NUS National University of Singapore | Department of Biological Sciences
Faculty of Science

VIRTUAL BIOLOGY COLLOQUIUM

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Hosted by Dr Long Yuchen

Shaping cells - From micromechanics to morphogenesis

By Anja Geitmann

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Plant cells come in a kaleidoscopic range of shapes that are intimately tied to their respective functions. The shaping of plant cells involves the deformation of the cell envelope driven by the internal pressure. The morphogenetic process is known to be regulated by the extensibility pattern of the primary cell wall, which in turn is thought to be predominantly governed by cellulose microfibrils. While this is well understood in simple cell shapes such as the cylindrical cells of the shoot or root, the generation of more complex cell shapes is less well characterized. Using mechanical modeling combined with 4D imaging, we investigated how the cell wall regulates the formation of the characteristic undulations of the jigsaw puzzle-shaped leaf epidermal cell in Arabidopsis. We showed that non-uniform distribution of cellulose microfibrils and demethylated pectin correlate with spatial differences in cell wall stiffness but intervene at different developmental stages. We discovered that lobe initiation involves a modulation of cell wall stiffness through the local enrichment in demethylated pectin, whereas the subsequent increase in lobe amplitude is mediated by the stress-induced deposition of aligned cellulose microfibrils. Finite element simulations lead us to propose that both steps are preceded by a turgor-driven mechanical buckling event that serves as the initial trigger for the multi-step morphogenetic process.

About the Speaker

Dr. Geitmann holds the Canada Research Chair in Biomechanics of Plant Development and she combines plant cell biology with engineering and mathematical concepts. Her research focuses on the cellular processes that are involved in plant reproduction and development. Dr. Geitmann obtained her PhD in 1997 from the University of Siena (Italy), following undergraduate and graduate studies in biology at the University of Constance (Germany), Oregon State University (USA), and Stockholm University (Sweden). Between 1997 and 2001 she performed postdoctoral research at the Université Laval, Québec, and at the University of Wageningen, The Netherlands. From 2001 to 2015 she was Professor at Université de Montréal and in 2015 she was appointed as the Dean of the Faculty of Agricultural and Environmental Sciences of McGill University.

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