Cattle overwintering areas in middle-European conditions – important "point" sources of nitrous oxide emissions

M. Šimek[1,2], J. Hynšt[1,2], P. Brůček[1,2], J. Čuhel[1,2], D. Elhottová[1], H. Šantrůčková[1,2] and V. Kamír[3]
[1]*Institute of Soil Biology, Academy of Sciences of the Czech Republic, Na Sádkách 7, 370 05 České Budějovice, Czech Republic, Email: misim@upb.cas.cz,* [2]*University of South Bohemia, 370 05 České Budějovice, Czech Republic,* [3]*Farm Borová, 382 08 Chvalšiny, Český Krumlov, Czech Republic*

Keywords: nitrous oxide, nitrogen, grassland, cattle, soil

Introduction Nitrous oxide (N_2O) emissions in grazed grasslands are strongly influenced by animal excreta (Fowler *et al*., 1997). In addition, soil compaction caused by animal traffic significantly influences soil physical conditions and thus directly or indirectly impacts on the microbial processes producing N_2O. In the Czech Republic pastures are mostly located in hilly and mountain areas. During the growing season, cattle are typically grazing, while during the winter the animals are concentrated near the animal house on a relatively small plot called an "overwintering area". The objective of this study was to estimate the fluxes of N_2O from a typical overwintering area, where the combined effects of soil compaction and deposition of urine and dung occur.

Materials and methods The overwintering area was at Borová Farm in South Bohemia. The area was 4 ha and it was used by 90 cows. Three microsites were identified, differing in extent of animal impact: 1 - severe impact (totally destroyed surface soil), 3 - moderate impact (visible changes in soil surface and vegetation), 5 - light to no impact (mostly unaffected soil and vegetation). Gas fluxes were determined 40 times between Oct. 2002 and May 2004 using portable chambers and samples were analysed using gas chromatography (Šimek *et al*., 2000).

Results The time course of N_2O emissions is given in Figure 1. In autumn 2002, the emissions of N_2O remained at a low "background level" for several weeks (around 5 g N/ha per d) in all microsites. They increased slightly in the middle of Nov. and again in Jan. 2003. However, substantial increases in N_2O fluxes were recorded from microsites 1 and 3 much later, in April and the beginning of May 2003, respectively. In contrast, gaseous losses from site 5 were relatively low. In late autumn 2003, peaks of N_2O emissions were found in microsites 1 and 3 indicating favourable conditions for microbial processes affecting N transformations. Large fluxes of N_2O from microsites 1 and 3 were then recorded in late spring 2004, similarly to a previous year's emission pattern. Total N_2O fluxes were estimated to be about 10, 8, and 1.5 kg N_2O-N/ha per y in microsites 1, 3, and 5, respectively.

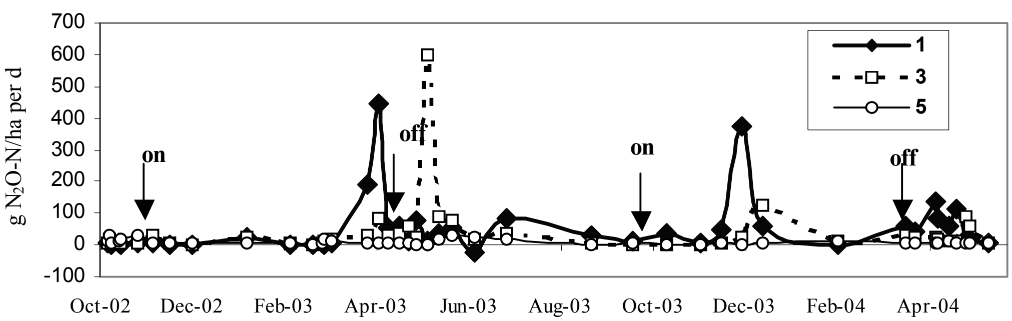

Figure 1 Fluxes of N_2O from three differently impacted microsites in a cattle overwintering area. Note: **on** and **off** inserted indicate when cattle were moved on and off the overwintering area

Conclusions These results indicate that the cattle overwintering plots, which are common in hilly areas in the Czech Republic, represent very important "point" sources of N_2O emissions. Although these specific pasture sites are relatively small, they can contribute substantially to overall N_2O fluxes.

Acknowledgements The research was supported by the EU project MIDAIR (No EVK2-CT-2000-00096) and by the Grant Agency of the Czech Republic (No 526/04/0325).

References

Fowler, D., U. Skiba & K.J. Hargreaves (1997). Emissions of nitrous oxide from grasslands. In: S.C. Jarvis and B.F. Pain (eds.) Gaseous Nitrogen Emissions from Grasslands. CAB International, Wallingford, 147-164.

Šimek, M., J.E. Cooper, T. Picek & H. Šantrůčková (2000). Denitrification in arable soils in relation to their physico-chemical properties and fertilization practice. *Soil Biology and Biochemistry*, 32, 101-110.