Niche complementarity for nitrogen: an explanation for the biodiversity and ecosystem functioning relationship?

ID 2106226
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Year 2006
Title Niche complementarity for nitrogen: an explanation for the biodiversity and ecosystem functioning relationship?
Journal Ecology
Volume 87
Number 5
Pages / **Article-Number** 1244-55
The relationship between plant diversity and productivity has largely been attributed to niche complementarity, assuming that plant species are complementary in their resource use. In this context, we conducted an 15N field study in three different grasslands, testing complementarity nitrogen (N) uptake patterns in terms of space, time, and chemical form as well as N strategies such as soil N use, symbiotic N fixation, or internal N recycling for different plant species. The relative contribution of different spatial, temporal, and chemical soil N pools to total soil N uptake of plants varied significantly among the investigated plant species, within and across functional groups. This suggests that plants occupy distinct niches with respect to their relative N uptake. However, when the absolute N uptake from the different soil N pools was analyzed, no spatial, temporal, or chemical variability was detected, but plants, and in particular functional groups, differed significantly with respect to their total soil N uptake irrespective of treatment. Consequently, our data suggest that absolute N exploitation on the ecosystem level is determined by species or functional group identity and thus by community composition rather than by complementary biodiversity effects. Across functional groups, total N uptake from the soil was negatively correlated with leaf N concentrations, suggesting that these functional groups follow different N use strategies to meet their N demands. While our findings give no evidence for a biodiversity effect on the quantitative exploitation of different soil N pools, there is evidence for different and complementary N strategies and thus a potentially beneficial effect of functional group diversity on ecosystem functioning.
Publisher Ecological Society of America
ISSN/ISBN 0012-9658 ; 1939-9170
edoc-URL http://edoc.unibas.ch/49366/
Full Text on edoc No;
PubMed ID http://www.ncbi.nlm.nih.gov/pubmed/16761603
ISI-Number WOS:000237552400020
Document type (ISI) Journal Article