UNIVERSITY of GUELPH

COLLEGE of BIOLOGICAL SCIENCE

DEPARTMENT OF MOLECULAR AND CELLULAR BIOLOGY

Announcement:

All interested members of the university community are invited to attend the Final Oral Examination for the degree of ***Master of Science*** *of*

LAURA CURRIE

On Monday, August 28, 2023 at 9:30 a.m. (SSC 1511)

Thesis Title: **Investigating chloroplast galactolipid membranes and lipid droplets in *Arabidopsis thaliana* and their role in tolerance to cold stress**

Examination Committee:

Dr. Yang Xu, Dept. of Molecular and Cellular Biology (Exam Chair)
Dr. Jaideep Mathur, Dept. of Molecular and Cellular Biology
Dr. Praveen Saxena, Dept. of Plant Agriculture
Dr. Joseph Colasanti, Dept. of Molecular and Cellular Biology

Advisory Committee:

Dr. Jaideep Mathur (Co-Advisor)
Dr. Praveen Saxena (Co-Advisor)
Dr. Ian Tetlow

Abstract: When non-acclimated temperate plants experience freezing conditions, intracellular ice crystal formation can occur. These ice crystals can puncture membranes leading to membrane leakiness. Upon thawing, damaged membranes undergo fusion and transition from gel phase to liquid crystalline phase which destroys cellular compartmentalization, osmotic potential, and subcellular concentration gradients. Preserving membrane integrity is thus a critical component of a plant's response to cold temperature stress. The chloroplast is a fundamental organelle of the plant cell that is comprised of a double membrane envelope and stacks of thylakoids. The chloroplast is also the site of *de novo* fatty acid synthesis which provides the building blocks for membrane lipids as well as neutral lipids for storage in lipid droplets. If chloroplast membranes are damaged, all photosynthesis related processes cease and the plants will perish under freezing stress. The gene SENSITIVITY TO FREEZING2 encodes a galactolipid transferase protein embedded in the chloroplast outer envelope membrane. When mutant *sfr*2 plants experience below freezing conditions, the plants do not recover from this cold stress. This study involved overexpressing the SFR2 gene and characterizing the plant behaviour at a macro, sub-cellular and biochemical level to further understand its role in plant cold tolerance. These approaches include SFR2 overexpression line creation, confocal laser scanning microscopy observation with fluorescent proteins, transmission electron microscopy, electrolyte leakage assays, time-lapse based studies of growth, leaf area, SPAD based measurements and ultra performance liquid chromatography - mass spectrometry analysis. These approaches will help elucidate if modifying the chloroplast outer envelope membrane properties will increase tolerance to various levels of cold stress.

Curriculum Vitae: Laura completed her Bachelor of Science (Hons.) in Plant Science with emphasis in Plant Biotechnology at the University of Guelph in April 2021. She began her Master of Science program in Molecular and Cellular Biology in Dr. Jaideep Mathur's lab in May 2021.