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Effects of nitrification inhibitor *nitrapyrin* on urea-based fertilizers in a Mediterranean calcareous soil; N dynamics and microbial functional genes.

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90 YEARS+ auth
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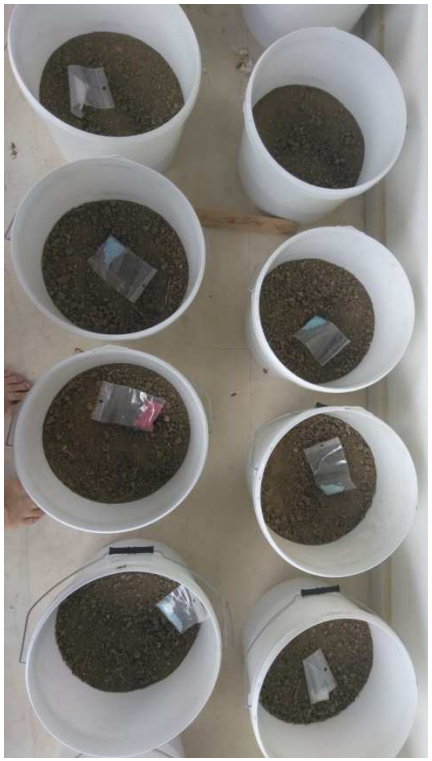
Introduction

Nitrogen fertilization is an important agronomic practice that secures and increases yields, with >100 million tons applied each year.

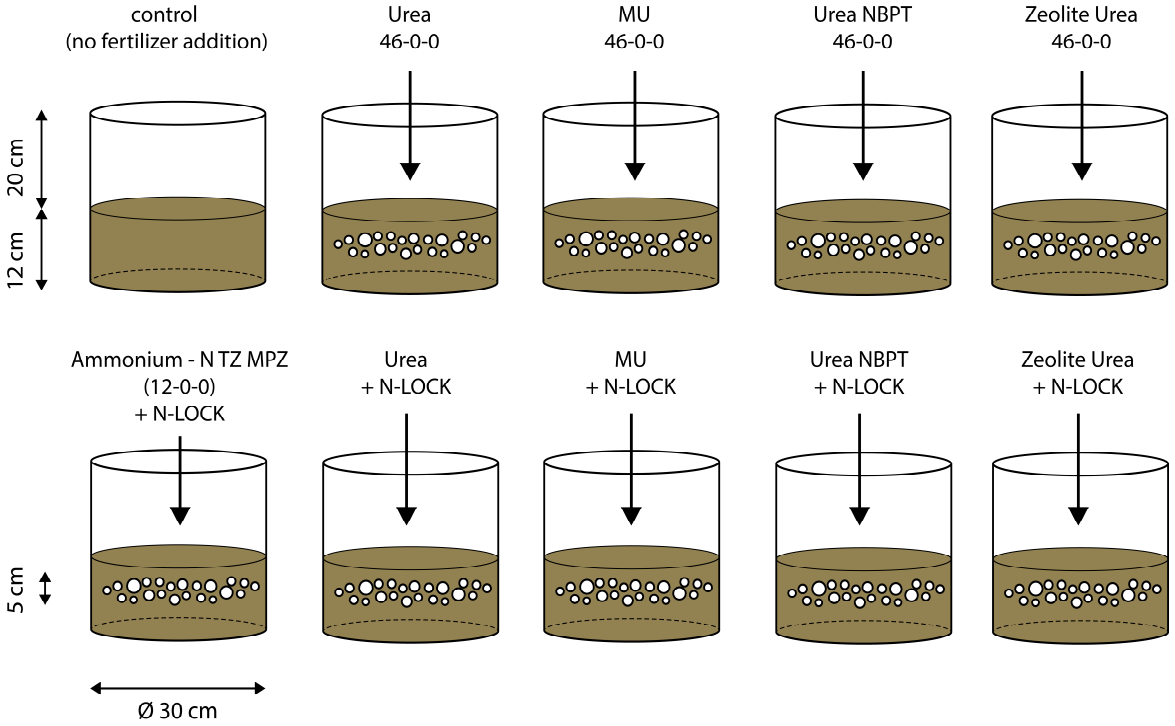
Nitrification inhibitors (NI) block the process of nitrification, resulting in a temporal increase of NH_4+ in the soils. For that reason NI are increasingly co-applied as a sustainable agricultural practice.

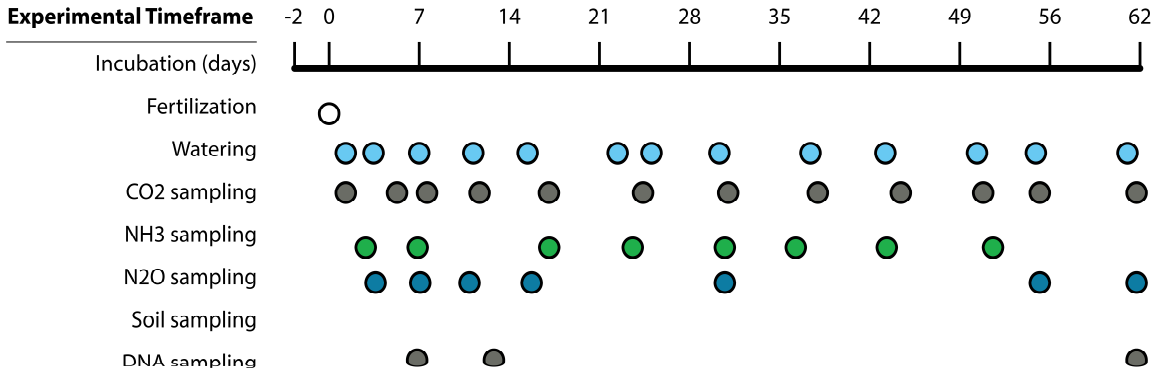
In a 60 day soil mesocosm experiment, we investigated the effects of Nitrapyrin (NI; 2-chloro-6-(trichloromethyl)pyridine) co-applied with a selection of urea-based fertilizers: urea (U); U with urease inhibitors (U+UI); methylene-urea (MU); and zeolite-coated urea (ZU), on a typical Mediterranean soil.

Experimental Setup



- 7 kg soil
- 4 replicates
- 5 g urea / 18 g AN
- Fertilizer at 5 cm below surface
- ~ 60% WFPS



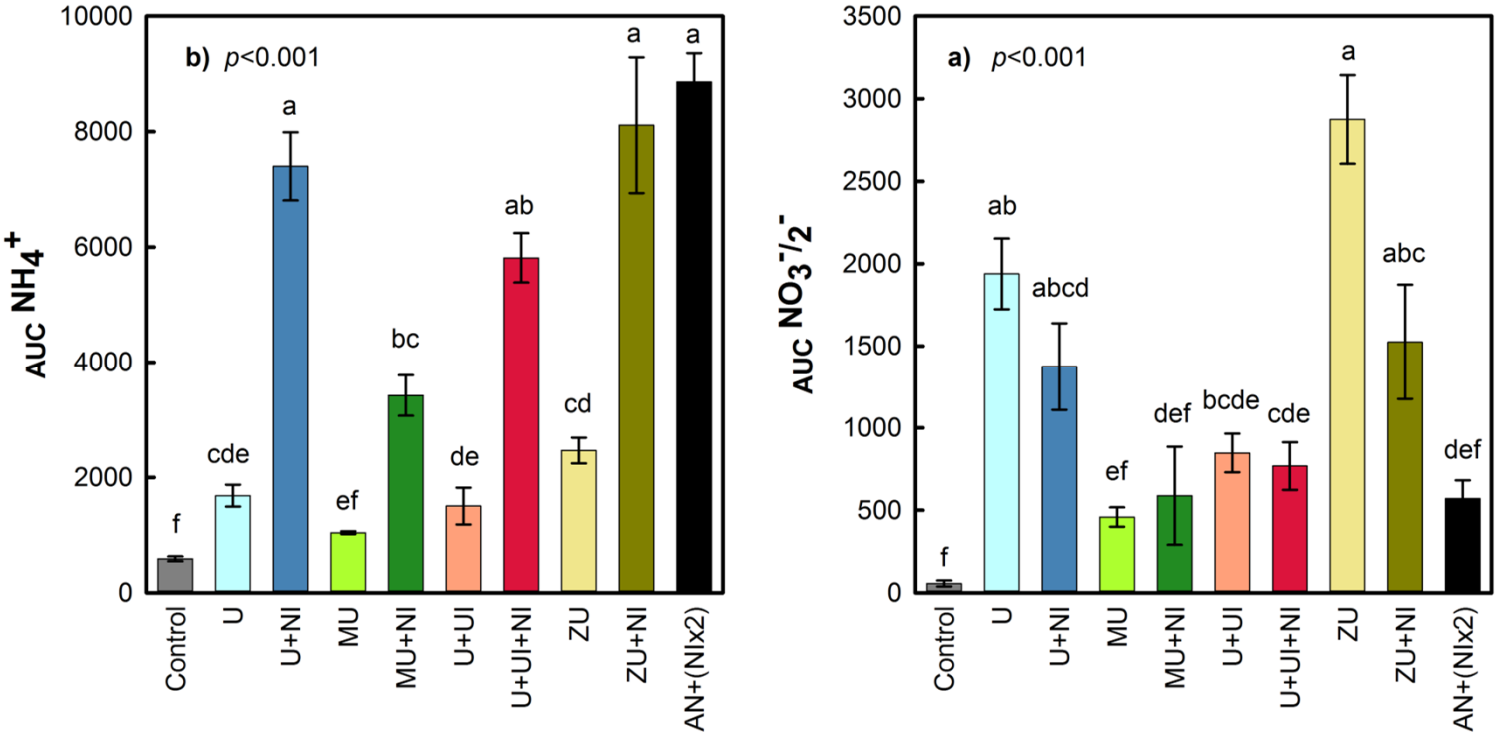


Soil NH_4^+ and $NO_3^-/_2^-$

Typical nitrification – denitrification pattern was observed, just after rapid urea hydrolysis (<5 d)

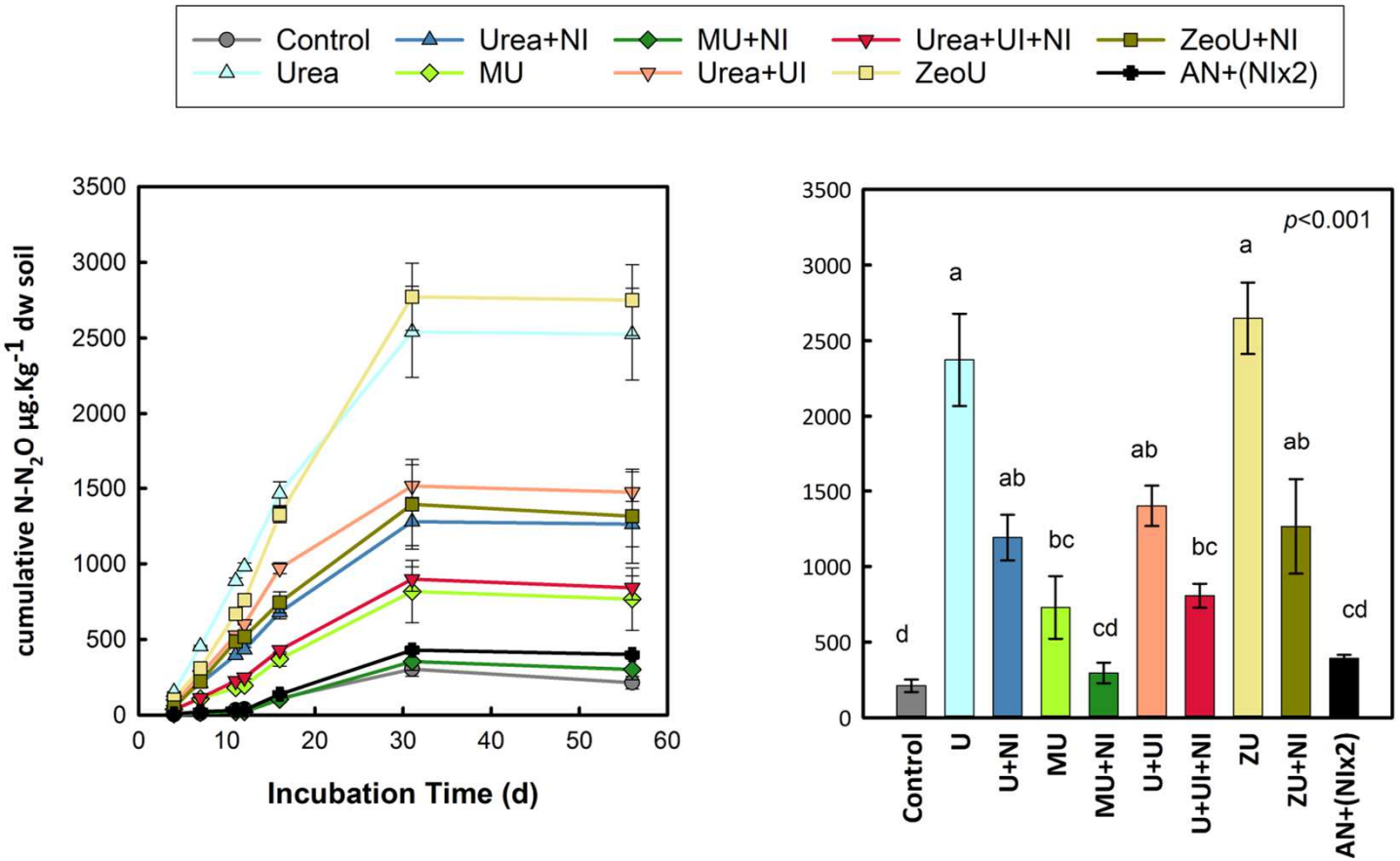
Integrated measurements (area under the curve) of soil NH_4^+ and $NO_3^-/_2^-$ showed that:

- NI retained NH_4^+ for a longer period (1.3 to 3.3 fold) in the mesocosms.
- there were lower levels of $NO_3^-/_2^-$ with NI, except MU+NI and U+UI+NI



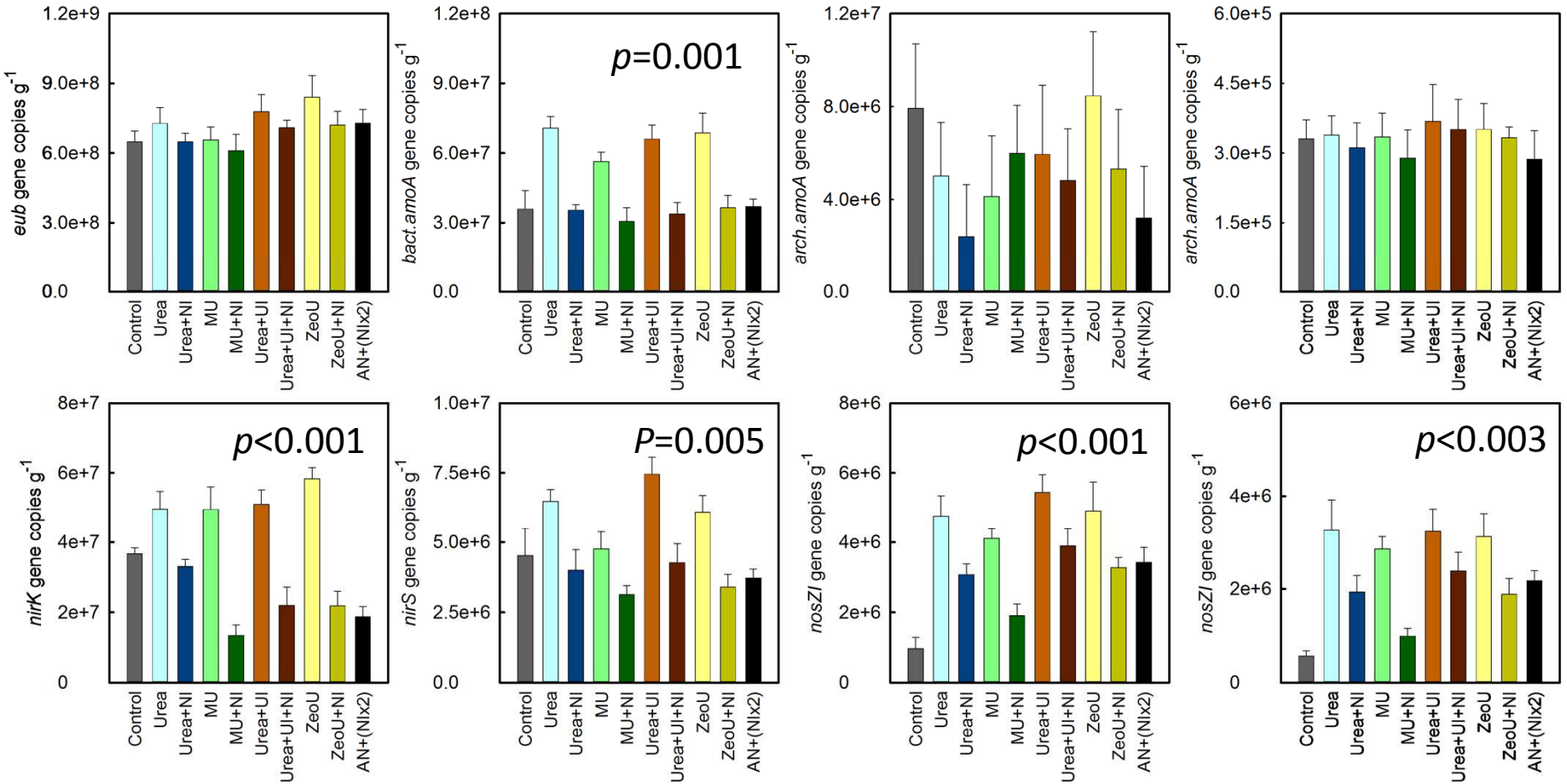
Gas emissions of CO_2, N_2O and NH_3

- No significant differences in C mineralization (CO_2) and total C were found
- Higher cumulative NH_3 emissions were observed in treatments receiving NI
- Soil N_2O emissions were reduced by 40% with UI, 50% with NI, and 66% with NI+UI.



Microbial group abundance (qPCR) at 14 d

- No change in overall microbial abundance, however:
- Less ammonia oxidizing bacteria (*amoA; p=0.001*)
- Less denitrifying microbes (*nirK*, *nirS*, *nosZI* &*II p<0.05*) with NI



Research Highlights

- Nitrification inhibitor (NI; nitrapyrin), retained NH_4+ for a longer period in the soil
- Higher cumulative NH_3 emissions were observed in treatments receiving NI
- No differences in C mineralization (CO_2) and total C were found among all treatments
- NI suppressed N_2O emissions in all fertilizer types (Urea, Urea+NBPT, MU, Zeolite-Urea)
- Fertilized mesocosms had higher total N (+ 500 mg Kg^{-1}) than the control
- No change in overall microbial abundance (*eub*)
- Less ammonia oxidizing bacteria (*amoA; p=0.001*) with NI
- Less denitrifying microbes (*nirK*, *nirS*, *nosZI* &*II p<0.05*) with NI

For any further questions, suggestions or collaboration ideas please contact me:

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Thank you and stay safe!!!