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Modifications of cell wall properties by production of recombinant resilin composites in transgenic plants

Itan Preis, Shaul Lapidot, Miron Abramson and Oded Shoseyov
Robert H. Smith Faculty of Agriculture, Food and Environment, The Hebrew University of Jerusalem, Israel

Resilin is a polymeric rubber-like protein, secreted by insects to specialized cuticle regions. Its unique mechanical properties allow, among others, the outstanding jumping ability of fleas, up to 30 cm high. The elastic properties of resilin are achieved by formation of di-tyrosine bridges within resilin monomers and cuticle polysaccharides, generated by peroxidase enzymes, in the insect cuticles. This highly resilience and elastic protein was optimized for expression in tobacco and was directed to the cell wall by a signal peptide. Cross-linking of resilin to the cell wall polysaccharides was enabled by utilizing the presence of natural plant cell wall peroxidases. Resilin was located in the cell wall by immunohistochemistry. Increase in typical di-tyrosine blue florescence of the cell wall, indicates resilin polymerization and cross-linking. The integration of resilin to the cell wall changed the mechanical properties of the plant tissue. Transgenic stems showed reduction in young's modulus and an increase in the ability to strain before failure. Moreover, changes in the formation of the plant cell wall, due to the cross-linking of resilin, improved sugars release from plant material.

Tobacco is a model plant in this research. Transformation of resilin to eucalyptus trees is currently in progress. Such transgenic trees can be wind resilient and used in the future for production of elastic wood and fibers from transgenic forest, for the paper and wood products industry and for replacement of synthetic materials, with biodegradable ones.

itan.preis@mail.huji.ac.il