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 ***Doctor of Philosophy*** *of*

KIAH BARTON

on Friday, April 3, 2020 at 1:30 p.m. in SSC 3317

Thesis Title: **Investigations on the influence of cellular sugar and endoplasmic reticulum dynamics on plastid pleomorphy in *Arabidopsis thaliana*.**

Examination Committee:

Dr. A. Bendall, Dept. of Molecular and Cellular Biology (Exam Chair)
Dr. M. Emes, Dept. of Molecular and Cellular Biology
Dr. J. Colasanti, Dept. of Molecular and Cellular Biology
Dr. I. Tetlow, Dept. of Molecular and Cellular Biology
Dr. S. Mackenzie, Dept. of Biology, Penn State

Advisory Committee:
Dr. J. Mathur (Adv)
Dr. I. Tetlow
Dr. J. Colasanti
Dr. B. Shelp

Abstract: Plastids exhibit continuous changes in shape over time, seen either as alterations in the form of the entire plastid or as the extension of thin stroma-filled tubules (stromules). Live-imaging of fluorescently-highlighted organelles was used to assess the role of cellular sugar status and endoplasmic reticulum (ER) rearrangement in this behaviour. Plastids in the pavement cells of *Arabidopsis* are shown to be chloroplasts and a brief summary of their physical relationship with other cellular structures, their development, and their stromule response to exogenous sucrose is presented. Of the several sugars and sugar alcohols tested, plastid elongation in response to exogenously applied sugars is specific to glucose, sucrose and maltose, indicating that the response is not osmotic in nature. Sugar analogs, used to assess the contribution of sugar signalling to a process, and the sucrose signalling component trehalose-6-phosphate have no effect on stromule formation. Stromule frequency increases in response to multiple nutrient stresses in a sugar-dependent manner. Mutants with increased sugar accumulation show corresponding increases in stromule frequencies, though plastid swelling as a result of excessive starch accumulation negatively affects stromule formation. The elongation and retractions of plastids is seen to correlate with the rearrangement of the ER. Transient dilations in tubular portions of plastids, as well as gaps in stromal fluorescence, are associated with regions of spatial interaction with the ER. The degree of plastid elongation correlates with the size of the ER polygons both regionally and at the level of individual plastids, with more elongated etioplasts seen alongside smaller ER polygons. The disruption of ER structure or rearrangement through treatment with Latrunculin B, Brefeldin A or cold temperatures corresponds with a decrease in general plastid elongation and the inhibition of stromule induction by sucrose. The *endoplasmic reticulum morphology 1-1* mutant has compromised ER structure and this correlates with a general reduction in plastid tubulation. The evidence presented here suggests that cellular sugar has a pivotal role in inducing plastid pleomorphy in an ER-mediated manner.

Continued…

Curriculum Vitae:

Kiah obtained her Bachelor of Science (Honours) at the University of Guelph in 2012, and then began her M.Sc. in the fall of the same year with Dr. Jaideep Mathur. In the summer of 2014, Kiah transferred to the Ph.D. program, where she has continued her research in Dr. Mathur's lab.

Awards:

NSERC Alexander Graham Bell Canada Graduate Scholarship (CGS-M) 2012
Ontario Graduate Scholarship 2013
Dr. Donald R. Phillips Scholarship 2014
NSERC Alexander Graham Bell Canada Graduate Scholarship (CGS-D) 2015-2018

Publications:

Barton KA, Wozny MR, Mathur N, Jaipargas E-A, Mathur J (2018) Chloroplast behavior and interactions with other organelles in Arabidopsis thaliana pavement cells. J Cell Sci 131: jcs202275

Delfosse K, Wozny MR, Anderson C, Barton KA, Mathur J (2018) Evolving Views on Plastid Pleomorphy. Plant Cell Monographs Volume 23: Concepts in Cell Biology – History and Evolution. pp. 185-204

Barton KA, Schattat M, Jakob T, Hause G, Wilhelm C, McKenna J, Mathe C, Runions J, Van Damme D, Mathur J (2016) Epidermal pavement cells of Arabidopsis have chloroplasts. Plant Physiol 171: 723-726

Delfosse K, Wozny MR, Jaipargas E-A, Barton KA, Anderson C, Mathur J (2016) Fluorescent protein aided insights on plastids and their extensions: A critical appraisal. Front Plant Sci 6: 1253

Schattat M, Barton K, Mathur J (2015) The myth of interconnected plastids and related phenomenon. Protoplasma 252: 359-371

Mathur J, Barton KA, Schattat MH (2013) Fluorescent protein flow within stromules. Plant Cell 25: 2771-2772

Barton K, Mathur N, Mathur J (2013) Simultaneous live-imaging of peroxisomes and the ER in plant cells suggests contiguity but no luminal continuity between the two organelles. Front Physiol 4:196. Article.

Mathur J, Mammone A, Barton K (2012) Organelle extensions in plant cells. J Integr Plant Biol 54: 851-867

Schattat M, Griffiths S, Mathur N, Barton K, Wozny M, Dunn N, Greenwood J, Mathur J (2012) Differential coloring reveals that plastids do not form networks for exchanging macromolecules. Plant Cell 24: 1465-1477

Schattat MH, Barton K, Mathur J (2011) Correlated behavior implicates stromules in increasing the interactive surface between plastids and ER tubules. Plant Signal Behav 6: 715 -718

Schattat MH, Barton K, Baudisch B, Klossgen RB, Mathur J (2011) Plastid stromule branching coincides with contiguous ER dynamics. Plant Physiol 155:1667-1677