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Resistance and recovery of rhizospheric carbon and nitrogen flow in fungi- and bacteria-dominated plant communities after drought

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We investigated the effect of drought on the plant driven carbon flow to the soil microbial community and its effects on the nutrient return to the plants. This is important in order to understand the functioning of marginal mountain grasslands that are strongly effected by socio-economic and environmental change.
We performed an experimental summer drought on an abandoned grassland and a traditionally managed hay meadow and traced the fate of recent assimilates through the plant-microbial-soil continuum. We applied $13CO_2$ and 15N pulses, at peak drought and in the recovery phase shortly after rewetting.
Drought decreased the total C uptake in both grassland types and led to a shift from leaf to root carbohydrate storage, especially in the meadow.
The microbial community of the abandoned grassland held more saprotrophic fungal and Gram (+) bacterial markers compared to the meadow. Drought increased the AM and saprotrophic (A+S) fungi:bacteria ratio in both grassland types. At peak drought the 13C transfer into AM fungi, saprotrophic fungi and Gram (-) bacteria was stronger reduced in the meadow than in the abandoned grassland, which contrasted the patterns of the root carbohydrate pools.
In both grassland types the C allocation largely recovered after rewetting. Slowest recovery was found for AM fungi and their 13C uptake. In contrast, all bacterial markers quickly recovered C uptake. In the meadow, where plant nitrate uptake was enhanced after drought, C uptake was even higher than in control plots.
Our results suggest that resistance and resilience (i.e. recovery) of plant C dynamics and plant-microbial interactions are negatively related, i.e. high resistance is followed by slow recovery and vice versa. The abandoned grassland was more resistant to drought than the meadow and possibly had a stronger link to AM fungi that provided better access to water through the hyphal network. In contrast, meadow communities strongly reduced C allocation to storage and C transfer to the microbial community in the drought phase, but in the recovery phase invested C resources in the bacterial communities to gain more nutrients for regrowth. We conclude that management of mountain grasslands increases their resilience to drought.