Sources of nitrous oxide in organically managed grass-clover pastures

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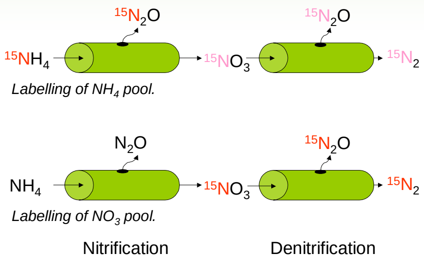
Background

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.

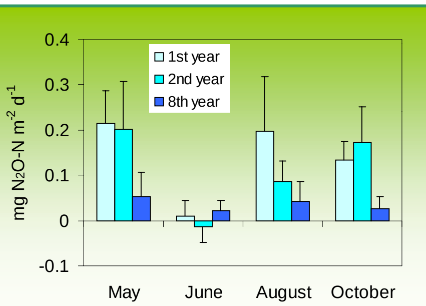
Injection of ^{15}N-labelled NH_4 and NO_3 (10 APE) in 30 cm diam. × 25 cm high monoliths of the grass-clover pastures.



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
1st	20 (58)	25 (29)	33 (21)	28 (25)
2nd	15 (37)	25 (26)	26 (22)	29 (21)
8th	18 (41)	32 (15)	29 (18)	32 (18)

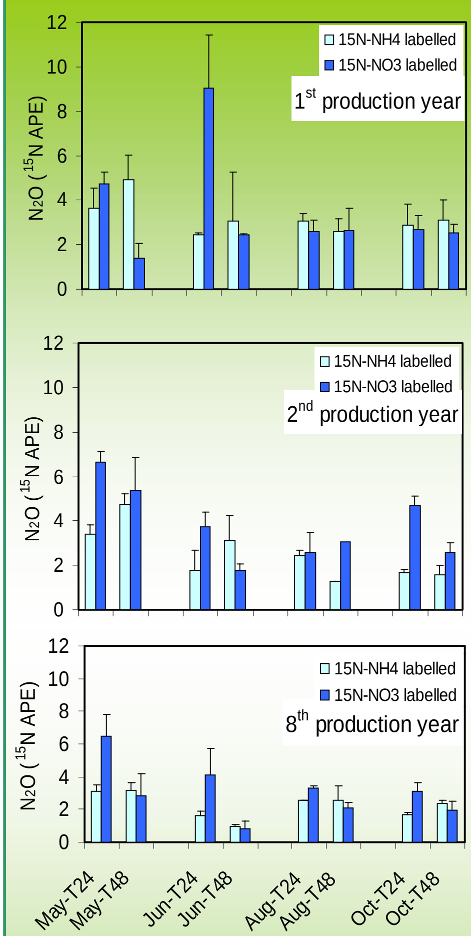
Soil inorganic N (mg N kg^{-1} soil; % as NH_4 in parenthesis). The soil is characterised as a loamy sand (Typic Hapludult).



- Emission losses of N_2O averaged 0.14 mg N m^{-2} d^{-1} in 1st production year and decreased to 0.08 mg N m^{-2} 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 mg N m^{-2} 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-NH4 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 indenpendent 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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