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BSc (Agriculture), University of Ghana, 2009
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DEPARTMENT OF BIOLOGY

TITLE OF THESIS:	PHYSIOLOGY OF MECHANICAL STRESS-INDUCED NEEDLE LOSS IN POSTHARVEST BALSAM FIR (ABIES BALSAMEA L.)
TIME/DATE:	9:30 am, Wednesday, April 18, 2018
PLACE:	Room 3107, The Mona Campbell Building, 1459 LeMarchant Street

EXAMINING COMMITTEE:

Dr. Donald Smith, Department of Plan Science, McGill University (External Examiner)

Dr. Claude Caldwell, Department of Plant, Food and Environmental Sciences, Dalhousie University (Reader)

Dr. Sam Asiedu, Department of Plant, Food and Environmental Sciences, Dalhousie University (Reader)

Dr. Raj Lada, Department of Plant, Food and Environmental Sciences, Dalhousie University (Supervisor)

DEPARTMENTAL REPRESENTATIVE:	Dr. Paul Bentzen, Department of Biology, Dalhousie University
CHAIR:	Marilyn Macdonald, PhD Defence Panel, Faculty of Graduate Studies

Abstract

Postharvest needle loss in balsam fir, *Abies balsamea* L., presents a major challenge for the Christmas tree industry. It was hypothesized that postharvest needle abscission is caused by mechanical stresses such as shaking, baling and storage temperatures triggered by certain physiological and biochemical processes and modulated by the storage environment. We discovered that baling cause, 1.03°C increase in needle temperature, 2-folds, 5-folds, and 2-folds increases in membrane injury index, ethylene and VTC evolutions, respectively. Control trees had a 16% increase in needle loss compared to higher shaking duration (60 sec.), while baled of 1 tree lost 13% more needles compared to control. These trends corresponded with ethylene and VTC evolutions. Trees stored continuously at 20°C and 30°C lasted for 7 and 14 days at higher humidity of 83% and 85%, respectively. Exposing baled trees to low temperature of 3ºC promoted NRD through maintaining high AWU and reducing ethylene and VTC (3-carene) evolution. Storage of trees that were shaken and baled at vapor pressure deficit of 0.26 kPa also increased NRD and AWU by 2-folds, and decreased ethylene by 2-folds and a near perfect relationship between total VTC and individual VTCs (3-carene and β-pinene) and NRD was observed. XPP was significantly (ρ=0.05) higher (-0.61MPa) in trees that were exposed to a combined treatment of 60sec shaking and bale of 5 trees compared to their respective controls. A 34.6% increase in XPP was recorded in the upper tier of trees compared to the lower tier. While a 12.12% decrease in impedance was recorded in the upper tier of control trees, trees shaken and baled showed a 31.49% decrease in impedance as a result of damaged tissues. These results indicate that balsam fir trees respond to mechanical stress caused by shaking and/or baling, by a decline in water uptake, increase in ethylene and VTCs specifically, 3-carene, β-pinene and β-terpene leading to postharvest needle abscission, which was modulated by storage of trees at low temperature (3ºC) and low VPD (0.26 kPa).

Key words: Christmas tree, shaking, baling, stress, temperature, MII, ethylene, VTC, needle abscission