



Tensile test of plant cell wall analogs thin films using image stereocorrelation

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P5-19

Elastic properties of the growth-controlling outer cell walls of maize coleoptile epidermis

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The effects of tensile stress and temperature on cell wall elasticity have been investigated in the outer cell walls of coleoptile epidermis of 4- and 6-day-old *Zea mays* L. seedlings. The change in tensile stress from 6 to 40 MPa caused the increase in cell wall elastic modulus from 0.4 to 3 GPa. Lowering the temperature from 30 to 4 °C resulted in instantaneous and reversible cell wall elongation of 0.3-0.5 %. At a given temperature and stress level the wall elastic modulus of 6-day-old seedlings tended to be 30% higher than that of 4-day-old plants. The relationship between cell wall elasticity and mechanical stress indicated that the stress distribution within the cell wall is highly uneven. Analysis of the effect of temperature on wall elastic strain showed that structural differences between crystalline and amorphous load-bearing polymers were not the only cause of the uneven stress distribution. We suggest that the uneven stress distribution is partially related to the stress gradient between inner and outer layers of the cell wall.

A. Lipchinsky et al. (2013) *Acta Physiol. Plant.* doi:10.1007/s11738-013-1255-4.

P5-20

Tensile test of plant cell wall analogs thin films using image stereocorrelation

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The plant cell wall can be the optimal scale of investigation for understanding the properties and the variability of vegetal organs structure. At the molecular scale, the wall constituents' organisation might have a strong influence on these properties. Primary cell walls are separated into monocotyledons (cereals) and dicotyledons (fleshy fruits) depending on the type of molecules involved (cellulose, hemicelluloses, pectin, etc.). These polymers structures and concentration within the cell wall change during the organ development (i.e., growth and maturation). Cell wall models built from commercial polymers have been used in the literature to study the influence of these components and their organisation on cell wall mechanical properties. However these analogs, although they're interesting, don't take into account the molecule modification with time (growth and maturation) and space (organisation within the tissue) or the change of the hydration state of the wall with time.

We aim to characterize mechanical properties of thin films made of hemicelluloses extracted from organ with an original method that permit molecular structure to be preserved (Assor et al., 2013) ^[1]. The first step of our work consists in developing a specific static tensile test adapted to cell wall analogs. These tests are made in a temperature and humidity controlled environment. Due to their low thickness (around some tenth of micrometre at best), these films are particularly difficult to handle and the mechanical measurements are thus coupled with an image stereo-correlation device. It allows us to measure the strain fields at the surface of the sample, even if it is not perfectly plane, and thus to check the real loading of the film. Finally, this measurement technique allows us to measure the elastic longitudinal modulus of the film together with its Poisson's ratio without any effect of the tensile machine stiffness or occurrence of slippage in the loading grips.

[1] Assor, C. ; Quémener, B. ; Vigouroux, J. ; Lahaye, M. Fractionation and structural characterization of LiCl-DMSO soluble hemicelluloses from tomato. *Carbohydrate Polymers*, **2013**, Vol 94, Issue 1, 46-55.