Physiology of Postharvest Needle Abscission as Influenced by Mechanical Stress

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Introduction

Baling of trees is an important handling process practiced by farmers for easy handling and less expensive transport of trees. However, it is believed that baled trees undergo mechanical stress, closing their stomata and leading to water stress.

These phenomena also trigger the synthesis and evolution of volatile terpene compounds (VTCs) and ethylene, and in effect promote postharvest needle abscission.

It was hypothesized that baling of balsam fir trees causes mechanical stress, triggering changes in ethylene and VTCs, promoting postharvest needle abscission.

Baled balsam fir trees ready for transport

Objective of this research was to uncover the detrimental physiological effect of baling balsam fir trees on VTCs, ethylene, and postharvest needle abscission

Methods

Material Preparation and setup

3ft trees with average age of 6 years were harvested in the winter of 2014. They were subjected to baling of 1, 2, 3, 4 and 5 trees per bale using tree baler. The control was trees of no baling. Trees were kept outside the laboratory to acclimatize for 3 days. In the laboratory, fresh cut of the tree trunk was done and trees setup in 3L of water in a glass jar over the entire period of the study.

Experimental Design

The experiment followed a completely randomized design with a total of 30 randomly selected trees from a farmer's orchard in New Ross, NS. Each treatment was replicated 5 times.

VTCs and Ethylene Analysis

Headspace extraction methods were adopted in both VTC and ethylene analysis. In the case of VTC extraction, solid phase microextraction (SPME) kit and procedure was used (Fig. 1A) and the ethylene extraction was done using air-tight syringe (Fig. 1B). Both were followed by analysis using GC - FID (Fig. 1C).

Fig 1A. Branch sealed in air-tight jar to incubate for 60mins for VTC extraction

Fig 1B. Branches in parafilm-sealed flasks to incubate for 12hrs for ethylene extraction

Fig 1C. VTC and ethylene analysis using GC-FID

Results

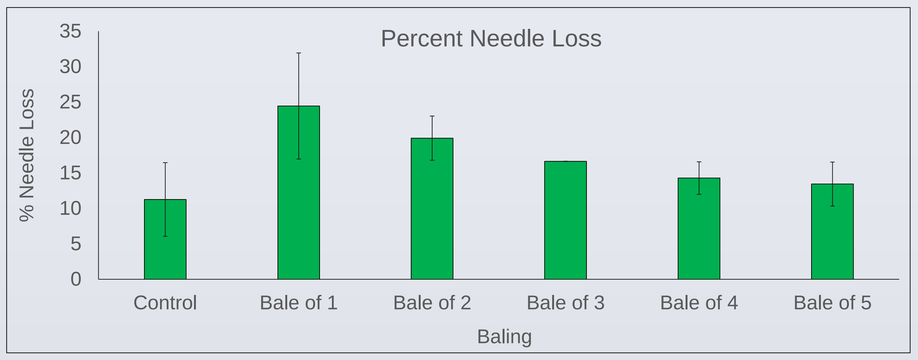

Fig 2: Percent needle loss of trees subjected to baling treatments of control (no baling), 1, 2, 3, 4 and 5 trees per bale

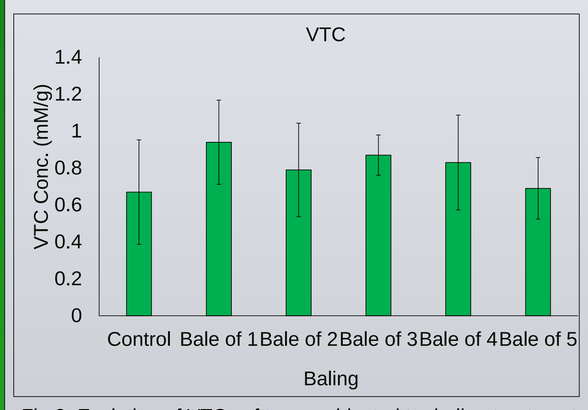

Fig 3: Evolution of VTCs of trees subjected to baling treatments of control (no baling), 1, 2, 3, 4 and 5 trees per bale

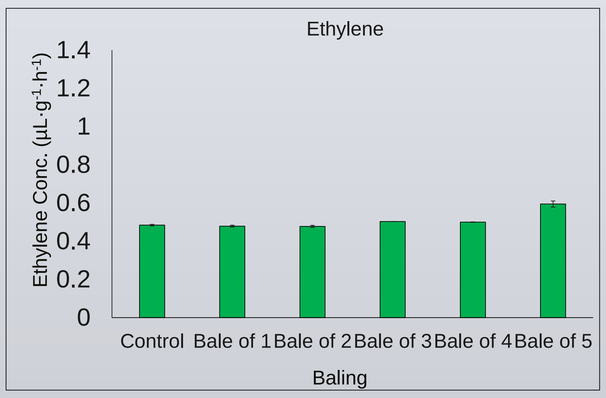

Fig 4: Ethylene evolution of trees subjected to baling treatments of control (no baling), 1, 2, 3, 4 and 5 trees per bale

- No baling or baling of 3 to 5 trees are less detrimental to needle loss compared to baling few (1 and 2) trees (Fig. 2). This is somewhat consistent with VTC evolution, since control and bale of 5 had lower concentrations of VTCs (Fig. 3).
- Contrary, we see a constant increase in ethylene evolution with increase in number of trees per bale (Fig. 4). This might be as a result of mechanical stress caused by baling.
- However, these trends do not reflect on the postharvest needle loss of the trees since our previous studies have suggested that an increase in both VTC and ethylene correspond with an increase in postharvest needle loss.

Conclusion

- This study suggests that the more trees in a bale the less they loose needle. However, it is better not to bale the trees at all.
- Higher VTCs conc. in trees that are baled and lower amounts in trees that are not baled, as well as higher conc. of ethylene with increase in number of trees per bale suggest a possible link between VTCs, ethylene and baling.
- However we cannot say that synthesis and/or release of VTCs and ethylene have effect on postharvest needle abscission.

Acknowledgements

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