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How do soil texture, plant community composition and earthworms affected the infiltration rate in a grassland plant diversity experiment depending on season?

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Background and aims: In this study we analyzed the influences of plant community characteristics, soil texture and earthworm presence on infiltration rates on a managed grassland plant diversity experiment assessing the role of biotic and abiotic factors on soil hydrology.
Methods: We measured infiltration using a hood infiltrometer in subplots with ambient and reduced earthworm density (earthworm extraction) nested in plots of different plant species richness (1, 4, and 16), plant functional group number and composition (1 to 4; legumes, grasses, small herbs, tall herbs) in early summer (June) and autumn (September, October) 2011.

Results: The presence of certain plant functional groups such as grasses and legumes influenced infiltration rates and this effect enhanced during the growing season. Infiltration was significantly higher in plots containing legumes than in plots without, and it was significantly lower in the presence of grasses than in their absence. In early summer, earthworm presence and biomass increased the infiltration rates, independently of plant species richness. In October, plant species richness only affected infiltration rates in reduced earthworm plots. At the end of the growing season earthworm populations were negatively influenced by grasses and positively by legumes. In September, infiltration rates were positive related to the proportion of finer grains. The correlation disappears when removing all plots containing legumes from the sample. For all measurements the infiltration rates decreases from early summer to autumn at the matric potentials at pressure zero and -0.02 m, but not for smaller macropores at matric potentials -0.04 and -0.06m.

Conclusions: Considering infiltration rates as ecosystem function, this function will largely depend on the ecosystem composition and season, not on biodiversity per se. Our results indicate that biotic factors are of overriding influence for shaping infiltration rates mainly for larger macropores, and should be taken into account in hydrological applications.