Electrolyte leakage test in assessing of cold hardiness in roots

Mikko Räisänen[1], Tapani Repo[2] Tarja Lehto[1]

1) mikko.raisanen@joensuu.fi, tarja.lehto@joensuu.fi, University of Joensuu, Faculty of Forestry, P.O. Box 111, FI-80101 Joensuu, Finland
2) tapani.repo@metla.fi, The Finnish Forest Research Institute, Joensuu Research Unit, P.O. Box 68, FI-80101 Joensuu, Finland

We examined root cold hardiness in Norway spruce trees in a field experiment by electrolyte leakage test after controlled freezing exposures. Roots were separated from soil by washing them prior to freezing tests.

Material and Methods

Fine roots for cold hardiness tests were sampled during autumn and prepared for electrolyte leakage tests prior to freezing tests. Samples were frozen at seven different freezing temperatures.

Relative electrolyte leakage was calculated as percentage of ions in solution of test tubes after frost exposure (EL1) and after heat killing of samples (EL2). Freezing tolerance (LT_{50}-value) was calculated by non-linear regression of EL1/EL2 against exposure temperature (Fig. 1).

For studying the mortality of fine roots in the field during winter, root samples were collected in the spring and the viability of roots was estimated visually under stereomicroscope.

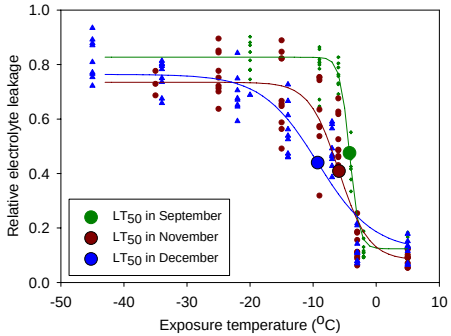

Fig. 1. Regression curves for calculation of LT_{50}-value.

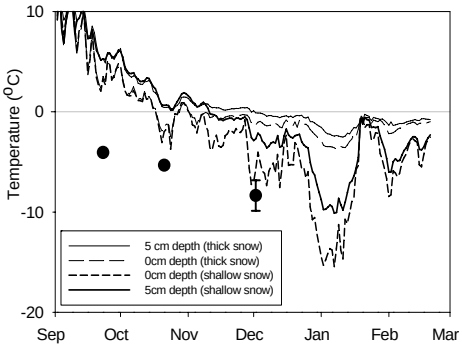

Fig. 2. Soil temperature in the experimental site (lines) and LT_{50} of roots (plot with S.E. bars).

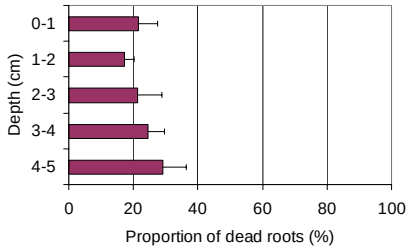

Fig. 3. Proportion of dead roots on DW basis at different depths of humus layer in May 2003.

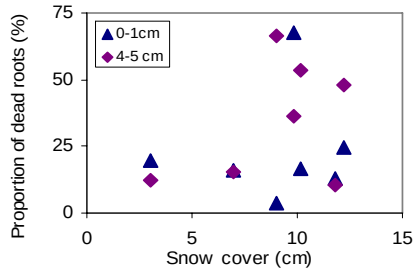

Fig. 4. Proportion of dead roots on DW basis at two depths of soil in May in relation to snow cover under sampled trees in December 2002.

Results and discussion

When roots were exposed to frost, relative electrolyte leakage of samples increased enabling the assessment of cold hardiness of roots (Fig. 1).

In the field experiment, assessed cold hardiness of roots was, however, rather low compared to minimum soil temperatures during winter (Fig. 2).

Despite that, there was no more root mortality in surface layer of soil which was exposed to more severe freezing during winter (Fig. 3) and not under the trees where isolating snow cover was shallow (Fig. 4).

On the basis of results we are concerned that:

-either freezing tolerance decreased in roots during sample preparation,

-or the calculated freezing tolerance (LT_{50}-value) is not the lethal temperature for roots.