Does nitrogen-source usage and allocation of plant species change with dynamic ecosystem development? - A ^{15}N-labelling study

Vanessa Stahl, Wolfram Beyschlag, Christiane Werner

Exp. and Systems Ecology, University of Bielefeld, Germany

In the recent years, compound specific 15N-labelling are increasingly applied in ecosystem research. Especially in nitrogen limited habitats like open sandy grassland, this tool allows new insights in ecosystem processes. Dry acidic grasslands are endangered because of environmental and land use changes like enhanced atmospheric nutrient deposition which accelerates successional processes. Former works indicated that niche differentiation with respect to spatial, temporal and chemical N-uptake pattern occurs in grasslands. So far there is a general lack of knowledge about these processes and their temporal dynamics throughout succession. In order to better understand ecosystem processes we investigated the temporal and spatial variability of different N-source utilization among different plant species in dry acidic grasslands considering niche differentiation. We hypothesized that small-scale dynamics in the natural habitat may affect niche differentiation among different plant species. In three different early successional sites we investigated N-uptake patterns of two co-occurring plant species (Corynephorus canescens, Rumex acetosella) of different functional groups under natural conditions using compound specific labelling (15NO3--, 15NH4+- and 15N-13C-Glycine). We showed (1) similar N-compound preferences of both species but different uptake rates across all three successional sites, (2) species-specific differences in both biomass and N-uptake strategy and (3) marked seasonal dynamics in respect to N-uptake, N-allocation and N-source partitioning. Both species showed dynamic niche sharing across the successional stages in respect to N-source usage. Nitrate was the main N-source in the early and later successional stage, but a preference towards ammonium occurred at the cryptogam site in June. Both species increased N-uptake in the later successional stage in June, which was associated with increasing plant biomass of C. canescens, whereas R. acetosella showed no significant differences among successional stages. Nevertheless, seasonal changes in N-allocation in flowers or roots and the time of peak N-uptake differed between successional stages. Hence, we found a pronounced plasticity in the realized niches of co-occurring plant species in respect to N-compound usage. Furthermore, our results indicate that ecological niches of plant species can be dynamic and that niche sharing may occur. Compound-specific labelling provides an excellent opportunity to trace dynamic pattern in ecosystem research.