MPK6-MYB46 Regulatory Module Suppresses Plant Biomass Formation During Salt Stress

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Project Goal:

Overarching goal of this project is to develop designer bioenergy crops for sustainable production of biomass feedstock under various growth conditions.

Abstract:

Secondary cell walls, located between the plasma membrane and primary cell wall, are a defining feature of xylem fibers and vessels, providing mechanical support for plants and serving as a conduit for long-distance transport of water and solutes. They constitute the vast majority of plant biomass and are of economic importance to humans as fiber, animal feed, pulp for manufacture of paper, and as an environmentally desirable, cost-effective, renewable source of energy. The biosynthesis of secondary walls occurs in a highly-coordinated manner by successive encrustation and deposition of cellulose fibrils, hemicelluloses and lignin upon cessation of cell growth. This process requires a coordinated transcriptional activation of the biosynthetic genes for the components, suggesting the existence of one or more central transcriptional regulators. The plant specific R2R3-MYB transcription factor MYB46 functions as a master switch for secondary cell wall biosynthesis, ensuring the exquisite expression of the secondary wall biosynthetic genes in the tissues where secondary walls are critical for plant growth, such as the stem. However, suppression of MYB46 function is needed during environmental stresses that trigger nascent defense responses including impermanent cessation of vegetative growth. Little is known about how this opposing control of secondary cell wall formation is achieved with the speed and specificity of plant response to environmental changes. Post-translational modification of MYB46 may offer a such regulatory mechanism. MYB46 has two conserved mitogen-activated protein kinase (MPK) phosphorylation target sites, suggesting that MYB46 is a substrate for phosphorylation by MPKs. While phosphorylation of transcription factors is well known to modulate their levels and activities, no evidence has been shown for post-translational regulation of secondary cell wall biosynthesis. Here, we show that MYB46 is phosphorylated by abiotic stress-activated MPK6 and subsequently degraded by the proteasome pathway. This MPK6-MYB46 regulatory module provides novel insights into the tissue- and/or condition-specific activity of MYB46, and the interplay of secondary wall formation and environmental signaling.