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Livestock identity effects on belowground biomass, fine root morphology, and nitrogen allocation in pastures differing in species diversity

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In Europe, extensively managed semi-natural agricultural meadows count among the most species rich ecosystems. Over the last 50 years, a decline of these important habitats occurred due to land use intensification. Much research focusing on the relationship between biodiversity and productivity demonstrated a positive influence of species richness on aboveground productivity, nutrient retention and ecosystem stability. These positive biodiversity effects could occur via complementary resource use (e.g. by different rooting depths) and by different disturbance responses. Most research has focused on aboveground biodiversity effects ignoring the root compartment despite its importance for water and nutrient resource uptake. We investigated the impact of different livestock identities (cattle, sheep, cattle & sheep) on belowground biomass and nitrogen allocation as well as fine root morphology within two biodiversity classes in mesothrophic pastures.

Biomass and nitrogen concentrations in the aboveground parts of the plants was measure from 6 grazed plots per treatment. Root samples (< 2 mm and > 2 mm in diameter) were taken from two soil depths (0-10 cm, 10-20 cm) to investigate the specific root length and the root length density as well as the root nitrogen concentration was measured. For four target species, additional analyses of specific root length and tissue density were conducted.

Although aboveground biomass was reduced up to 80 % by livestock grazing, belowground biomass was not reduced as compared to ungrazed control plots in high diversity pastures. In the low species diversity treatment, sheep grazing significantly reduced belowground biomass. Fine root C/N ratio was lower in grazed than in not grazed plots and higher in the upper soil depth. Sheep grazing led to higher specific root lengths but fine root tissue densitiy was not affected by livestock identity.

Keywords: grassland, shoot/root ratio, fine root morphology, nitrogen, biodiversity