Is organic farming a mitigation option? – A study on N_2O emission from winter wheat

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CROPSYS

A 4-year interdisciplinary project

The overall goal is to quantify productivity and environmental impacts of different organic and conventional cropping systems across a range of soil and climatic conditions, and to identify management measures which contribute significantly to a sustainable development of the individual cropping systems.

Background

Agricultural soils is the major source of the strong greenhouse gas nitrous oxide (N_2O). In general, organic farming is regarded as a production system with low environmental impact, but it may not always be the case. Crop production in organic farming to a large extent relies on nitrogen (N) supply via decomposition of plant residue, manure and soil organic matter, which needs to be synchronised with the crop N demand in order to avoid N_2O losses. This is in contrast to conventional farming where mineral fertilizer is supplied when needed for plant growth. Statistical analyses have indicated that the N_2O emission factor is higher for manure (and presumably crop residues) than for mineral fertilizers (Lægreid and Aastveit, 2002).

Objective and experimental design

The objective of the study is to evaluate whether N_2O emissions from cropping systems are affected by 1) organic versus conventional farming, 2) proportion of N_2-fixing crops in the rotation and 3) use of catch crops. Nitrous oxide fluxes were measured in winter wheat field plots that belonged to four different long-term crop rotations at Flakkebjerg, Denmark:

C4-CC Conventional rotation without green manure and catch crops
O4-CC Organic rotation without green manure and catch crops
O4+CC Organic rotation without green manure, but with catch crops
O2+CC Organic rotation based on green manure with catch crops

Monitoring took place every second week from sowing in October 2007 to harvest in August 2008 using two-part static chambers (0.6×0.6 m^2).

Fig 1. Conventional winter wheat (C4-CC) and organic winter wheat (O4+CC) in May 2008. The crop yields in the conventionally managed plots were twice as high as in the organic plots.

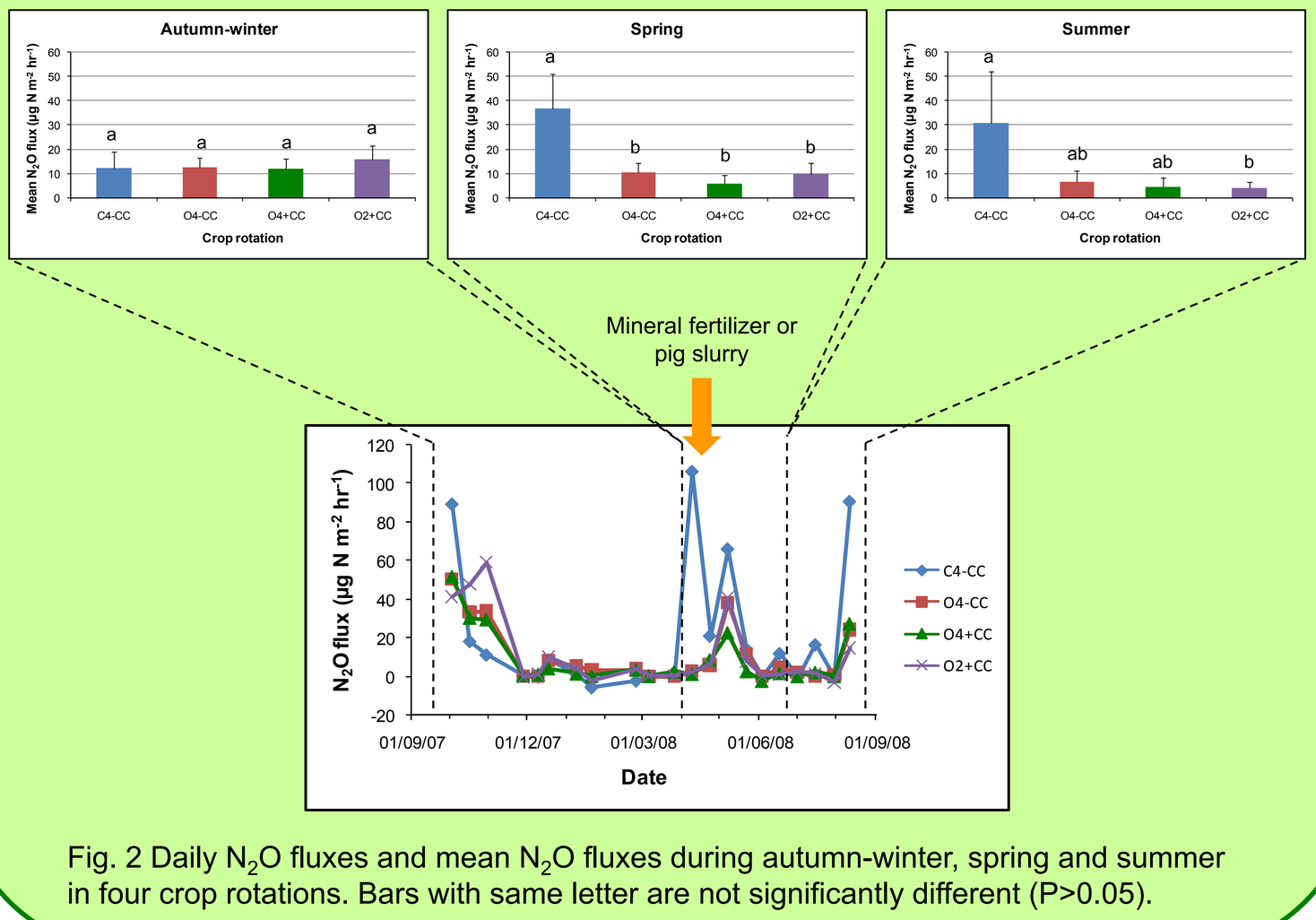

Fig. 2 Daily N_2O fluxes and mean N_2O fluxes during autumn-winter, spring and summer in four crop rotations. Bars with same letter are not significantly different (P>0.05).

Conclusions

- Organic farming could potentially be a mitigation option for atmospheric emissions of N_2O.
- During spring the N_2O emission from the conventional crop rotation (C4-CC) was higher than from the equivalent organic rotation (O4-CC; Fig. 2).
- During summer there was a tendency for a higher N_2O loss from the conventional rotation (P=0.066; Fig. 2).
- The N_2O emissions related to the production of a given amount of winter wheat was similar in the organic and conventional systems.
- The N_2O emission from the cropping systems was not affected by the presence of catch crops or by the proportion of N_2-fixing crops in the rotation (Fig. 2).

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Reference

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