Soil nutrients and lowered source:sink ratio mitigate effects of mild but not of extreme drought in trees

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Author(s) Schoenbeck, Leonie; Gessler, Arthur; Schaub, Marcus; Rigling, Andreas; Hoch, Guenter; Kahmen, Ansgar; Li, Mai-He
Author(s) at UniBasel Kahmen, Ansgar ; Hoch, Günter ; Schönbeck, Leonie ;
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Little is known about environmental factors that mitigate or intensify drought effects on tree functioning. We hypothesized that higher nutrient availability and manipulations of the source:sink ratio can partially compensate negative drought effects when drought is not too severe, whilst too extreme drought can inhibit carbon and nutrient uptake and allocation irrespective of nutrient availability or the plant source:sink balance. We exposed three year-old Pinus sylvestris saplings during two subsequent years to drought using four different water supply regimes (from no drought to extreme drought) and released drought thereafter. Trees were exposed to two soil nutrient regimes. In addition, partial and full needle removal was performed. We assessed biomass, leaf gas exchange and tissue non-structural carbohydrates (NSCs). Extreme drought reduced stomatal conductance, photosynthesis, biomass and NSC, whereas intermediate drought levels only slightly affected biomass and NSC. Defoliation stimulated photosynthesis and fertilization increased growth and root biomass fraction, but mainly in the two intermediate drought levels. Only extreme drought pushed P. sylvestris trees to mortality. We conclude that tree mortality under severe drought periods will not be mitigated, but that the effects of low intensity drought stress could be compensated by increased nutrient availability and decreased source:sink ratio.
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