Comparing greenhouse gas emissions from intensively managed grasslands and newly created species-rich grassland

Claire Horrocks

Intensive grassland management relies on the use of nitrogen fertilisers either mineral (e.g., ammonium nitrate) or organic (animal manures) to maintain high rates of productivity. The use of nitrogen fertilisers can lead to increases in emissions of the greenhouse gas nitrous oxide, which has a global warming effect nearly 300 times greater than carbon dioxide. Intensive management can also have a negative impact on plant and microbial biodiversity as high nutrient concentrations lead to dominance by rapidly growing grass species adapted to nutrient rich soils.

Under the Common Agricultural Policy farmers can receive subsidies in order to convert intensively managed grasslands into extensively managed species-rich grassland by sowing a species-rich seed mix and stopping fertiliser applications.

We compared nitrous oxide emissions (using chambers installed in the field), soil nitrogen concentrations and plant diversity and soil microbial composition on an intensively managed (IM) grassland (part of the North Wyke Farm Platform, permanent pasture treatment) with newly created species rich grassland (SRG) also sited at North Wyke and part of the Wide Scale Enhancement of biodiversity (WEB) project.

We found that high residual concentrations of soil N from previous intensive management prevented the expected decreases in nitrous oxide emissions, and continued to limit plant diversity and favour microbial communities indicative of nutrient enriched soils at least three years after creation.

The findings from this study indicate the potential limitations for short term species-rich grassland creation. Current farming subsidy schemes provide payment to farmer to maintain species rich-grassland for in the UK last for between 3 and 7 years, however the evidence from this study using the North Wyke Farm Platform and other work carried as part of the same study suggests that due to the substantial legacy effect of former intensive management on soil chemical, physical and biological properties, many decades may be required to establish species-rich grasslands that provide optimal benefits to biodiversity, greenhouse gas emissions, and nutrient cycling.

Mean (n=4 ±1 SD) N2O fluxes measured February-June 2012 from the three North Wyke IM (black line)-SRG (grey line) paired plots

Mean (n=3± 1SD) soil available N as NO3⁻-N and NH4⁺-N at North Wyke IM and SRG plots in March-June 2012.