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Impact of drought on C forms and fluxes in the soil – plant continuum

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Global change is likely to increase the drought periods, which may have significant consequences for the turnover of SOM, in particular through their effect on plants. The aim of the study was to assess different compartments of the soil – plant continuum for their response to drought stress by combining field and laboratory experiments. We focused on three common grassland species (Lolium perenne, Festuca arundinacea and Dactylis glomerata) found to constitute grasslands of the temperate climate. We investigated drought impact on (1) plant biochemistry and potential mineralization of this material in soil, (2) decomposition of aboveground plant leaf litter of different quality, (3) plant-mediated soil C fluxes including (4) soil microbial biomass and their enzyme activities in the rhizosphere.

Plant elemental and biochemical composition showed contrasting changes depending on the species in response to drought stress. The changes in elemental and biochemical composition of leaf litter, ultimately influenced its mineralization in soil. Drought stress highly modified the decomposition dynamics of litter from the three grassland species as a function of litter quality.

Moreover, drought stress resulted in significant decrease in both shoot and root biomass in monocultures, while root biomass did not change when they were grown in mixture. Under drought stress, we observed higher belowground allocation of photosynthates and the drought had reduced root-derived respiration. This resulted in significant changes of soil enzyme activities.

Our results suggested that plant species and community composition strongly influenced the drought effects in the rhizosphere. Thus, plant community composition and in particular the introduction of legumes might be used as a tool to attenuate drought stress not only because of different water use efficiency by plants, but also by their indirect effects on soil microbial activities affecting C and N cycles.