

杨树 ANT 基因调控维管发育的分子机制

韩晗*, 包芸菁, 陈家旭, 姚晓翠, 朱福远*

(南京林业大学, 南方现代林业协同创新中心, 南京林业大学生命科学学院, 江苏南京 210037)

摘要: 维管干细胞自我更新的同时分化发育形成木质部导管和纤维等以增加树木的生物量, 并最终影响木材的产量和品质。维管干细胞具备双面分化的能力, 其向树木茎秆向心方向发育形成木质部细胞, 向远心方向发育形成韧皮部。在茎的单个横切面, 维管干细胞仅由一层细胞圈组成, 它分化前的自我增值区域称为维管形成层。与干细胞相邻的木质部细胞是干细胞命运的组织者, 高浓度的生长素在组织者细胞中聚集, 在其一侧决定干细胞命运, 在其另一侧激活木质部命运决定因子 HD-ZIP III 家族基因。维管干细胞的活性还受到与根尖和茎尖干细胞类似的小信号肽-受体-WOX 网络的调控。ANT 家族基因特异地维管形成层表达, 这种特异地表达模式暗示其可能参与调控维管形成层的发育。我们构建了杨树 ANT 基因突变体、杨树 ANT-RNAi 的转基因杨树和 ANT 过表达的转基因杨树。相比于野生型, ANT 突变体和 ANT-RNAi 抑制的转基因杨树株高变高且茎秆中有更多的木质部导管, 而 ANT 过表达的杨树矮小且木质部导管细胞数量和面积变少。通过进一步的分子生物学研究发现, ANT 对木质部导管的抑制作用可能由直接调控 HD-ZIP III 家族基因实现。该研究为木材育种提供一个新潜在的靶基因。

Dissecting the molecular functions of ANT in Poplar vascular development

Han Han^{1*} Yunjing Bao¹ Jiayu Chen¹ Xiaocui Yao¹ Fuyuan Zhu^{1*}

(Co-Innovation Center for Sustainable Forestry in Southern China, College of Life Sciences, Nanjing Forestry University, Nanjing 210037, China)

Abstract: While vascular stem cells self-renew, they differentiate and develop into xylem cells including xylem vessels and fibers to increase the biomass of trees, and ultimately affect the yield and quality of wood. Vascular stem cells have the ability to differentiate on both sides. They develop into xylem cells in the centripetal direction and develop into phloem in the opposite direction. In a single cross section of the stem, vascular stem cells are composed of solely one cell layer circle, and their propagation area before differentiation is called the vascular cambium. The xylem cells adjacent to the stem cells are organizers of stem cells. High concentrations of auxin accumulated in the organizer cells determine the stem cell fate on one side, and activate the xylem fate identity genes HD-ZIP III genes on the other side. The activity of vascular stem cells is regulated by a small signal peptide-receptor-WOX network that similar to that of root and shoot apex stem cells. ANT family genes are specifically expressed in the vascular cambium, and their specific expression pattern suggests that they may be involved in regulating the vascular cambium development. We constructed poplar ANT loss-of-function mutants, poplar ANT RNAi transgenic poplars, and ANT overexpressed transgenic poplar. Compared with the wild type, *ant* mutants and ANT-RNAi suppressed transgenic poplars were taller and had more xylem

vessels in their stems, while ANT overexpressed poplars were shorter and had fewer xylem vessel cells and areas. Further molecular biological studies revealed that the inhibitory effect of ANT on xylem vessels may be achieved by directly regulating HD-ZIP III family genes. This study may provide a new target gene for wood breeding.