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Methods to investigate the biomechanics of the plant cell wall

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The plant cell wall is the envelope of every plant cell. It consists mainly of polysaccharides. The cell wall resists the internal hydrostatic pressure of the cell, also known as turgor pressure. Turgor and the cell wall cooperate to create the hydrostatic skeleton of the plant. Young plants and young parts of the plant, which do not yet have rigid mechanical tissues, rely only on this hydrostatic skeleton to maintain their architecture. This is the reason why wilting in the shortage of water is so noticeable in young plants.

On the one hand, the cell walls must be strong enough to resist the turgor pressure. On the other hand, it must be extensible to allow the growth of the plant cell. It should be noted that the enlargement of plant cells is much more prominent than that of animal cells. A plant cell can increase its size to 1000 times its initial size. During the whole process, no cracks or tears should appear in the cell wall and its thickness should be maintained.

Another aspect that is directly regulated by the mechanical properties of the cell wall is the shape of the cell. In order to fulfill their functions, plant cells sometimes acquire rather sophisticated shapes. However, even relatively simple shapes require the cell wall to have different properties on different sites. Turgor pressure acts uniformly in all directions, so the acquisition of any shape other than spherical requires local heterogeneity of cell wall properties.

Thus, the plant cell wall is a unique material that combines strength, extensibility and heterogeneity. The study of the plant cell wall in terms of mechanics is important both for developmental biology and for the design of smart materials as a source of inspiration.

This talk will focus on the methods used to study the biomechanics of plant cell walls, with an emphasis on atomic force microscopy as the primary and most widely used technique.

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