Soil nutrient availability alters tree carbon allocation dynamics during drought

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Author(s) Schönbeck, Leonie; Li, Mai-He; Lehmann, Marco M.; Rigling, Andreas; Schaub, Marcus; Hoch, Günter; Kahmen, Ansgar; Gessler, Arthur
Author(s) at UniBasel Kahmen, Ansgar ; Schönbeck, Leonie ; Hoch, Günter ;
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Drought alters allocation patterns of carbon (C) and nutrients in trees and eventually impairs tree functioning. Elevated soil nutrient availability might alter the response of trees to drought. We hypothesize that increased soil nutrient availability stimulates root metabolism and carbon allocation to belowground tissues under drought stress. To test this hypothesis, we subjected three-year-old Pinus sylvestris saplings in open-top cambers during two subsequent years to drought using three different water treatments (100%, 20% and 0% plant available water in the soil) and two soil nutrient regimes (ambient and nitrogen-phosphorus-potassium (N-P-K) fertilization corresponding to 5gN/m2/yr) and released drought thereafter. We conducted a 15N and 13C labelling experiment during the peak of the first-year drought by injecting 15N labelled fertilizer in the soil and exposing the tree canopies to 13C labelled CO2. The abundance of the N and C isotopes in the roots, stem and needles was assessed during the following year. C uptake was slightly lower in drought stressed trees, and extreme drought inhibited largely the N uptake and transport. Carbon allocation to belowground tissues was decreased under drought, but not in combination with fertilization. Our results indicate a potential positive feedback loop, where fertilization improved the metabolism and functioning of the roots, stimulating C allocation to belowground tissues. This way, soil nutrients compensated for drought-induced loss of root functioning, mitigating drought stress of trees.
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