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DEPARTMENT OF BIOLOGY

TITLE OF THESIS: IDENTIFICATION AND MANIPULATION OF KEY REGULATORS IN LACE PLANT PROGRAMMED CELL DEATH

TIME/DATE: 10:00 am, Friday, May 26, 2017

PLACE: Room 3107, The Mona Campbell Building, 1459 LeMarchant Street

EXAMINING COMMITTEE:

Dr. Peter Bozhkov, Department of Chemistry & Biotechnology and Swedish University of Agricultural Sciences and Linnean Center for Plant Biology (External Examiner)

Dr. Patrice Côté, Department of Biology, Dalhousie University (Reader)

Dr. Mark Johnston, Department of Biology, Dalhousie University (Reader)

Dr. Arunika Gunawardena, Department of Biology, Dalhousie University (Supervisor)

Dr. Christian Lacroix, Department of Biology, University of Prince Edward Island (Co-Supervisor)

DEPARTMENTAL REPRESENTATIVE: Dr. Joe Bielawski, Department of Biology, Dalhousie University

CHAIR: Dr. John Archibald, PhD Defence Panel, Faculty of Graduate Studies

ABSTRACT

The lace plant (*Aponogeton madagascariensis*) is an aquatic monocot species that has emerged as a model for studying developmental programmed cell death (PCD). In multicellular eukaryotes, PCD plays vital roles in development and survival through the targeted deletion of compromised or superfluous cells. PCD occurs as part of normal leaf development in the lace plant and results in perforations throughout the lamina, thereby creating the lattice-like appearance from which its common name was derived. The lace plant provides an excellent model system due to: the predictability of PCD, the suitability of its leaves for live cell imaging, and availability of axenic cultures allowing for efficient propagation and pharmacological experimentation. Taking advantage of the lace plant system features, the cellular dynamics and time-course analysis of lace plant PCD has been described, however little is known about the regulation of this rarely observed type of developmentally regulated cellular death in leaves. The objective of this study is to identify the key regulators of lace plant PCD and to develop a genetic transformation protocol that will allow for greater control and understanding of the process. The regulators investigated include the phytohormone ethylene, antioxidants and reactive oxygen species (ROS), and the autophagic “self-eating” intracellular degradation pathway. Data indicate that ethylene and ROS are positive regulators of lace plant PCD, while antioxidants and autophagy function in cell survival and confer tolerance to the induction of cell death. Additionally, we show that the lace plant is amenable to *Agrobacterium tumefaciens*- mediated genetic transformation. The work shown here provides a model for lace plant PCD signaling and a framework to advance the system moving forward. Elucidating the mechanisms controlling cellular death in the lace plant contributes to the PCD literature. The ability to regulate PCD has a wide range of applications from agriculture to medicine. Understanding of plant PCD regulation can be employed to reduce postharvest losses or to develop crops more resistant to environmental stressors, and potential medicinal applications may arise due to the functional conservation observed among eukaryotic lineages for this vital process.