

Impacts of nursery cultural treatments on stress tolerance in 1 + 0 container white spruce (*Picea glauca* [Moench] Voss) seedlings for summer-planting

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Abstract: Impacts of nursery cultural treatments (T) on stress tolerance of greenhouse-grown 1 + 0 container white spruce (*Picea glauca* [Moench] Voss) seedlings (mean height 24 cm, root collar diameter 3.1 mm) for summer planting were studied. Seedlings were subjected to 12-h short-day treatments of 0 (T₀), 3 (T₃), 7 (T₇), 10 (T₁₀), or 15 (T₁₅) days, followed by 0, 7, 17, 40, or 46 days of reduced N supply, respectively. Relevant physiological and morphological factors were examined concurrently. Foliar N concentrations exceeded optimal levels and differed little among treatments, suggesting a minor confounding role for N reduction. Both frost and drought tolerance increased incrementally from T₀ through T₁₅. Electrolyte leakage index decreased steadily from T₀ (25% for roots, 17% for needles) to T₁₅ (1% for roots, 2% for needles) after 2-h exposure of fine roots to – 2°C and of needles to – 8°C. Withholding soil watering for 19 days caused 80% mortality among seedlings in T₀, 50% in T₃, and < 10% in T₇–T₁₅. The transpiration decline curve suggested that enhanced drought tolerance was largely attributable to quicker stomatal closure during water stress and lower cuticular transpiration rate. The treatments increased root growth capacity on a per-seedling, but not per-root-mass, basis. Needle primordia were developed in all T₇–T₁₅ seedlings but not in T₀ and T₃ treatments, suggesting that nurseries may need no more than 7 days of blackout application for conditioning spruce seedlings for summer planting. Shoot dry weight fraction increased gradually from T₀ through T₁₅ and was linearly correlated with needle specific weight and frost tolerance, and may thus be useful in monitoring progress of conditioning treatments.

Keywords Short-day • Conditioning • Drought tolerance • Frost tolerance • Physiology

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