SUPPLEMENTAL FIGURES

Viscoelastic Properties of Cell Walls of Single Living Plant Cells Determined by Dynamic Nanoindentation

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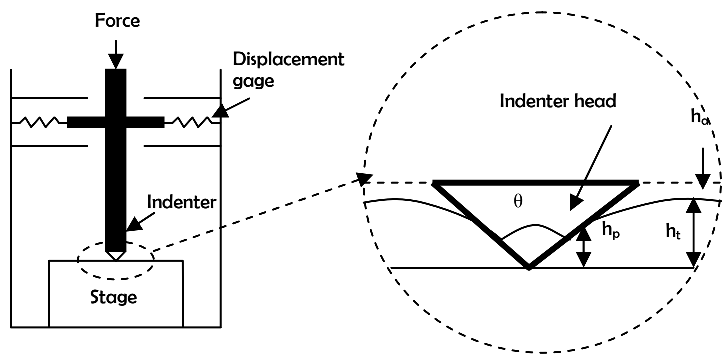
A



B

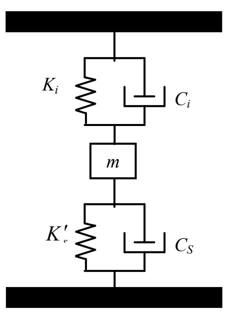


Fig. S1 Schematic of the nanoindentation system and a Mechanical model for the dynamic behavior of the nanoindenter-sample system.

A) During testing, a force is applied on the indenter column, which drives the indenter tip into the specimen on the stage while the displacement of the indenter column is continuously monitored. h_a is the distance from the edge of the contact of the specimen surface, h_p is the contact depth, h_t is the depth from the original specimen surface and θ is the face angle of the indenter.

B) The values of the spring stiffness, K_i and the damping, C_i, of the indenter instrument as well as the mass, m of the tip and shaft. The values of C_s and K'_s represent the mechanical analogs for the stiffness and the damping of interaction between the tip and the sample.

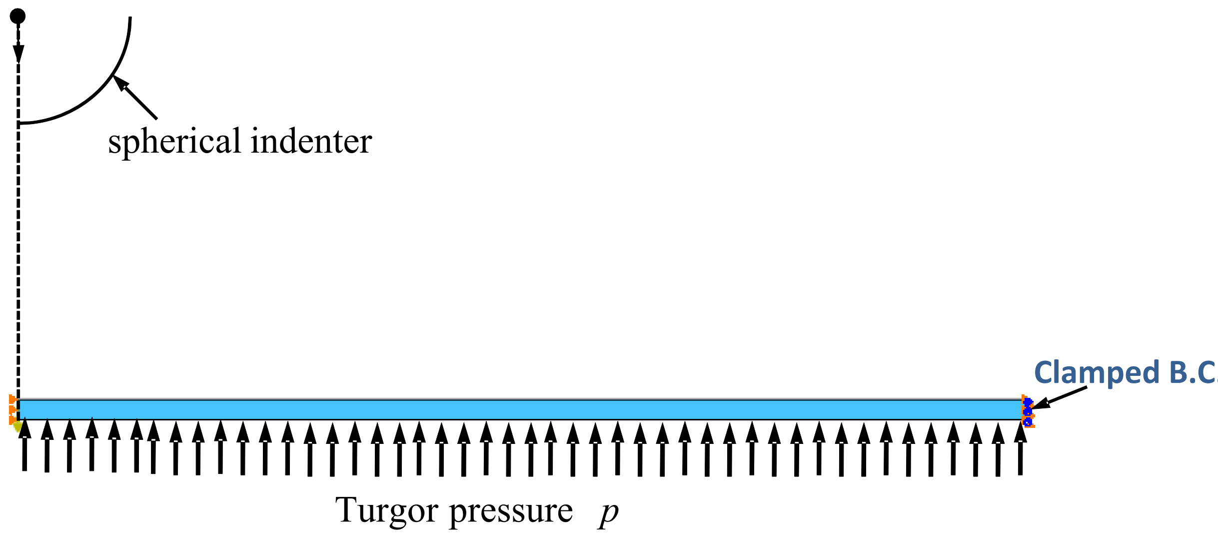
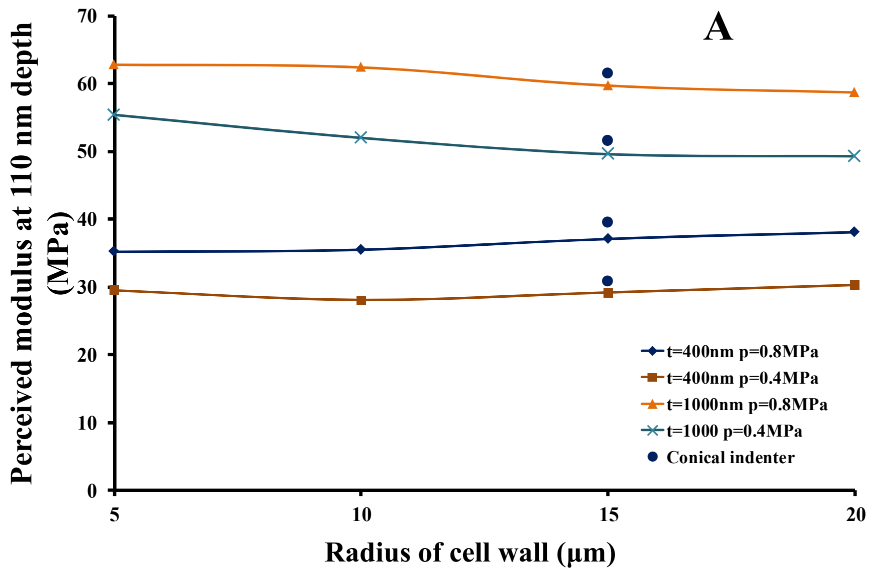


Fig. S2 Finite element axisymmetric model for a plant cell wall subjected to turgor pressure and indentation load.



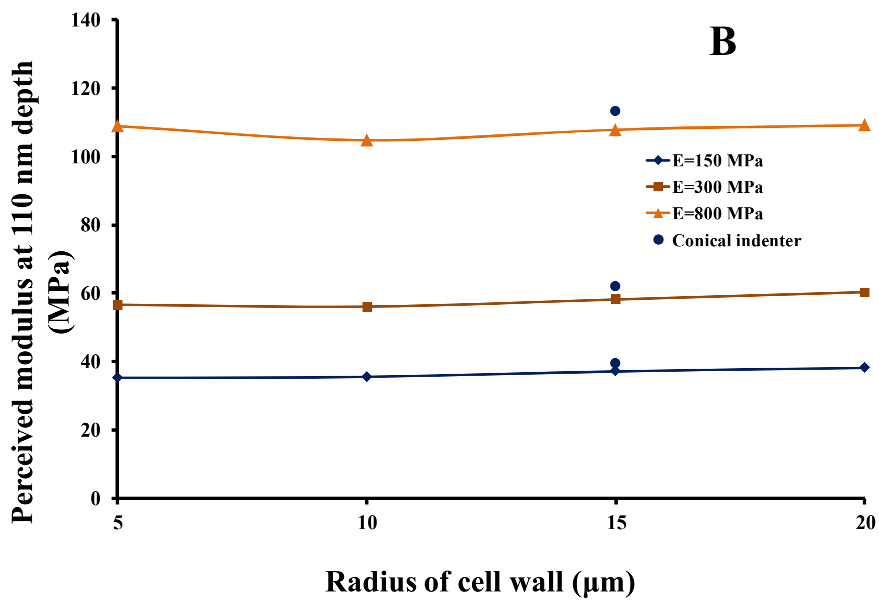


Fig. S3 Perceived modulus at 110 nm depth as a function of the radius of the cell used for the finite element model for various values of thickness (t) and pressure (p), and wall modulus (E) for both a conical (blue circles) and spherical indenter (all other symbols). In (a), wall modulus is fixed (E = 150 MPa) while t and p are varied. In (b), thickness and pressure are fixed (t = 400 nm; p = 0.8 MPa) and modulus is varied. Note that the change with respect to cell radius is negligible in comparison with thickness or pressure. In addition, the change with respect to tip shape is less than 6 % as expected (Fischer-Cripps, 2004).

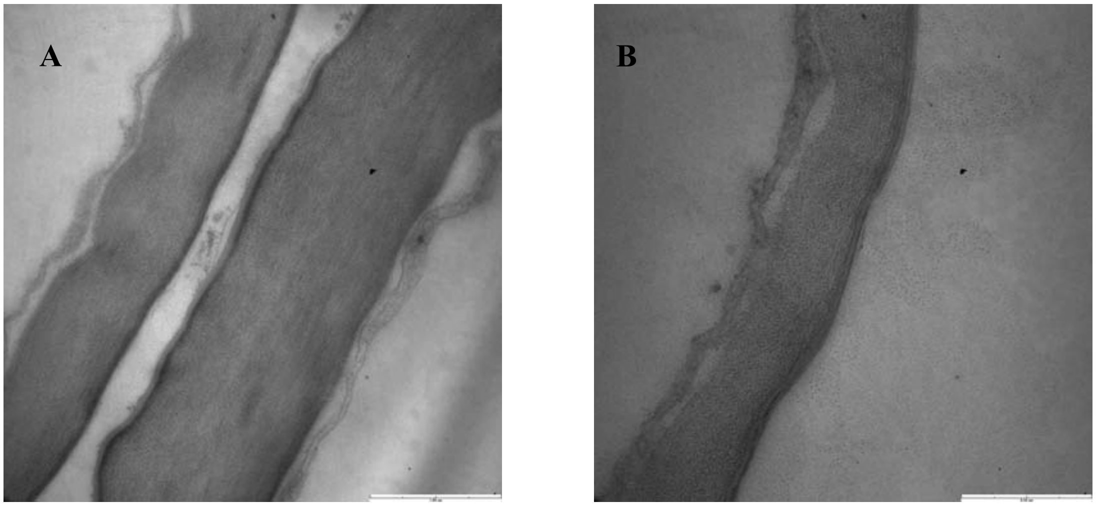


Fig. S4 Transmission electron microscope (TEM) images: A) two adjacent walls of an old Columbia leaf (x 15k; the scale bar is 1 μm); B) wall of an old WS leaf (x 30k; the scale bar is 0.5 μm).

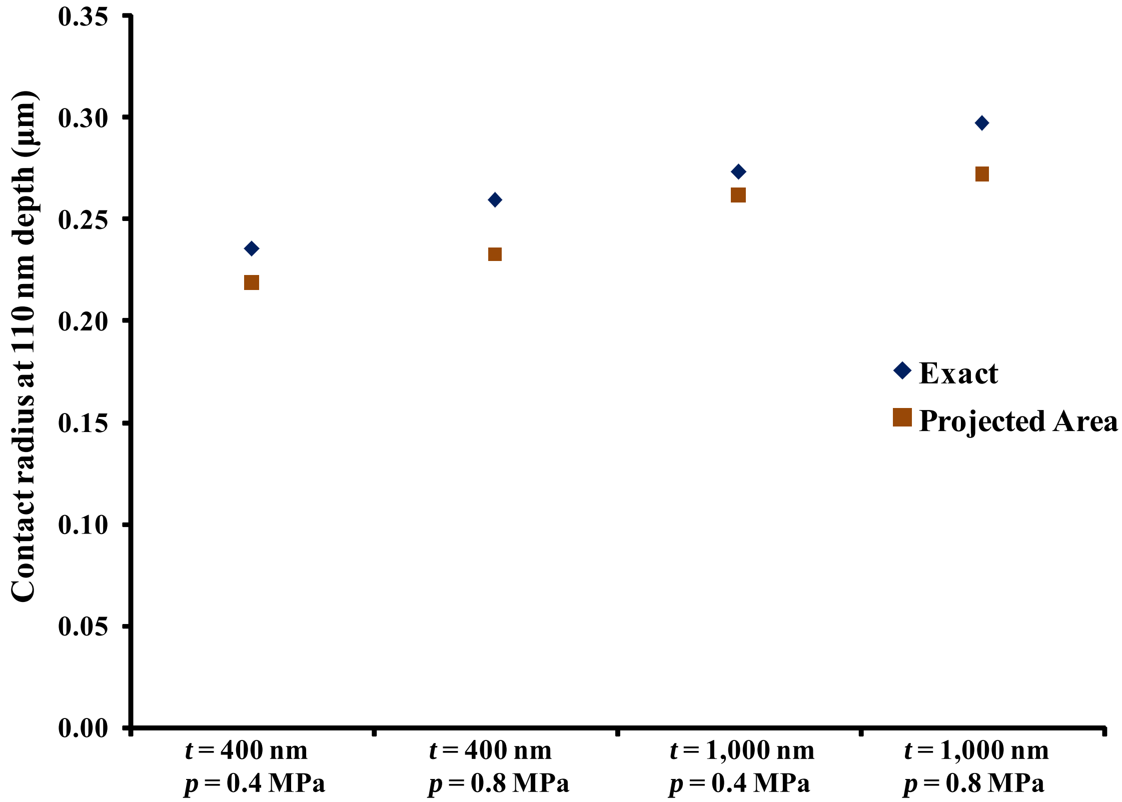


Fig. S5 Contact radius for a spherical indenter at a depth of 110 nm as a function of turgor pressure (*p*) and cell wall thickness (*t*). The 'exact' result is the contact radius determined from the finite element simulations. The result for "projected-area approximation" is determined from the slope of the computational load-displacement curve as discussed in Fig. 8 (Oliver and Pharr, 1992). The contact radius differs by at most 9 % because the indentation depths used here are shallow.