

## Overwinter storability of conifer planting stock: operational testing of fall frost hardiness

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**Abstract** - Operational stock-testing facilities that estimate overwinter storability of seedlings (ability to survive and grow after storage) need a reliable method that provides fast results to forest nurseries. We compared three methods using container-grown seedlings of Douglas-fir, interior spruce, lodgepole pine, and western larch from forest nurseries in British Columbia. On three to nine dates in autumn, frost hardiness at  $-18^{\circ}\text{C}$  was estimated using visible injury of foliage or stems (VI), electrolyte leakage from needles or stems (EL), and chlorophyll fluorescence of shoots (CF). Seedlings were placed into overwinter cold storage ( $-2^{\circ}\text{C}$ ). In the spring, stored seedlings were planted in nursery beds: survival and growth were assessed after one growing season. There were close correlations ( $r = 0.93$ ) between the assessment methods. Seedlings lifted after they reached thresholds of 69% or higher for CF and 25% or lower for EL and VI had over 90% survival at harvest and doubled shoot dry weight compared with seedlings lifted earlier. Measuring CF was the fastest and most easily replicated method to estimate successful storability, and reduced testing time by 6 days relative to VI tests.

**Keywords** Chlorophyll fluorescence • Electrolyte leakage • Visible injury • Freeze-testing

### Introduction

Forest nurseries in many countries place tree seedlings in cold storage after the growing season to accommodate flexible planting schedules. In British Columbia, Canada, about

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