

Appraisal of root leakage as a method for estimation of root viability

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Introduction

Root system is quite sensitive to environmental and operational stresses. Operational stresses, in particular, might impair root vitality. These operations may include lifting, storage, grading, insecticide treatment, packaging, dispatch, receipt and temporary storage or combinations of these. During those operations seedlings are exposed to stresses like high and low temperatures, desiccation, rough handling, storage and even fire. Assessment of fine root vitality, which seedling survivability strongly depends on, is only possible after the roots have suffered damage. However, even in such a case, damage is often invisible or can hardly be measured in a generally acceptable way. An apparently acceptable test is the Root Electrolyte Leakage (REL). It elucidates the root cell membrane integrity as well as changes in membrane functions. Thus, it would be expected to be a valid indicator of root injury and therefore of the seedling survival potential.

The Method

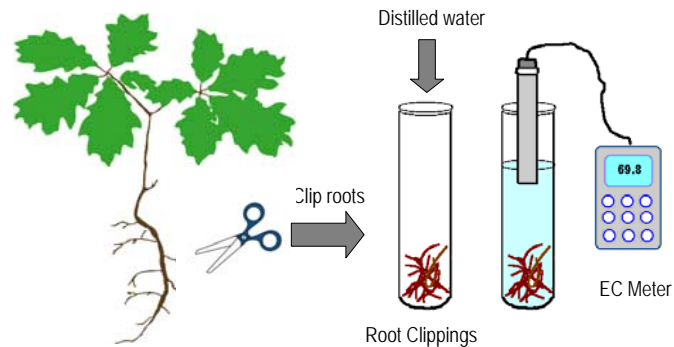
For REL test of fine roots (diameter < 2 mm), root system is washed in cold tap water to remove soil and then rinsed in deionised water (pH 5 - 7) to remove adsorbed ions. Samples are selected from a particular portion of the root systems. Weight of the root samples ranges between 100 and 500 mg. Individual samples are submerged in 16 ml distilled or deionised water in 28-mL universal glass bottles (with a ratio of tissue to water of approximately 1/20). The bottles are capped and shaken at room temperature for 22 h. Then the first conductivity (C1) of the bathing solution is measured using a conductivity probe with a built-in temperature compensation system. Samples are killed (e.g. autoclaving at 110°C for 10 min) and shaken for another 22h at room temperature before a second conductivity measurement (C2). REL is expressed as

$$REL = (C1/C2) \times 100$$

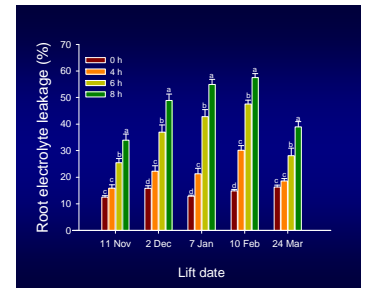
Review Objectives:

1. Present the fundamentals of this method.
2. Provide a concise assessment of literature related to the examination of REL as an indicator of tree seedling quality.
3. Present evidence of seasonal variations of REL.
4. Determine how REL responds to different stress conditions.
5. Suggest priorities for future research and practical recommendations for REL testing.
6. Finally, we will provide an assessment of leakage of organic compounds as an indicator of root damage.

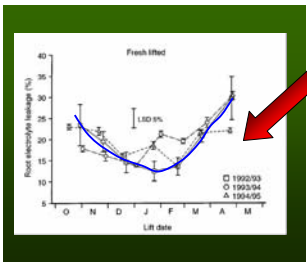
Measuring REL



REL response to heat stress

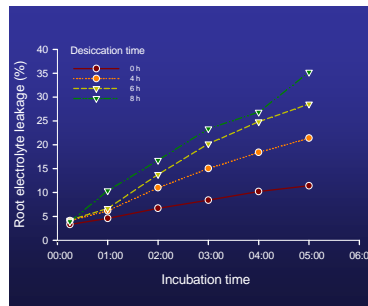


Results



Seasonal Variation in REL

REL is a dynamic variable and varies seasonally in seedlings regardless of root injury.

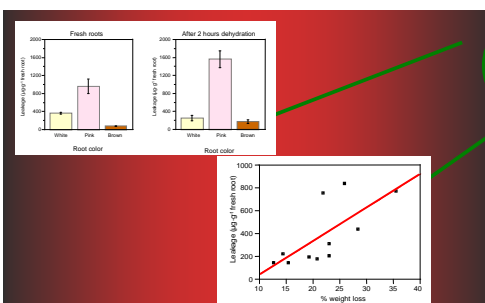


Root electrolyte leakage of Sitka spruce (*Picea sitchensis* B) seedlings at time of lifting over three lifting seasons in Ireland. Vertical bars on the symbols indicate standard errors, at 5% LSD of the means. (Adapted from O'Reilly et al. 2000)

the interpretation of REL must take into account:

- physiological condition of seedlings
- potential for genetic variation between seed sources
- nursery practices.

Leakage of organic compounds as indicators of root damage. Leakage of ninhydrin-active substances from different root types following various levels of dehydration



Main Findings

- ◆ REL test is a quick, inexpensive and simple method for assessing physiological status of sample fractions of root system.
- ◆ Results are quantitative and are generally obtained within 48 hours.
- ◆ REL may be useful in quantifying damage caused by cold storage and freezing temperatures.
- ◆ REL varies seasonally in seedlings regardless of additional root injury.
- ◆ Increase in REL is related to decreases in seedling survival and performance potential but this relation is not universal for all species.
- ◆ REL should be considered as a relative index of plant quality only since the relation between REL and survival varies with cultural and handling practices prior to planting and post-planting environmental conditions.
- ◆ The method can be a useful indicator of seedling damage provided that acceptable thresholds of survival probability will be established and adequately correlated with concrete REL values. It is recommended that REL be used in conjunction with other measures of seedling physiological determinants.
- ◆ In order to improve the method and decrease variation, attention should be paid to preserve root membrane integrity.

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