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Recovery of *Populus tremuloides* seedlings following severe drought causing total leaf mortality and extreme stem embolism

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In contrast with other native *Populus* species in North America, *Populus tremuloides* (aspen) can successfully establish itself in drought-prone areas, yet no comprehensive analysis has been performed on the ability of seedlings to withstand and recover from a severe drought resulting in complete leaf mortality. Here, we subjected 4-month-old aspen seedlings grown in two contrasting soil media to a progressive drought until total leaf mortality, followed by a rewatering cycle. Stomatal conductance (g_s), photosynthesis and transpiration followed a sigmoid decline with declining fraction of extractable soil water values. Cessation of leaf expansion occurred close to the end of the linear-decrease phase, when g_s was reduced by 95%. Leaf mortality started after g_s reached the lowest values, which corresponded to a stem–xylem pressure potential (Ψ_{xp}) of −2.0 MPa and a percent loss of stem hydraulic conductivity (PLC) of 50%. In plants with 50% leaf mortality, PLC values remained around 50%. Complete leaf mortality occurred at an average stem PLC of 90%, but all seedlings were able to resprout after 6–10 days of being rewatered. Plants decapitated at soil level before rewatering developed root suckers, while those left with a 4-cm stump or with their stems intact resprouted exclusively from axillary buds. Resprouting was accompanied by recovery of stem hydraulic conductivity, with PLC values around 30%. The percentage of resprouted buds was negatively correlated with the stem %PLC. Thus, the recovery of stem hydraulic conductivity appears as an important factor in the resprouting capacity of aspen seedlings following a severe drought.

Introduction

Most native *Populus* species in Western North America are particularly abundant in riparian zones and other areas where water availability is usually plentiful (Kranjcec et al. 1998). In contrast, *Populus tremuloides* (aspen) is generally an upland species and can occupy seasonally dry areas (Kranjcec et al. 1998). Several physiological traits might explain the successful establishment of aspen in drought-prone areas: tight stomatal control with drying soil and increasing vapor pressure deficit (Dang et al. 1997, Hogg et al. 2000, Iacobelli and McCaughey 1993), less vulnerability to

Abbreviations – ELL, Ellerslie soil; FESW, fraction of extractable soil water; NPQ, non-photochemical quenching parameter; PLC, percent loss of stem hydraulic conductivity; PMX, potting mix; PSII, photosystem II.