The effect of species loss on productivity has been shown to be comparable to changes in agricultural management. However, not only productivity, but also the N cycle is relevant for food production comprising beneficial as well as threatening effects of agricultural management.

In a new study published in the March–April issue of the Soil Science Society of America Journal, a group of German researchers (www.the-jena-experiment.de) investigated the effect of grassland management on the relationship between plant diversity and N yield or soil mineral N (N\textsubscript{min}) concentrations. Grassland management comprised mowing two or four times a year in conjunction with 0, 100, or 200 kg N fertilization per hectare. These measures were applied along a gradient of plant diversity in terms of functional groups (legumes, grasses, and non-leguminous small and tall herbs; mixtures of one, two, three, or all four functional groups) and plant species numbers (mixtures of 1, 2, 4, 8, 16, 60 plant species). Two years after establishing the management treatments, plant biomass and soil to a depth of 15 cm were sampled and N concentrations in plant tissue as well as N\textsubscript{min} concentrations (sum of NO\textsubscript{3}– and NH\textsubscript{4}+) in soil were analyzed.

The highest productivity was observed under moderate management intensity (mowed twice a year and 100 kg N ha\textsuperscript{-1}), which can be attributed to the growth-stimulating fertilizer effect associated with enough time for regrowth. The absolute effect of species richness on productivity (difference between means of 16 species mixtures and monocultures) ranged between 374 and 627 g m\textsuperscript{-2} yr\textsuperscript{-1} and was greater than the absolute effect of fertilizer addition (182 and 74 g m\textsuperscript{-2} yr\textsuperscript{-1}; the difference between fertilizer application rates under the same mowing frequency). Fertilization doubled soil N\textsubscript{min} concentrations irrespective of application rates. Therefore, mixtures of several grassland species can be beneficial for increasing productivity while reducing fertilizer costs and N leaching risks.

With increasing management intensity, the positive effect of the presence of legumes on N yield and soil N\textsubscript{min} concentrations disappeared. Soil N\textsubscript{min} concentrations were not affected by plant species richness. However, plant species richness was positively related to N yield in all management treatments. In the control (mowed twice a year, non-fertilized), competition for nutrients very likely underlie plant species richness effects. The most pronounced plant diversity effect was found for the highest management intensity (mowed four times a year and 200 kg N ha\textsuperscript{-1}). Under higher management intensity, a combination of competition for light and adaption to mowing frequency seemed to be responsible for plant species richness effects. The comparable plant species richness effect in the case of competition for nutrients and for light in mixtures mowed twice a year suggests that the type of resource limitation might not be decisive for the extent of the plant species richness effect on productivity and N yield in grasslands. Instead, differences in competition intensity might be more appropriate to explain plant species richness effects along soil fertility gradients in grasslands.

The concurrence of highest N yield in high-diversity mixtures under most intensive management indicates that some plant species must have more than compensated for the N uptake of non-adapted species that did not survive frequent mowing, highlighting the value of plant diversity as an insurance against anthropogenic disturbances including management measures.


doi:10.2134/csa2015-60-4-5