



# Nitrous Oxide Emission from high productive grassland as a function of soil compaction and nitrogen fertilization

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## 1. Introduction

- Soil compaction induces a reduction of macropores → increasing N<sub>2</sub>O emission (Sitaula & Hansen, 2000; Yamulki & Jarvis, 2002)
- High nitrogen fertilization → increasing N<sub>2</sub>O emission (Breitenbeck & Blackmer, 1980; Velthof et al, 1997)
- Lack of studies dealing with the simultaneous analysis of soil compaction and high fertilizer input on grassland
- Aim of this study: Calculation emissions of CO<sub>2</sub>equivalents for a grassland site in Northern Germany with regard to N<sub>2</sub>O emission induced by soil compaction and N fertilization

## 3. Results:

- 2007: dry spring → no increase of daily N<sub>2</sub>O emissions caused by soil compaction in spring (fig. 1, left); humid weather in summer → increase of daily N<sub>2</sub>O emission in all treatments.
- 2008 and 2006: humid spring → soil compaction causes a considerable reaction of the daily N<sub>2</sub>O emissions in the high fertilized treatments (fig. 1, right; 2006 data not shown, similar to 2008).
- In every experimental year N-fertilization in combination with soil compaction causes high cumulative N<sub>2</sub>O emissions (fig. 2). Due to the combination of dry spring and humid summer in 2007 high N<sub>2</sub>O emission where caused by the N-fertilization.
- Due to a high proportion of alfalfa the DM-yields of the not fertilized plots were not statistically different from those of the fertilized treatments (data not shown).

## 2. Method:

Experimental site: experimental station „Hohenschulzen“ (University of Kiel) in Northern Germany; mean annual temperature 8.3°C, mean annual precipitation 777mm  
 Soil texture: sandy loam – loamy sand  
 Uniform multispecies grassland with three cuts per year  
 Experimental design:  
 split-plot factorial design  
 Experimental years 2006, 2007 and 2008  
 3 replicates

### Treatments:

- **controlled soil compaction:** a. control = zero soil compaction  
 b. soil compaction (= contact area pressure 228 kPa) in early April
- **N fertilization** a. 0 vs b. 360 kg N ha<sup>-1</sup> as calcium ammonium nitrate
- Year of initial controlled soil compaction (2006, 2007 & 2008)



N<sub>2</sub>O emissions were measured using the Close-Chamber-method (Hutchinson & Mosier, 1981); daily / weekly measurement

Cumulative N<sub>2</sub>O measurements were calculated by linear interpolation between daily/ weekly data

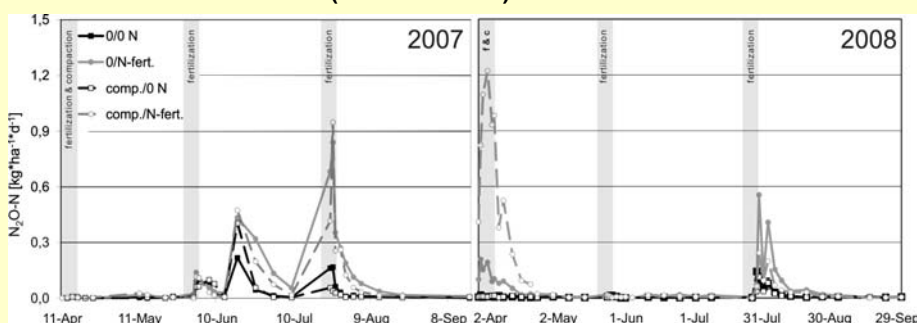


Figure 1: N<sub>2</sub>O-flux [kg N<sub>2</sub>O-N ha<sup>-1</sup> d<sup>-1</sup>] during the measuring period (Apr. to Sept.); the vertical bars represent the combined treatments of soil compaction and N fertilization

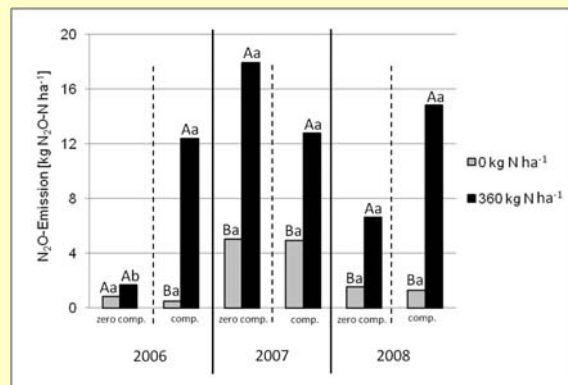


Figure 2: Cumulative nitrous oxide emissions [kg N<sub>2</sub>O-N ha<sup>-1</sup>] for soil compaction and N-fertilization treatments in 2006-2008; Capital letters indicate a significant difference due to the fertilization, lower cases indicate a significant difference due to the soil compaction

## 4. Conclusion

- With respect to N<sub>2</sub>O emissions on grassland soil compaction has to be avoided especially under wet soil conditions and simultaneous high N-application

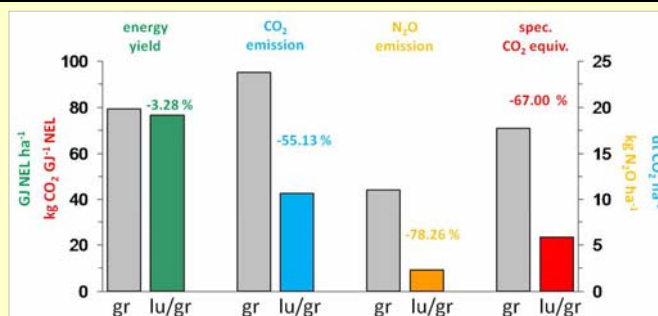


Figure 3: Calculation of CO<sub>2</sub>equivalents per unit net energy for the different N fertilization treatments; gr = high N fertilized grassland, lu/gr = zero N fertilized, lucerne dominated grassland; N<sub>2</sub>O emission calculated under the assumption of soil compaction of 50 % of the area.

- Fig. 3 shows the calculation of specific CO<sub>2</sub> equivalents based on energy yield, CO<sub>2</sub>- and N<sub>2</sub>O- emissions: the nitrogen fertilized treatment emits 67% more CO<sub>2</sub> equiv. per unit harvested net energy than the unfertilized treatment.