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Nitrogen retention efficiency and nitrogen losses of a managed and phytodiverse temperate grassland

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In consequence of the increasing global population, it is necessary to keep N losses at the minimum while maintaining soil fertility and high yields. The goal of our study was to assess how management practices and sward functional diversity affected N losses and N retention efficiency in a temperate grassland. We measured N retention efficiency as the ratio of N losses (N2O emission and NO_3- and DON leaching) to soil available N (gross N mineralization rates). Our study was conducted in a grassland management experiment (GRASSMAN) located in Solling, Germany; the experimental design was three-factorial with two mowing frequencies (cut once and thrice per year), two fertilization treatments (180 – 30 – 100 kg NPK ha-1 yr-1 and no fertilization), and three sward compositions (dicot-enhanced swards with nearly equal proportions of dicots and monocots, control swards with $\sim$ 70% monocots and $\sim$ 30% dicots and monocot-enhanced swards with $\sim$90% monocots and 10% dicots). N2O emission and NO_3 leaching were significantly increased by fertilization and decreased by more frequent mowing. An interaction between these factors showed that frequent mowing can mitigate the negative effects of fertilization on N losses. N retention efficiency was largely influenced by fertilization and sward composition: N retention efficiencies were larger in unfertilized plots than fertilized plots, and decreased in the order of control > dicot-enhanced > monocot-enhanced swards. Microbial N immobilization turned out to be more important for N retention than plant N uptake. We concluded that over the past 5 decades the prevailing management practices have led to an equilibrium sward composition in this grassland ecosystem in which optimal proportions of monocots and dicots (i.e. unmanipulated control plots) developed to maximize N retention efficiency. Deviations from these proportions reduce N retention efficiency.