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*

# CECILY COSTAIN

**on Tuesday, October 6, 2020 at 9:30 a.m.** (online)

**Thesis Title**: **Effects of altered starch metabolism on growth and development of *Arabidopsis thaliana***

**Examination Committee:**

Dr. John Vessey, Dept. of Molecular and Cellular Biology (Exam Chair)
Dr. Ian Tetlow, Dept. of Molecular and Cellular Biology
Dr. Annette Nassuth, Dept. of Molecular and Cellular Biology
Dr. Joseph Colasanti, Dept. of Molecular and Cellular Biology

**Advisory Committee:**

Dr. Michael Emes (Advisor)
Dr. Ian Tetlow
Dr. Annette Nassuth

**Abstract:** Starch is an agronomically important insoluble polyglucan synthesized by plants as a means to store photoassimilates for subsequent use in metabolism and growth. Starch branching enzyme (SBE) is responsible for the production of alpha-(1,6)-linkages within amylopectin, contributing to its semi-crystalline structure. The accumulation of starch in floral organs such as the peduncle at the base of the flower plays an important role in the growth and development of reproductive tissues. It is hypothesized that modification of starch reserves in these tissues could affect flower production, embryo abortion and silique (pod) production. SBEI and SBEIIb cloned from maize (*Zea mays* L.) endosperm were constitutively expressed in a starchless line of Arabidopsis, lacking endogenous SBEs, and also in wildtype. Both *Zm*SBEI and *Zm*SBEIIb were able to individually restore starch synthesis in the null line (also referred to as the double mutant/dm), and transgenic lines complemented in both dm and wildtype backgrounds showed a starch excess phenotype at the end of the dark period. Effects on starch structure were observed, with transgenic lines exhibiting altered amylopectin chain length distribution and starch granule morphology. Arabidopsis lines expressing the most ZmSBEI and ZmSBEIIb protein exhibited higher SBE activity. Correlations were observed between reproductive tissue development and intensity of branching enzyme complementation. This result was particularly apparent in floral meristematic tissue, with strongly-complemented lines growing larger and producing more oilseed than wildtype controls. These results suggest branching enzyme activity in reproductive tissues may be a critical factor in determining seed yield in transgenic Arabidopsis plants. It can be concluded that the heterologous expression of either maize SBE ortholog in both dm and wildtype (Col-0) Arabidopsis plants can result in an increase in starch as well as altered amylopectin structure in both leaves and in reproductive tissues.

**Curriculum Vitae:** Cecily completed her Bachelor of Science (Hons.) at the University of Guelph in the spring of 2017, and then began her MSc with advisor Dr. Michael Emes in the Emes/Tetlow lab in the fall of the same year.