Contribution of four cover crops to SOM fractions and emissions of N_2O under Norwegian conditions

Rittl, T. F.[1]; Bárcena, T. G.[2]; Farkas, É.[2]; Henriksen, T. M.[2]; Kjær, S. T.[3]; Dörsch, P.[3] and Frøseth, R. B.[2]

[1]Norwegian Centre for Organic Agriculture (NORSØK); [2] Norwegian Institute of Bioeconomy Research (NIBIO); [3]Norwegian University of Life Sciences (NMBU)

Objective

In the **CAPTURE project**, we are evaluating to what degree cover crops contribute to sequestration of carbon (C) and emission of N_2O under Norwegian conditions.

Enviromental conditions

Soil type: Artificially drained Umbric Epistagnic Retisol
Mean annual temperature: 5.7 °C
Total annual precipitation: 795 mm

Methods

Pulse labelling with ^{13}C

We pulse labelled four different cover crop species; Italian ryegrass (IR), phacelia (PH), oilseed radish (OR) and summer vetch (SV) with ^{13}C -CO_2 through their growing period. Cover crops were grown in a monoculture to ensure detectable amounts of ^{13}C.

Fig.1. *^{13}C-pulse labelling events.*

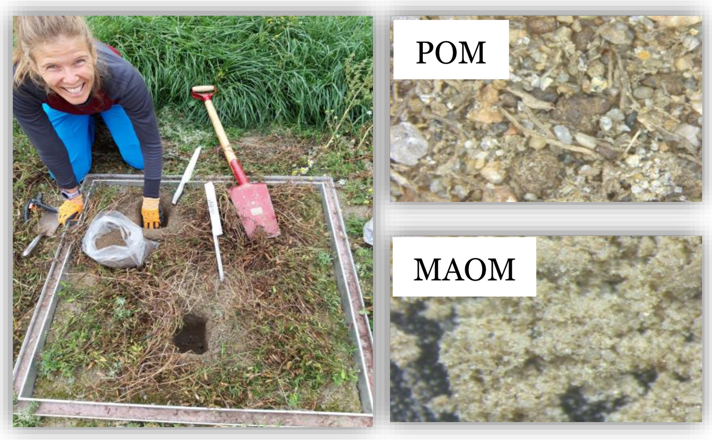

Fig.2. *Soil sampling at the end of the growing season. POM and MAOM fractions.*

At the end of the growing season, we measured how much ^{13}C was found in the soil particulate organic matter (POM) fraction and in the mineral organic matter fraction (MAOM).

N_2O emissions

In neighbouring plots, N_2O emissions from the same cover crops, grown in barley, were measured in manual chambers and with a field flux robot after threshing.

Fig.3. *Overview of the two experiments.*

Fig.4. *N_2O measurements with manual chambers(left) or robot (right).*

Preliminary results

Soil C sequestration

The results show that these cover crops allocated much more C to the aboveground than into roots and exudates. SV had the smallest percentage of ^{13}C in the belowground fractions.

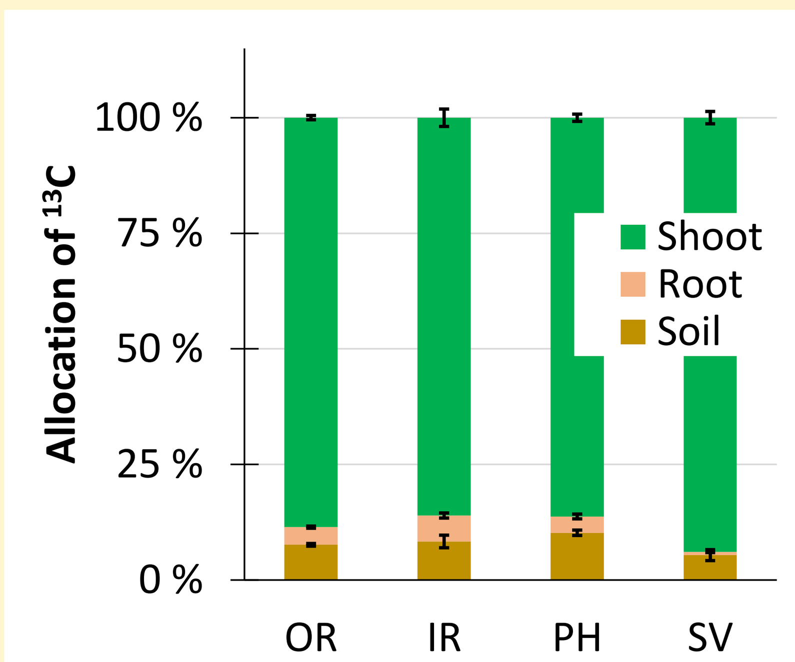

Fig. 5. *Allocation of ^{13}C to different plant fractions and soil.*

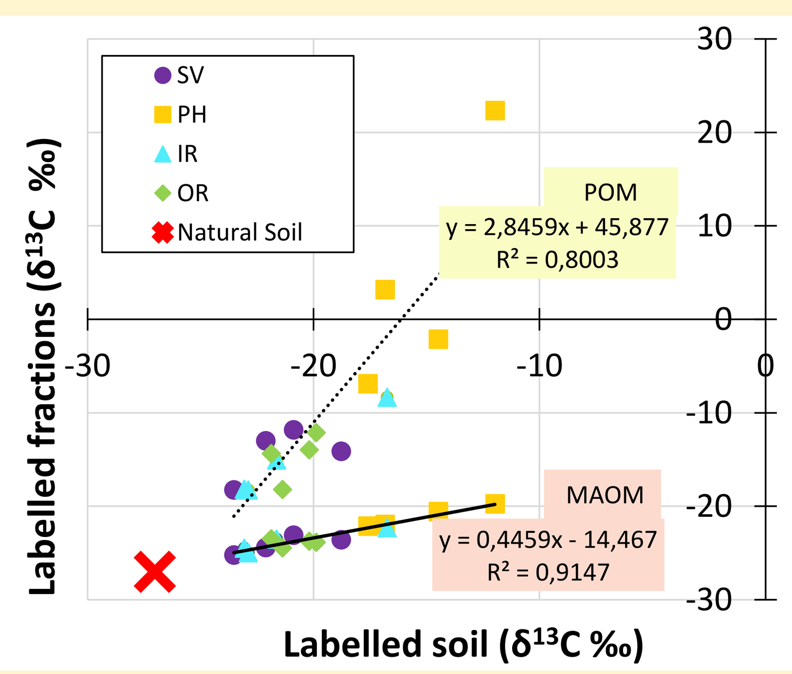

Fig. 6. *$\delta^{13}C$ in the different soil organic matter fractions. Red cross is the ^{13}C of unlabelled soil.*

At the end of the growing season, as expected, the POM fraction was more enriched with ^{13}C than the MAOM fraction. Both fractions were more enriched in the PH than in the other cover crop types.

N_2O emissions

Fluxes were highly variable over the year. High N_2O emissions during freeze-thaw cycles in spring has a major impact on total emission under our conditions.

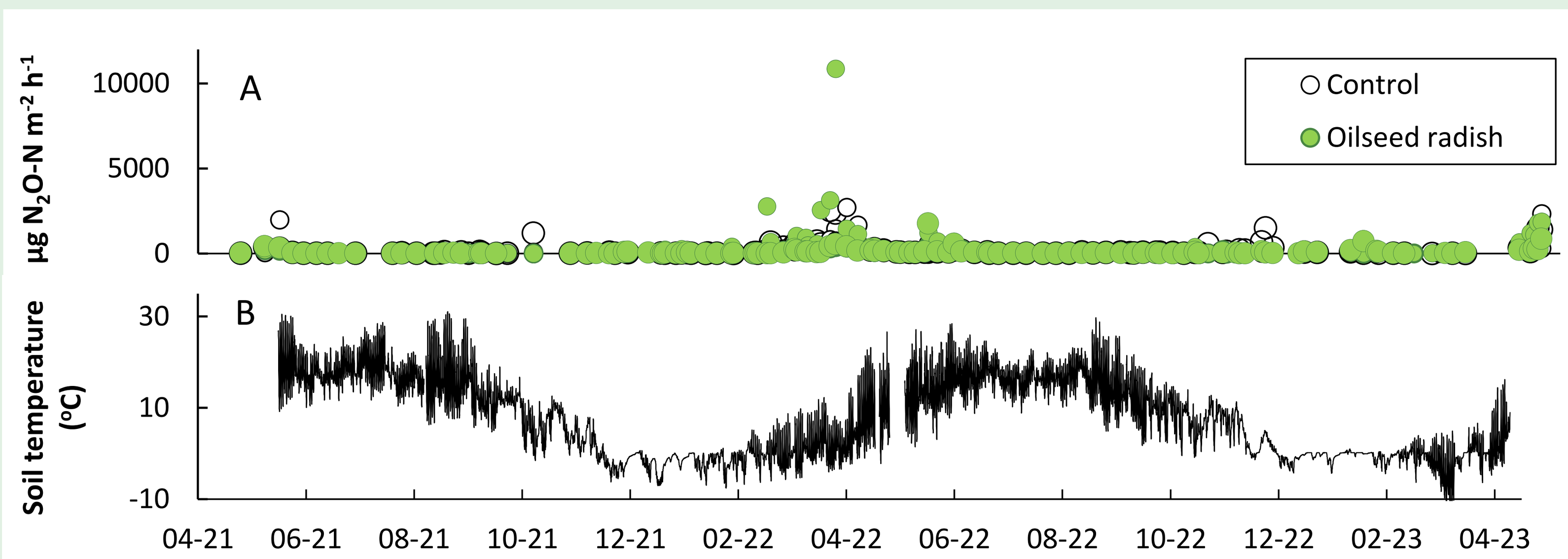

Fig.7. *A: Daily averages of N_2O fluxes measured. B: Average soil temperature at 2 cm depth measured in control plots.*

IR potentially reduces N_2O emissions, while OR tend to increase N_2O emissions during winter.

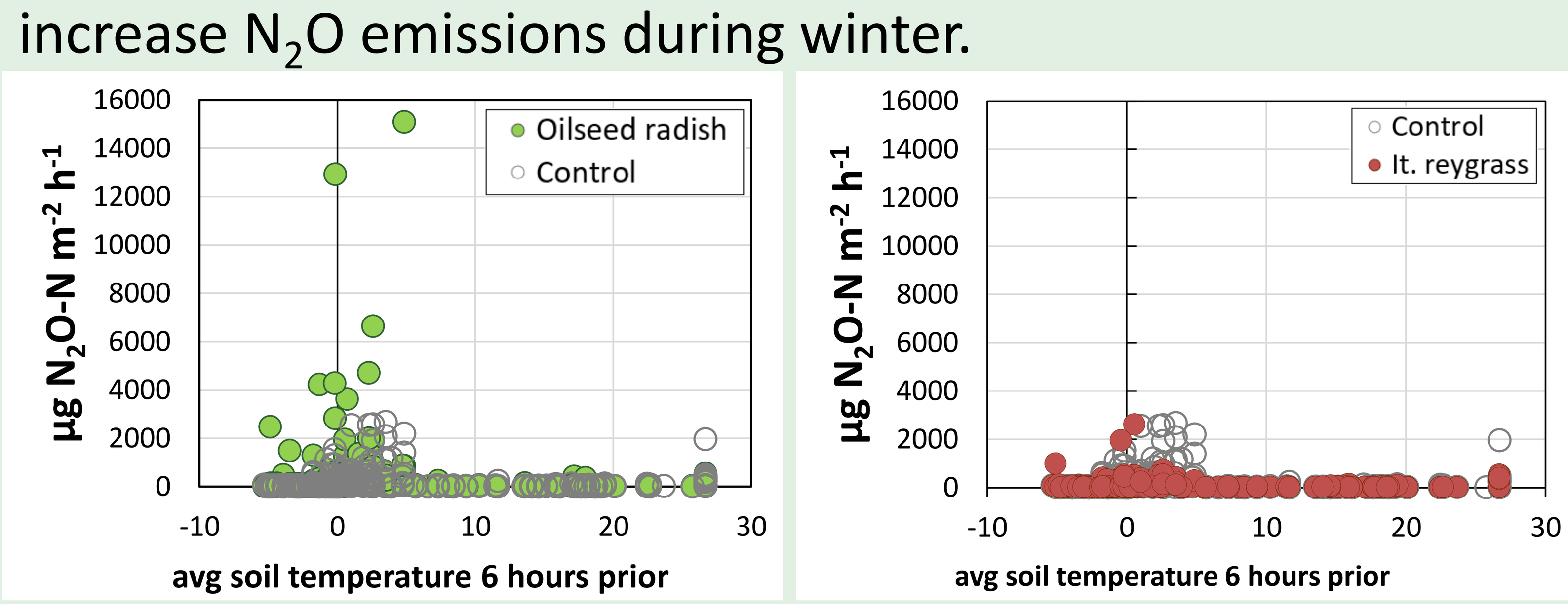

Fig.8. *Examples of N_2O fluxes as a function of preceding soil temperature. Plots including cover crops oilseed radish (left) and Italian ryegrass(right) are compared to controls with no cover crop.*

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NORSØK
Norsk senter for økologisk landbruk
Gunnars veg 6, NO-6630 Tingvoll

Tatiana F. Rittl
tatiana.rittl@norsok.no