DTA of buds of Norway spruce during cold acclimation in a stand with shoot diebacks

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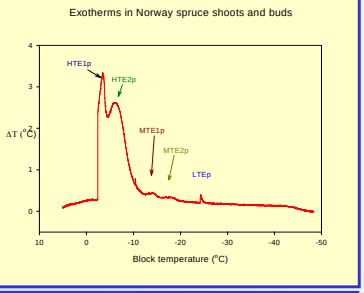

Figure 1.
A DTA curve of a sample. High temperature exotherms (HTE1 and HTE2), medium temperature exotherms (MTE1 and MTE2) and low temperature exotherm (LTE) are indicated.

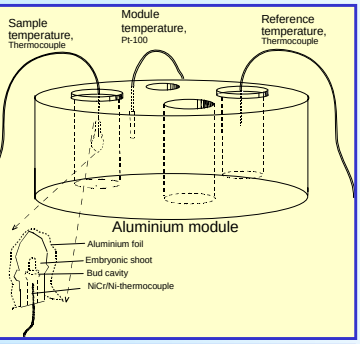

Figure 2.
A DTA module schematically. Difference between the temperature of three samples and reference temperature (ΔT) and the temperature of the module was recorded.

1. Introduction

Repeated dieback of terminal shoots is a problem in fertile Norway spruce (*Picea abies* (L.) Karst.) stands in Finland. One of the causes for the terminal shoot dieback is assumed to be decreased frost hardiness.

Freezing of embryonic shoot in dormant bud of Norway spruce forms a low temperature exotherm (LTE) which has been found to be lethal [1]. In this study, we compared cold acclimation of buds in trees with healthy apical shoots and trees with repeated shoot diebacks by differential thermal analysis (DTA).

2. Methods

Samples for DTA were collected five times during cold acclimation from the uppermost branches of healthy-looking trees and trees with shoot dieback. One DTA sample consisted of an apical bud of a major branch with 10 mm of stem. Lateral buds and part of the needles were dissected.

A NiCr/Ni-thermocouple (∅ 0.25mm) was set in a small hole punctured in the stem under the bud. Samples (12 in one run) were placed in four aluminium blocks in a freezing chamber (Fig. 2.). The differential temperature (ΔT) between the sample and the reference sensor was recorded using Dasylab software. The initial temperature of the DTA run was 5°C and the rate of cooling to -49°C was 5°C/h.

3. Results and Discussion

There were generally two high temperature exotherms (HTE1 and HTE2) between –2 and –7°C, two intermediate exotherms (MTE1 and MTE2) between –12 and –19°C and one low temperature exotherm (LTE) between –15 and –34°C (Fig. 1 and 3). The temperature of the LTE decreased with cold acclimation.

No differences in LTE were found between healthy-looking trees and trees with shoot dieback (Fig. 3). Thereby, lower frost hardiness (poistettu tekstiä) does not appear to be the reason for dieback. Nevertheless, air temperatures during winter are usually somewhat lower than observed LTE in most of the buds in the last sampling time. This may indicate unaccomplished stage of bud acclimation (Fig. 4). Loppuuko tässä ajatus kesken??

References:

[1] Pukacki, P. and Pukacka, S. 1987. Physiologia Plantarum 69: 156-160

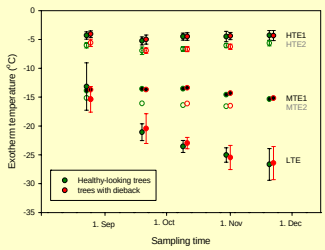

Figure 3.
Development of the expression temperature of different exotherms by DTA. Bars indicate ±SD.

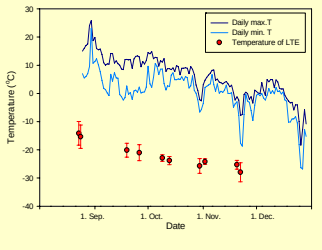

Figure 4.
Mean of LTE by sampling days with healthy trees and trees with dieback combined. Bars indicate ±SD. Lines represent daily minimum and maximum air temperatures respectively. Two adjacent means are different sampling days in a couple of days intervals (Onko tämä viimeinen lause tarpeen, koska asia näkyy kuvasta?).

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