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Effect of long-term drought on carbon allocation and nitrogen uptake of Pinus sylvestris seedlings

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Weather extremes such as drought events are expected to increase in the future as a result of climate change. The drought affects the allocation of carbon assimilated by plants e.g. by modifying the root to shoot ratio, amount of fine roots and the amount of mycorrhizal fungal hyphae.

We studied the effect of long term drought on the allocation of carbon in a common garden experiment with 4-year-old Pinus sylvestris seedlings. Half of the seedlings were exposed to long-term drought by setting the soil water content close to wilting point for over two growing seasons whereas the other half was grown in soil close to field capacity. We conducted a pulse labelling with $13CO_2$ in the end of the study by injecting a known amount of 13C enriched CO_2 to the seedlings and measuring the CO_2 uptake and distribution of 13C to the biomass of the seedlings and to the root and rhizosphere respiration. In addition, we studied the effect of drought on the decomposition of needle litter and uptake of nitrogen by 15N labelled needles buried in the soil in litter bags. The litterbags were collected and harvested in the end of the experiment and the changes in microbial community in the litterbags were studied from the phospholipid fatty acid (PLFA) composition. We also determined the 15N isotope concentrations from the needles of the seedlings to study the effect of drought on the nitrogen uptake of the seedlings.

Our results indicate that the drought had a significant effect both on the biomass allocation of the seedlings and on the microbial species composition. The amount of carbon allocated belowground was much higher in the seedlings exposed to drought compared to the control seedlings. The seedlings seemed to adapt their carbon allocation to long-term drought to sustain adequate needle biomass and water uptake. The seedlings also adapted their osmotic potential and photosynthesis capacity to sustain the long-term drought as was indicated by the measurements of osmotic potential and photosynthetic light response.