From Forest Nursery Notes, Summer 2008

116. © Appraisal of root leakage as a method for estimation of root viability.
Radoglou, K., Cabral, R., Repo, T., Hasanagas, N., Sutinen, M. L., and Waisel, Y. Plant Biosystems 141(3):443-459. 2007.

Plant Biosystems, Vol. 141, No. 3, November 2007, pp. 443–459

RECENT ADVANCES IN WOODY ROOT RESEARCH

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

K. RADOGLOU[1], R. CABRAL[2], T. REPO[3], N. HASANAGAS[1], M.-L. SUTINEN[4] & Y. WAISEL[5]

[1]*Forest Research Institute, NAGREF, Greece,* [2]*Urban Institute Ireland, Ireland,* [3]*Finnish Forest Research Institute (Metla), Finland,* [4]*Finnish Forest Research Institute (Metla), Finland, and* [5]*Department of Plant Sciences, Tel Aviv University, Israel*

Abstract

We review the applications of REL test as a technique for detecting injury and thereby forecasting survivability of transplanted seedlings. The objectives of the present review are to present the fundamentals of this method, assess the relevant literature, present evidence of seasonal variations of REL, describe how REL responds to different stress conditions, suggest priorities for future research as well as practical recommendations for REL testing, and assess leakage of organic compounds as an indicator of root damage. Seasonal changes in REL may be connected with root freezing tolerance that varies among plants of different seed sources and species and thus does not always indicate health state of seedlings. REL technique can be used for assessing frost hardiness of roots under certain conditions (e.g. roots should be sampled into the test tubes prior to the freezing test). It can be used for studying heat stress with certain prerequisites (e.g. series of high temperatures or different exposure times should be used to find a threshold for heat tolerance). In desiccation tolerance assessment, REL presents high variation depending on species. In case of rough handling or hypoxic conditions, the effect depends on certain developmental stages. Additionally, though REL may be useful in quantifying damage caused by cold storage, it should be considered as a relative index of plant quality only since the relationship between REL and survivability could vary depending on cultural and handling practices prior to planting as well as on post-planting environmental conditions. In some cases, REL is correlated with field performance of seedlings, but in other cases the correlation is weak. Factors as species, seed lots, developmental stage of root tissue, season, and bud dormancy intensity may affect REL. Thus, REL must first be calibrated to these factors before it can be reliably used to predict the field performance of all types of seedling stock. Ambient storage, ageing and amino acids and protein leakage are also discussed. Limitations and questions for future research are suggested (e.g. species-dependence and decreasing variation). In general, REL is casually and statistically related with root damage and survivability of seedling. However, it depends on many other factors apart from root damages, and thus it remains a great challenge to improve its reliability.

Key words: *REL, abiotic stress, membrane integrity, non-damage factors, reliability*

Introduction

The focus of this paper is to review a method of assessing seedling post-planting survival based on root system integrity. A number of papers and reviews have discussed seedling quality (Sutton, 1979; Ritchie, 1984; Duryea 1985; Puttonen, 1989; Puttonen, 1997; Sampson et al., 1997; Tanaka et al., 1997), however, these works have focused largely on above-ground morphology and whole plant physiological vigor (Grossnickle & Folk, 1993; Mattsson, 1997; Mohammed, 1997), which determines plant growth and development. Few publications have dealt with morphological and physiological attributes of root systems which constitute the most crucial factor for the survivability (Fitter, 1991).

Root system is quite sensitive to environmental and operational stresses. Operational stresses, in particular, might impair root vitality (McKay, 1997). 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 (Lindström & Mattson, 1989; Stattin et al., 2000),

Correspondence: K. Radoglou, Forest Research Institute, NAGREF, Vassilika, Thessaloniki, Greece. E-mail: radoglou@fri.gr

ISSN 1126-3504 print/ISSN 1724-5575 online © 2007 Società Botanica Italiana
DOI: 10.1080/11263500701626143