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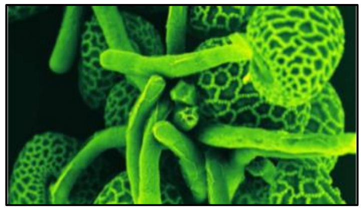

Role of callose in pollen tube invasive growth

Oral Defence by PhD Candidate Karuna Kapoor

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January 17, 2023 @ 13:00 — Mc Stewart Building, Room MS2 084

Abstract

A distinct feature of plant cells differentiating them from animal cells is the presence of the cell wall. The cell wall in plants plays a critical role in protecting the cell protoplast, serves as key location for many biochemical reactions involved in regulation of cell metabolism and cell biomechanics. The shape and geometry of plant cells are primarily defined by mechanical properties of different cell wall polysaccharides that are strategically deposited during cell differentiation and morphogenesis. The main objective of my thesis is to examine the mechanical role of callose, a ß-glucan, accumulated in significant amounts during pollen grain and pollen tube (male gametophyte) development. The pollen tube, a tubular structure produced by the pollen grain acts as a 'vehicle' to transport the male gametes (sperm cells) to a receptive ovule (female gametophyte) with the goal to achieve successful fertilization, eventually leading to seed formation. These tip-growing unique cells are exposed to different types of stresses such as turgor induced tension stresses in the cell wall and compressive stresses exerted by the growth matrix. Pollen tubes display a characteristic deposition of callose in the cell wall lining as well as distinct callose plugs that separate the active portion of the pollen tube cytoplasm from the degenerating segments. Although not a conditio sine qua non for pollen tube growth, callose plugs are suggested to be beneficial for successful fertilization. To understand the role played by callose in regulating pollen tube growth, in the first chapter I investigated the effects of mutations and enzymatic treatments on pollen tube growth behavior using mechanical assays. Combining growth assays, turgor measurement by incipient plasmolysis and high-resolution fluorescence microscopy, I was able to show that the reduction in callose deposition resulted in tubes with lower invading capacity and higher turgor pressure when exposed to a mechanical 9 obstacle. I also investigated the association of the actin cytoskeleton with callose deposition by exposing the tubes to pharmacological treatments and showed that actin seems to be involved in positioning and transporting callose synthases (enzymes producing callose) at the apex, subapex, and distal region of the pollen tube. The second chapter of my thesis is a review of the current state-of-the art of invasive capacity of a wide range of walled cells including those in plants, fungi, and oomycetes. The chapter elaborates on the role of turgor pressure and regulation of cell wall mechanical properties as well as the cytoskeleton in maintaining the invasive lifestyle of plants and fungi. The chapter also contains a mini review on various experimental approaches developed by these specialized cells to characterize this cellular behavior and to quantify the forces generated when invading a matrix.

About the Candidate

Karuna Kapoor obtained her bachelor's degree in Botany from Delhi University, India. She then pursued a master's in Biotechnology from Amity University, India, following which she moved to Canada to pursue another master's in the field of Plant Physiology from University of Manitoba. She is currently a Ph.D. candidate in department of Plant Science under Dr. Anja Geitmann's supervision. Her research focuses on exploring the biomechanics of pollen tube growth.