

Biochemical Pathways That Are Important for Cotton Fiber Cell Elongation

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The regulatory mechanism that controls the sustained cotton fiber cell elongation is gradually being elucidated by coupling genome-wide transcriptome profiling with systematic biochemical and physiological studies. Very long chain fatty acids (VLCFA), H_2O_2 , and several types of plant hormones including ethylene, gibberellin, and brassinolide have been reported to be involved in this process. Here we first identified by proteomic analysis a cotton cytosolic APX1 (GhAPX1) that was specifically accumulated during cotton fiber elongation. GhAPX1 expression was up-regulated in response to cellular H_2O_2 and ethylene, and it was involved in modulating the steady-state level of H_2O_2 . Also, when very long chain fatty acids (VLCFAs, C20~C30) were applied to ovule culture media, fiber growth was promoted significantly, and the addition of acetochlor (ACE), an inhibitor of VLCFA biosynthesis, abolished fiber growth completely. This inhibitory effect was overcome by 5 M of lignoceric acid (C24). Elongating fibers contained significantly higher amounts of VLCFAs than those of wild-type or the fuzzless-lintless (fl) mutant ovules. The plant hormone ethylene nullified the ACE inhibition of fiber growth while C24 was inactive in the presence of the ethylene biosynthesis inhibitor, L-[2-aminoethoxyvinyl]-glycine (AVG), which indicated that VLCFAs may act upstream of ethylene. Indeed, C24 treatment induced rapid and significant increase in transcription of ACO (1-Aminocyclopropane-1-Carboxylic Acid Oxidase) genes that resulted in a substantial ethylene release. C24 not only stimulated significant *Arabidopsis* root cell growth, but also complemented the cut1 phenotype by producing wild-type-length cells in mutant stems. Similar results were produced by transgenic expression of GhKCS13 in the cut1 background. Under both circumstances, promotion of *Arabidopsis* stem elongation was accompanied by a significant increase in transcription of ACO genes. Our results indicate that VLCFA and H_2O_2 are involved in the regulations of cotton fiber cell growth.