Three different growth responses of six gymnosperm species under long-term excessive irrigation and traits determining species resistance to flooding

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April 16, 2024

Abstract

In the era of extreme weather events, plant resistance to excessive water should be considered for plantations in frequently flooded areas. Therefore, we quantified the resistance to excessive irrigation (REI) in seedlings of six conifer species on the basis of their morphological, physiological, and biochemical traits. Two different irrigation regimes, natural precipitation as a control treatment and additional irrigation by sprinklers (30.89 ± 2.80 % above natural precipitation) as excessive irrigation, were applied for three consecutive years. There were three distinct responses in biomass accumulation: Chamaecyparis obtusa and Abies holophylla significantly increased their aboveground and underground biomass and showed a strong REI; Pinus thunbergii and P. densiflora, both resistant to drought, significantly decreased their aboveground and underground biomass and showed a weak REI. Larix kaempferi and Pinus koraiensis showed a medium REI with only aboveground biomass increment in the former and no biomass change in the latter. Plant biomass responses corresponded well with the changes in morphological, physiological, and biochemical traits. Biomass augmentation resulted from an increase in leaf size, leaf mass per area (LMA), maximum photosynthesis rate, and leaf water potential. Flavonoids, LMA, and stomatal conductance are the most important traits to access species REI.

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