physiological and transcriptional coordinated response to high nitrogen environment gave females better nitrogen assimilation and utilization ability than males. The results will provide new knowledge for understanding and predicting the dynamics of natural populations and ecological consequences of sex composition of dioecious plants in related habitats under the background of increasing nitrogen deposition.

Key words: poplar; gender differences; nitrogen fertilizer; transcriptional regulation