

Abstract

Onion epidermal peels were used as a model system to study the micromechanical behaviour of plant tissue in relationship to the structural parameters of the cells in the tissue. Mechanical properties of onion epidermal tissue were measured using a miniature tensile stage mounted under a microscope. Epidermis peels were subjected to tensile tests in longitudinal and transverse direction, while the deformation of the individual cells in the tissue was monitored. Onion epidermal peels were found to produce in both directions a biphasic stress–strain curve consisting of two clearly distinguishable linear parts of different slope with a transition zone in between. Cell area was found to exert a significant negative influence on stiffness and strength of the samples, but also aspect of the cells in the tissue had a significant influence on stiffness. Samples with smaller, less elongated cells have a broader transition zone and a lower strain at maximum stress than samples with long and big cells. Analysis of the images acquired at subsequent times in the test allowed the measurement of the cell deformations. Deformations of cells were found to be larger in transverse samples as compared to longitudinal samples. The information gained provided insight into factors determining the mechanical properties of vegetative tissues and will serve as input for the development of models to describe and to predict mechanical behaviour of plant tissues.