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Legumes have the potential to alter nitrous oxide (N2O) emissions in grass-legume mixtures via changes in soil N availability, but the influence of legume abundance on N2O fluxes in grazed multi-species grasslands has faced little attention to date. In this paper, a combination of 15N-labelled fertilizer application and automatic chamber measurements was used to investigate N2O fluxes and soil-plant N transfers for high- and low-density clover patches in an intensively-managed, upland pasture (Auvergne, France) over the course of one growing season. During the six-month study period, N2O fluxes were highly variable. Maximum daily N2O emission was 52 g N2O-N ha−1, and was associated with fertilizer application early in the growing season. Smaller peaks of N2O emission occurred in response to cutting events and fertilizer application later in the growing season. Nitrous oxide fluxes derived from 15N-labelled fertilizer peaked at 40% shortly after fertilizer application, but the dominant source of N2O fluxes was the soil N pool. Contrary to expectations, clover density had no significant effects on N content or patterns of 15N recovery in plant or soil mineral N pools. Nevertheless, we found a tendency for increased N2O-N losses from the low clover treatment. Furthermore, 15N recovery in N2O was higher in the low- compared to the high-density clover treatment during favorable growing conditions, suggesting transient shifts in plant/soil competition for N depending on legume abundance. Multiple regression analysis revealed that water-filled pore space (WFPS) and clover dry mass were the main factors driving cumulative N2O emissions in the high clover treatment, whereas variation in cumulated N2O emissions in the low clover treatment was best explained by WFPS and grass mass. We hypothesize that clover density had indirect effects on the sensitivity of N2O emissions to abiotic and biotic factors possibly via changes in soil pH. Overall, our results suggest that spatial heterogeneity in clover abundance may have relatively little impact on field-scale N2O emissions in fertilized grasslands.

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