

PtoHAT22 自然变异通过脱落酸-细胞分裂素信号稳态影响杨树的气候适应和种群分布

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摘要:作为固定生物体,植物必须协调其新陈代谢,以在不断变化的环境条件下优化生产力和种群传播。植物激素作为关键的信使,整合环境信号与内部发育状态,决定植物的进一步生长和代谢过程,影响它们的环境适应性和种群分布。在本研究中,我们鉴定了一个新的基因 *PtoHAT22*, 编码一种新的同源结构域亮氨酸拉链蛋白,在杨树中调控抗旱和生长。ABA 诱导的 *PtoHAT22* 通过 *PtoSnRK2s.1-PtoMYB84-PtoHAT22* 级联抑制细胞分裂素(CK)信号,建立了一个脱落酸(ABA)信号正反馈回路。同时, *PtoSnRK2s.1* 和 *PtoHAT22* 分别磷酸化和转录抑制 *PtoAREB3*, 在 ABA 信号传导中发挥制动调节作用,以对抗干旱胁迫。此外, *PtoHAT22* 中的一种移码突变导致蛋白功能丧失,并影响了中国东西部气候区域内毛白杨自然种群的分布和生态位分化。这一发现在脱落酸和细胞分裂素信号平衡调控中识别出一个重要新组分,为毛白杨的气候适应性和种群生态分布提供了新的见解。

Natural variation of *PtoHAT22* confers climate adaptation and population distribution of *Populus* by abscisic acid-cytokinin signaling homeostasis

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Abstract: As sessile organisms, plants must coordinate their metabolism to optimize productivity and population propagation under changing environmental conditions. Plant hormones act as crucial messengers integrating environmental signals with internal developmental status, determining further growth and metabolic processes in plants, and impacting their environmental adaptation and population dispersion. Here, we identify a gene, *PtoHAT22*, encoding a new homeodomain-leucine zipper protein that regulate drought resistance and growth in *Populus*. The ABA-induced *PtoHAT22* inhibits the CK signaling to establish an ABA signaling positive feedback loop through *PtoSnRK2s.1-PtoMYB84-PtoHAT22* cascade. Concurrently, *PtoAREB3* is phosphorylated and transcriptionally inhibited by *PtoSnRK2s.1* and *PtoHAT22*, respectively, exerting a braking modulation on ABA signaling to combat drought stress. Furthermore, a frame-shift mutation in *PtoHAT22* resulting in loss of protein function and impacting the distribution and ecological niche differentiation of natural populations of *Populus*

tomentosa across eastern and western climatic regions in China. This discovery identifies an important new component in the homeostatic balance between ABA and cytokinin signaling and provide new insight into climate adaptation and population ecological distribution in *Populus*.