NitriKlim
Bewertung von Nitrifikationsinhibitoren als Klimaschutzmaßnahme

THÜNEN

Site-differentiated assessment and efficacy of nitrification inhibitors as a climate mitigation measure in crop production: the joint project 'NitriKlim'

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Background

- Agriculture is responsible for about 80% of the total **nitrous oxide (N_2O)** emission in Germany with application of synthetic and organic **fertilizers** being the main sources of N_2O.
- **Nitrification inhibitors (NI)** inhibit the transformation of fertilizer ammonium to nitrate, thereby **reducing** direct **N_2O emission** by nitrification and denitrification and indirect N_2O emission from nitrate leaching (Fig. 1).

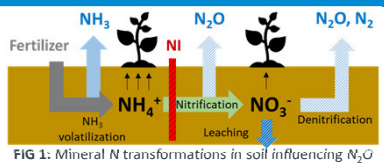

FIG 1: Mineral *N* transformations in soil influencing N_2O formation and postulated effects of NIs

Objectives

Nitrification inhibitors could potentially be recommended as climate protection measure on a national scale. However, there are some open questions with regard to the precise potential of **N_2O emission** reduction, to **crop production and economic outcome**, and **environmental issues**.

Research questions and experimental approaches

Assessing reductions in N_2O emission

Reduction of N_2O emissions at different sites?
- Field experiments at seven sites in Germany (Fig. 2; ● wheat and ○ brokkoli)

Relevant reduction effect on an annual basis?
- Whole-year N_2O measurements

Effectiveness of different NIs?
- Comparison of available NIs in field + lab incubation experiments (DMPP, DCD+ATC, MPA, DMPSA, Nitrapyrin, 2-NPT)

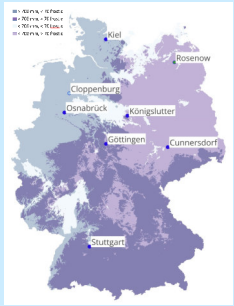

FIG 2: Field exp sites, data based on German Weather Service 1991-2020

Long-term effects of repeated NI application, including efficacy of newly applied NIs?
- Field experiments at seven sites in Germany with 3-year crop rotations and repeated application of NI (Fig. 2, ●, ●)
- Nitrification potential in the soil after 3 years
- Lab incubation experiment including soils with long-term NI application history

Effects on nitrate leaching and associated indirect N_2O emissions?
- Modelling of nitrate leaching at field experimental sites
- Leaching experiments with soil columns simulating heavy rainfall

Assessing crop production and economic outcome

Effects on crop yield and quality?
- Yield and quality assessments in field experiments + literature data

Simplified fertilization management with NIs?
- Effects of less N doses on yield and nitrogen uptake

Economic outcome of using NIs?
- Cost calculations based on field experimental management data

Level of acceptance among farmers?
- Acceptance analysis by questionnaire for farmers

Assessing environmental concerns

Negative impacts on soil microbial communities?
- Soil microbiome analysis from field experiments

Risk of NI leaching to the ground water?
- Leaching experiments with soil columns of contrasting texture
- Modelling of the leaching process for different NIs

Stimulation of ammonia or methane emissions?
- NH_3 emissions measurements after fertilizer (slurry) application
- CH_4 emissions are measured along with N_2O

Anticipated results

- **Assessment of efficacy of NIs** on direct and indirect (gaseous NH_3, nitrate leaching) N_2O emissions from fertilizers
- Integration of **NI effects** in the **national greenhouse gas reporting**
- **Regionalized concepts** for application of NI in crop production
- **Evaluation of environmental risks** connected with use of NI

Project partners

1. Thünen Institute of Climate-Smart Agriculture, **Braunschweig**
2. Thünen Institute of Biodiversity, **Braunschweig**
3. Georg August University **Göttingen**, Plant Nutrition
4. Christian-Albrechts-University **Kiel**, Agronomy and Crop Science
5. Martin Luther University **Halle** with SKW, **Cunnersdorf** testing site
6. **Kassel** University, Environmental Chemistry
7. **Osnabrück** University of Applied Sciences
8. Julius Kühn-Institute of Crop and Soil Science, **Braunschweig**
9. **Hohenheim** University, Department of Fertilization and Soil Matter Dynamics

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