ABSTRACT

"A blueprint for cellulose synthesis in higher plants"

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Cellulose is one of the most abundant and important biopolymer on our planet. It provides rigidity for anisotropic cell growth and plant morphology, and constitutes an essential raw material for many important industrial applications, including biofuels and materials. Cellulose is synthesized by plasma membrane located cellulose synthase (CesA) proteins that track along cortical microtubules in elongating interphase cells. We discovered the protein (CSI1/POM2) that provides the functional link between the CesAs and the microtubules. This discovery was partly based on the similar expression, or co-expression of the CSI1/POM2 gene and the CesA genes. Interestingly, we have found that many genes that are co-expressed with the CesA genes indeed are important for cellulose production. We extended this analysis and found that certain patterns of functionally related genes formed co-expressed gene modules, and that these modules have been duplicated and subsequently sub-functionalized many times. Through evolutionary estimates we could furthermore conclude that these duplication events were associated with specific events during plant evolution. We propose that plants use the duplication of co-expressed gene modules to create new functions through neo- or sub-functionalization of members in the modules, and that this may serve as a basis for the development of new biological processes in plants.