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# Grassland management affects belowground carbon allocation in mountain grasslands and its resistance and resilience to drought

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Future climate scenarios do not only forecast increased extreme events during summer, but also more frequent drought events in the early season. In mountain grasslands, different land uses may contribute to the response of the ecosystem to climate changes, like drought in May and June.

In this study, we examined the drought response of two differently managed grasslands, 1) a more intensive used meadow and 2) a less intensive used abandoned area. Our aim was to highlight differences in both resistance and resilience of ecosystem functioning, based on carbon (C) belowground allocation as a key function in the plant-rhizosphere continuum. Therefore, we used an isotopic approach and in particular, we used 13C pulse labelling to track the fate of newly assimilated C from leaves, to roots and to soil, up to different microbial communities. We performed two 13C pulse labellings, the first during the acute phase of drought, when the water status of soil was drastically decreased compared to the control; and the second during the recovery phase, when the soil water status was restored to control level. We followed the kinetics of 13C incorporation in above- and below-ground bulk material as well as non-structural sugars, in general soil microbial biomass, in different soil microbial communities and in $CO_2$ respired from roots, up to 5 days from each labelling.

Preliminary results from the 13C analyses of bulk phytomass material and soil microbial biomass indicate, as expected, different kinetics of aboveground 13C incorporation and its belowground allocation. During the acute phase of drought, 13C incorporation shows a decrease compared to the control for both land uses, with generally higher reductions in meadow treatments. Root 13C tracer dynamics follow the leaf 13C enrichment with a delay. High label amounts are found in leaves directly after labelling, whereas in roots high 13C incorporation is found first after 24 hours, accompanied by a fast decrease of 13C label in leaves and followed by a stable phase. In microbial biomass, tracer dynamics generally reflect the root 13C enrichment and consequently show a more pronounced effect of drought in meadow treatments. Nevertheless, at the second labelling, 13C incorporation in leaves as well as 13C allocation to roots fully recovered to control level, in both, abandoned and meadow treatments. Accordingly, we assume that the C transfer to soil microbial biomass also should have been restored at that time (analyses in progress). Furthermore, the 13C analysis of individual microbial biomarker lipids will give us a more detailed view on the molecular mechanisms underpinning resistance and resilience of mountain grasslands.

Additionally, we also analysed the 13C composition of $CO_2$ respired by roots, to study how much and how fast newly assimilated C is respired at the root level. Our results show, that already 24 hours after labelling the canopy, newly formed C has been translocated and respired at the root level. We don't have enough data to show a difference in drought resistance between the two different land uses. However, preliminary results from labelling the rewetted plots indicate that the flux of newly formed $CO_2$ from roots, both in abandoned and meadow treatments, recovers completely from drought with non-significant difference among the land use treatments (in accordance with bulk phytomass analyses). Moreover, data on the compound specific 13C composition in above- and below-ground biomass will highlight the relationship between C allocation in grassland species and the C respired by roots as $CO_2$ as well as the C transferred to the microbial community in the rhizosphere.