N_2O emission and governing factors on arable fields

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Abstract

This study focuses on the soil N_2O emission of an arable field. We set up soil column experiments in laboratory and based on these findings we started field measurements in a long term tillage experiment at Józsefmajor Experimental and Training Farm, Hungary.

In this study we investigated the effects of different fertilizer doses, soil water content (SWC) and different tillage methods on soil N_2O emission.

Methods

We collected soil samples (d=10 cm, h=10 cm) in column shaped containers from mouldboard ploughing (MP) and notillage (NT) treatment from a chernozem soil.

We kept the SWC on the initial filed conditions (around 27% at MP and 29% at NT) and we applied CAN (0, 40, 80, 160, 240 kg h^{-1} N) as a fertilizer. In the figures 0. measurement day indicates the non-fertilized initial state of the samples.

For determining N_2O emission we sealed the sample columns airthightly and we used dynamic chamber method with PICARRO G2508 CRDS gas analyzer. During each measurement the incubation time was 15 minutes.

Findings

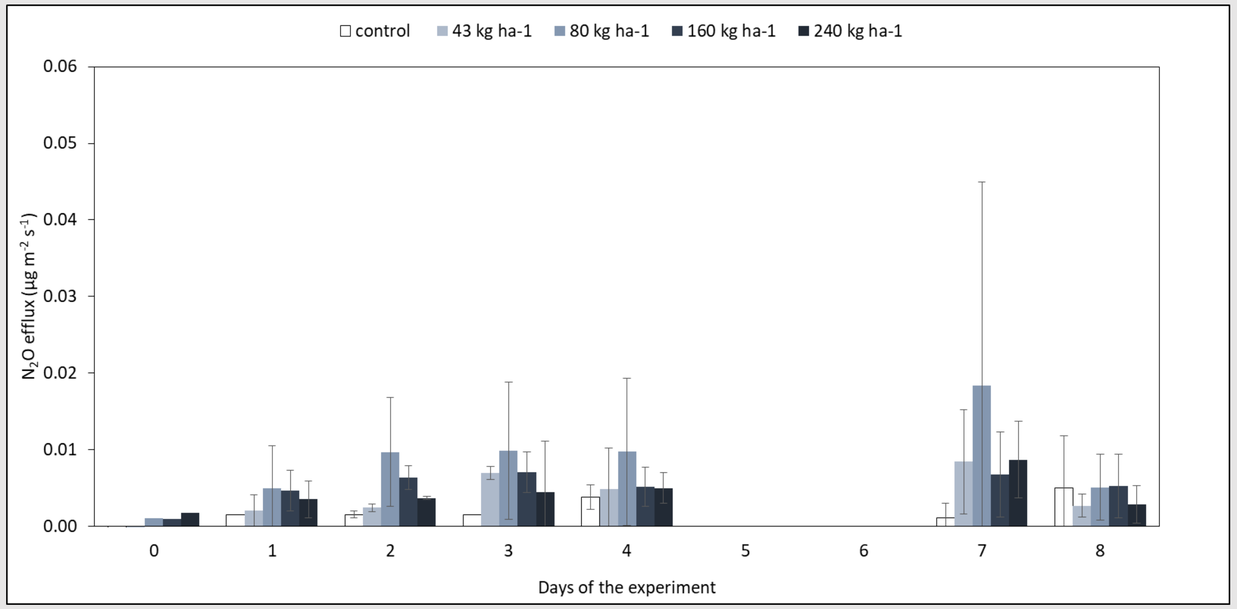

Fig 1. Different fertilizer doses experiment: After fertilizer application N_2O emission increases in MP till the 7th day of the experiment, then it decreases. Note that this experiment includes MP only. The highest mean N_2O emission (0.009±0.011 µg m^{-2} s^{-1}) occures in the treatment of 80 kg ha^{-1} N. There is significant difference between the non-fertilized control treatment and treatments of 80 kg ha^{-1} N (*p=0.041*), and 160 kg ha^{-1} N (*p=0.006*)

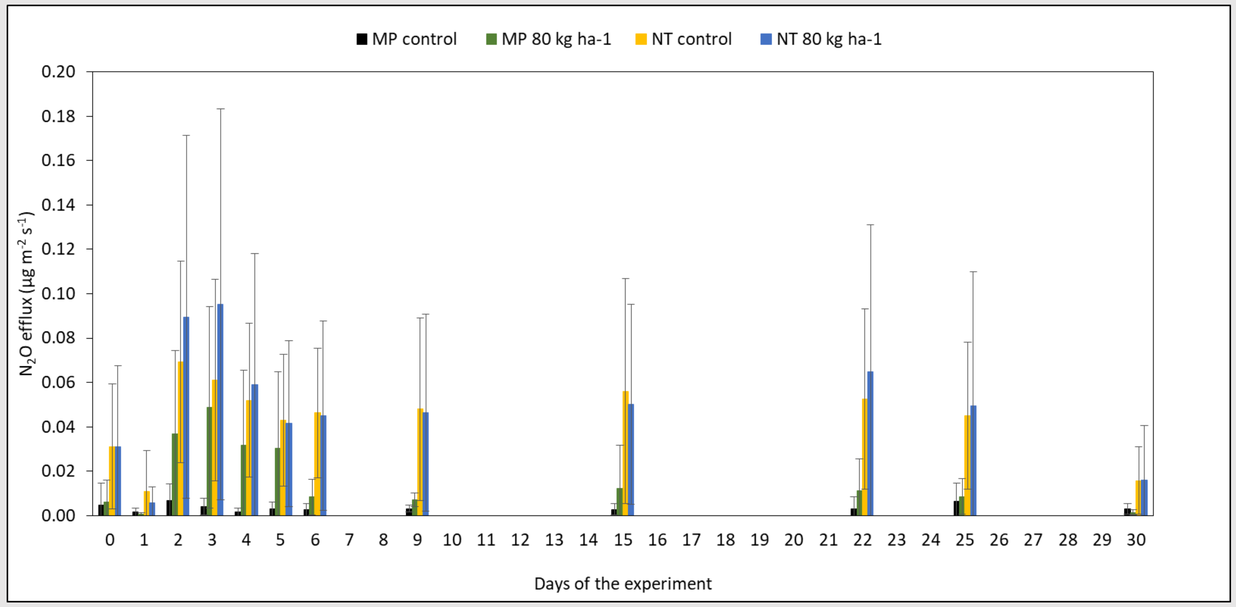

Fig. 2. Different tillage experiment: After fertilizer application N_2O emission increases in MP and NT in the first couple of days, then it decreases from the second part of the week.
The spatial variability of N_2O emission is very high, thus the standard deviation of the treatments are extremly high as well, especially in NT.
The control and fertilized NT have higher mean N_2O emissions (0.044±0.017 µg m^{-2} s^{-1}; 0.049±0.026 µg m^{-2} s^{-1}) compared to control and fertilized MP (0.003±0.002 µg m^{-2} s^{-1}; 0.017±0.016 µg m^{-2} s^{-1}). There is significant difference between control and fertilized MP (*p=0.014*), and between all MP and NT (*p=0.000-0.002*). There is no difference between control and fertilized NT (*p=0.573*).

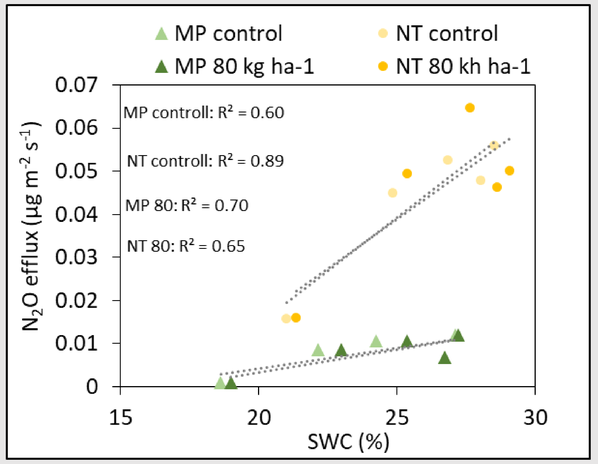

Fig. 3. SWC dependency experiment: MP has lower SWC than NT in case of every measurements similarly to field conditions. The correlation between SWC and N_2O emission is fairly strong and positive (r^2=0.89) in case of control NT treatment and moderately positive in case of the rest of the treatments (r^2= 0.60-0.70).

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