

Sources of nitrous oxide in organically managed grass-clover pastures



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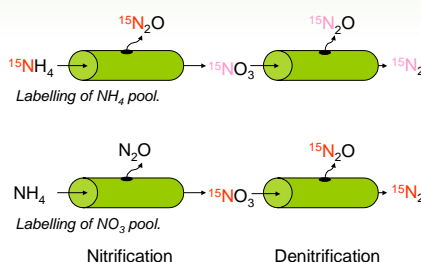
Background

Organic farming practises, and in particular dairy production systems based on grass-clover pastures are becoming increasingly abundant within Danish agriculture. Grass-clover pastures may provide a mitigation option to reduce grassland nitrous oxide (N_2O) emissions (Velthof et al. 1998).

The objectives of this work was to examine the relationship between N_2O emissions and transformations of inorganic N in organically managed grass-clover pastures of different ages. Results from the project will be used for calibration of the FASSET whole-farm nitrogen transformation model.

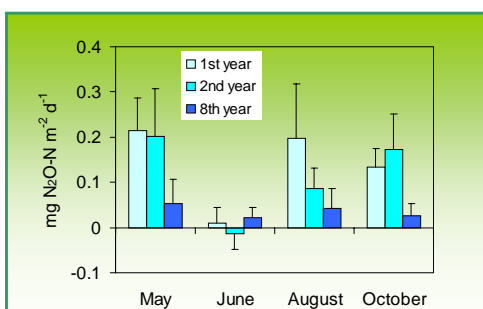


Injection of ^{15}N -labelled NH_4 and NO_3 (10 APE) in 30 cm diam. x 25 cm high monoliths of the grass-clover pastures.



Principles of ^{15}N isotopic labelling approach used in this study. The fractional contribution of nitrification and denitrification to N_2O emissions is assessed by comparison with enrichments of the NH_4 - and NO_3 -pools (data not presented).

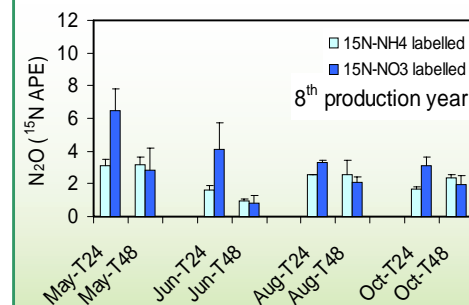
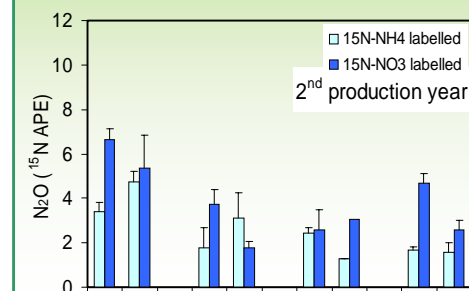
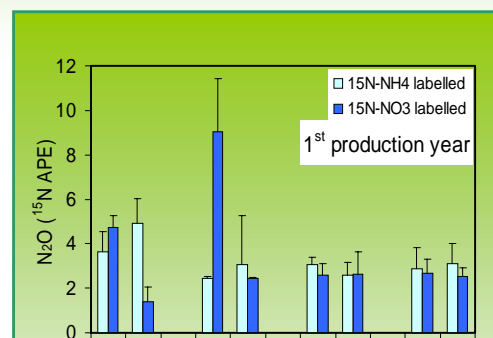
Production year	May	June	August	October	Soil inorganic N (mg N kg^{-1} soil; % as NH_4 in parenthesis). The soil is characterised as a loamy sand (Typic Hapludut).
1 st	20 (58)	25 (29)	33 (21)	28 (25)	
2 nd	15 (37)	25 (26)	26 (22)	29 (21)	
8 th	18 (41)	32 (15)	29 (18)	32 (18)	



- Emission losses of N_2O averaged $0.14 \text{ mg N m}^{-2} \text{ d}^{-1}$ in 1st production year and decreased to $0.08 \text{ mg N m}^{-2} \text{ d}^{-1}$ in 8th production year.
- The N_2O emission losses equals 0.1-0.2 % of the N-fixation measured in same plots (Eriksen and Vinther, 2002).
- The losses of N_2O among pasture age was independent of soil inorganic N. This may be explained by changes in plant-microbial competitive abilities and functioning of N_2O producing bacteria.

Conclusions

- Nitrous oxide emissions losses from organically managed grass-clover pastures were relatively small amounting to 0.8 to $0.14 \text{ mg N m}^{-2} \text{ d}^{-1}$
- The N_2O emission was less than 0.2% of the N-fixation.
- The N_2O emission decreased with increasing pasture age, independent of soil N availability
- Nitrification and denitrification both contributed significantly to the N_2O emissions.
- The proportion of denitrification vs. nitrification appeared to increase with increasing pasture age.



- Nitrogen-15 enrichments of N_2O produced in $^{15}NH_4$ and $^{15}NO_3$ labelled grass-clover monoliths. The enrichment of N_2O was measured 24 hrs and 48 hrs after ^{15}N -labelling. APE is atom percent excess.
- Nitrification and denitrification both contributed significantly to the N_2O emissions. However, from these data only it can not be determined if the contribution with $^{15}N-NH_4$ labelling is from nitrifier-denitrification or 'true' denitrification.
- The proportion of denitrification appears to exceed that of nitrification in 2nd and 8th year pastures, but is independent of time of year.

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Acknowledgements

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References

Velthof, G.L., van Beusichem, M.L. and Oenema, O. 1998. Mitigation of nitrous oxide emission from dairy farming systems. *Environmental Pollution* **102**, 173-178.
Eriksen, J. and Vinther, F. 2002. Nitrate leaching in grazed grasslands of different composition and age. Poster presented at "European Grassland Conference", May, France.

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