The effect of nitrification inhibitors on wheat crop performance on coarse-grained soils in Mediterranean environments

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Outline

- Role of nitrification inhibitors (NIs) in agriculture.

- Aims and objectives.
- Study design.

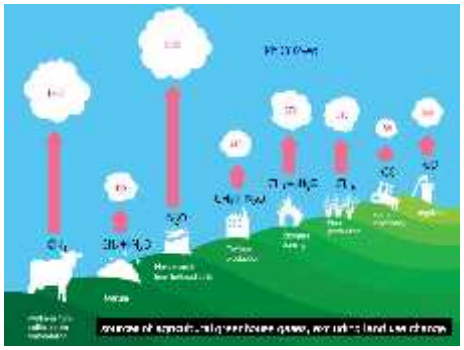
- Laboratory Studies.
- Glasshouse pot trials.
- Field trials.

- Conclusions & future work.

- Acknowledgements.
- Questions.

Role of nitrification inhibitors in agriculture

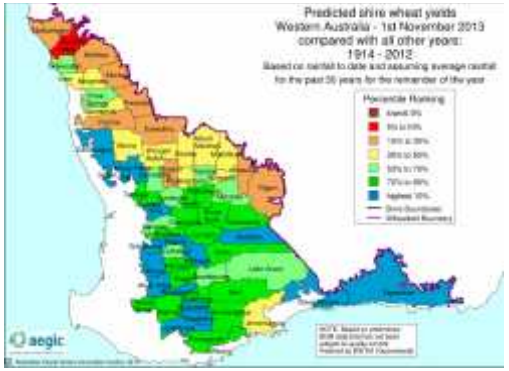
- N fertilisers essential aspect of modern agriculture.
- For most crops accumulation of N is inefficient <50%.
- N losses detrimental – environmentally & economically.



- Nitrification inhibitors (NI) (e.g. DMPP, DCD, Nitrapyrin) means to limit N losses.
- Inhibits AMO enzyme in ammonia oxidising microorganisms (bacteria & archaea).
- Stops conversion of $NH_4^+ \rightarrow NO_2^-$.
- NH_4^+ less mobile than NO_3^- → retained in soil.
- **Use in agriculture remains uncertain.**

Aims and objectives

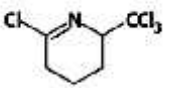
- GRDC funded project.
- Improving nitrogen use efficiency (NUE) in the Western Australian (WA) wheatbelt.
- Is there a role for NIs in these cropping systems?
- How do NIs influence ammonia oxidiser populations?
- **Why WA wheatbelt?**



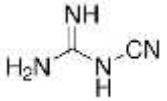
- Provides ≈50% of Australia's wheat crop (+ considerable canola & barley).
- Mediterranean climate (cool, wet winters → hot, dry summers, 350-500 mm annual rainfall).
- Predominantly coarse-grained soils (deep sands or sand/clay duplex).
- Low organic C (≈1%), acidic (pH 4-6).

Laboratory Incubations

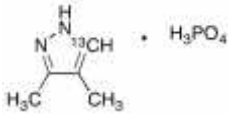
2 Wheatbelt soils



Nitrapyrin



Dicyandiamide (DCD)



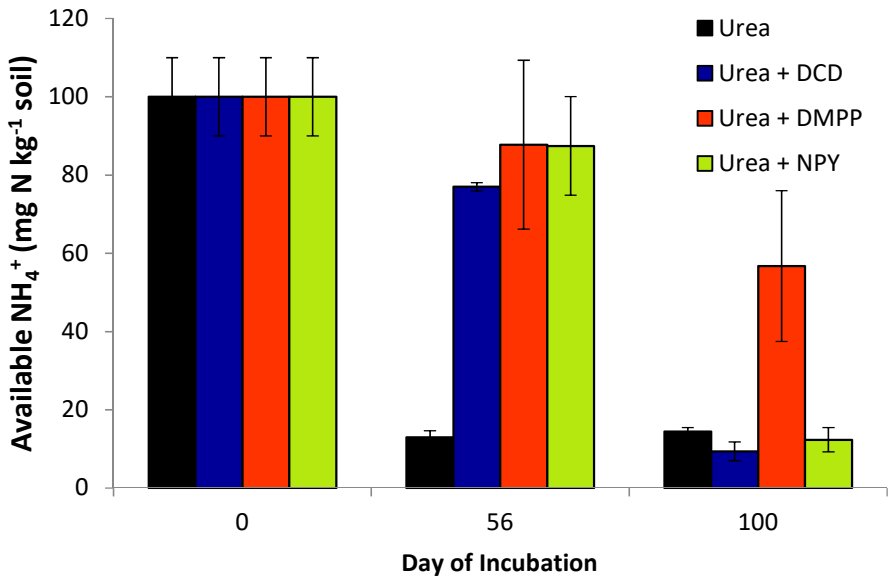
3,4, dimethylpyrazole phosphate (DMPP)

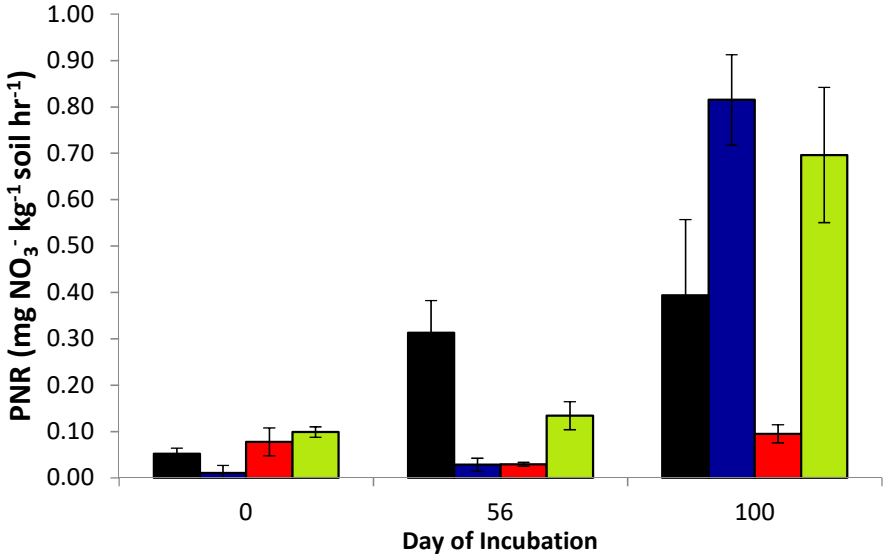
4 fertiliser treatments (100 mg N kg^{-1} soil)

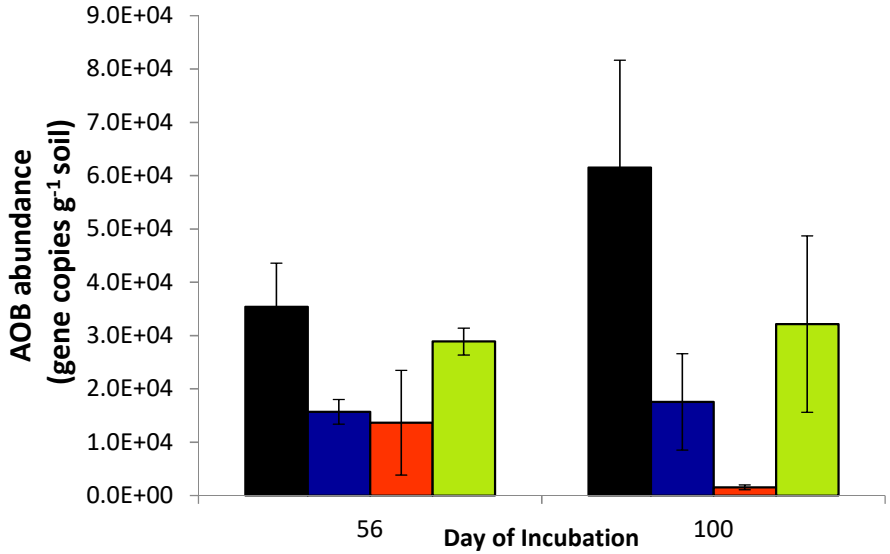
Laboratory Incubation (20 °C, 100% field capacity, 100 days)

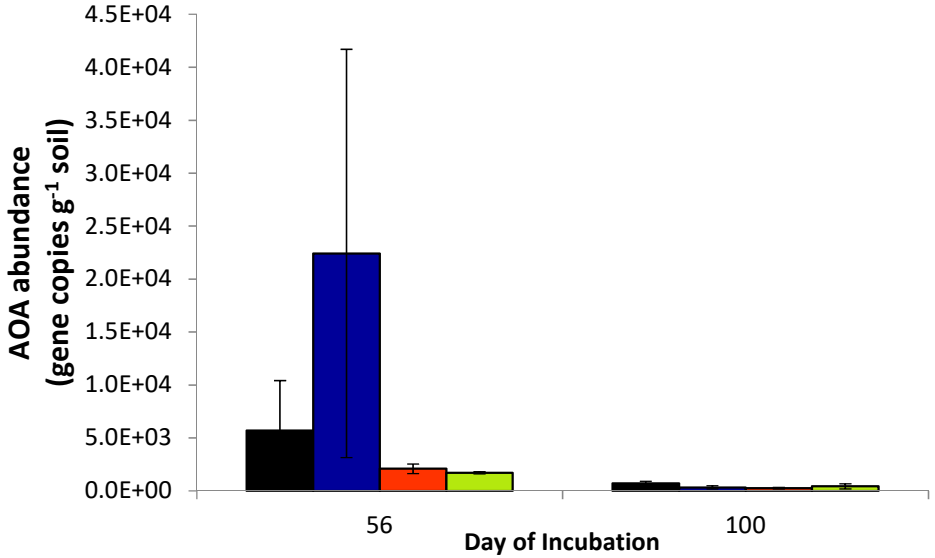
N species, PNR, AOA/AOB abundances measured

Laboratory soil incubations



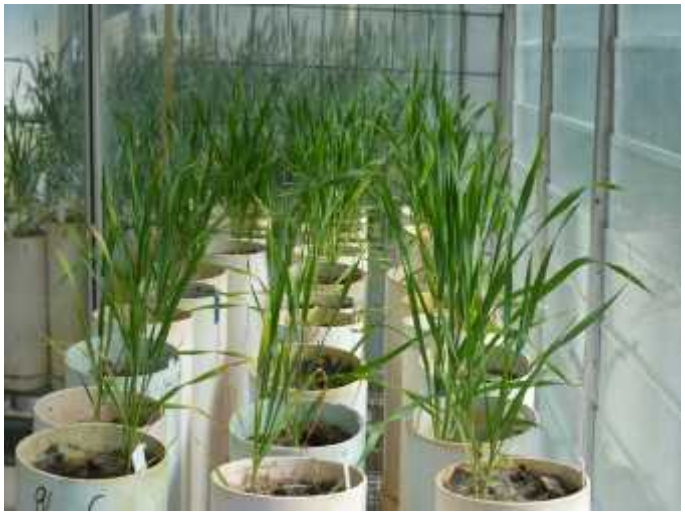






Glasshouse pot trials

2 Wheatbelt soils

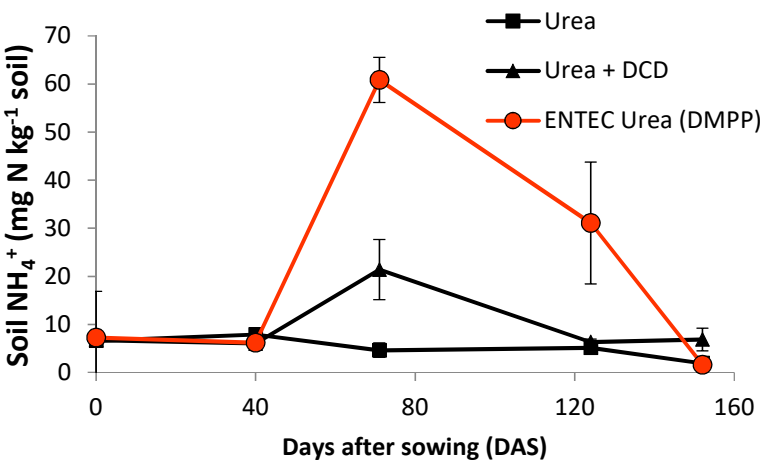


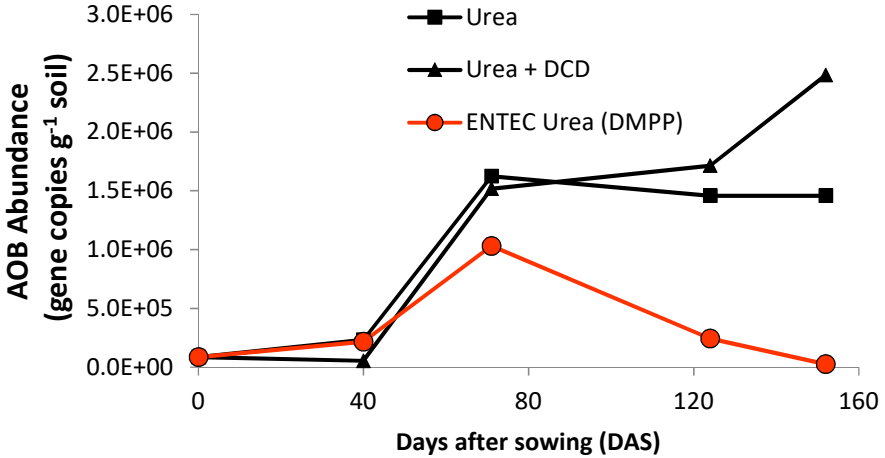
Wheat - *Triticum aestivum cv.* Mace

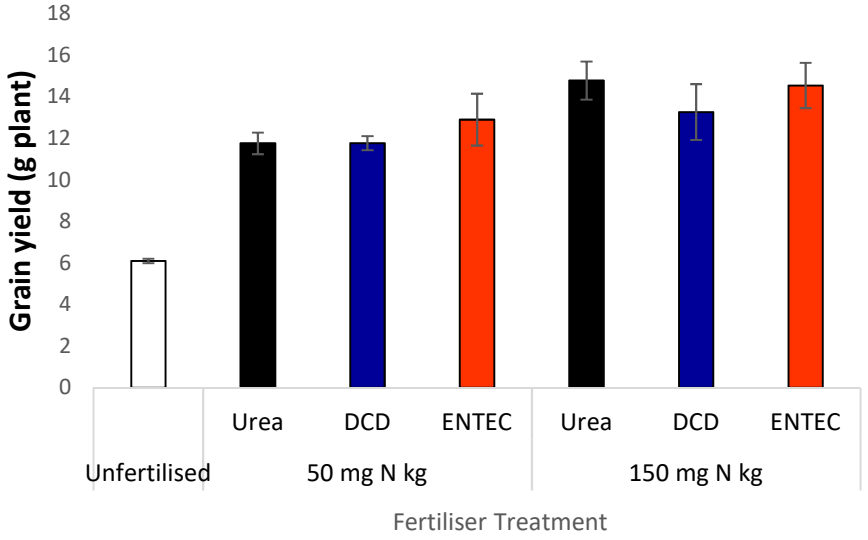
3 N fertilisers - Urea, DMPP, DCD
2 rates (50 & 150 mg N kg^{-1} soil)

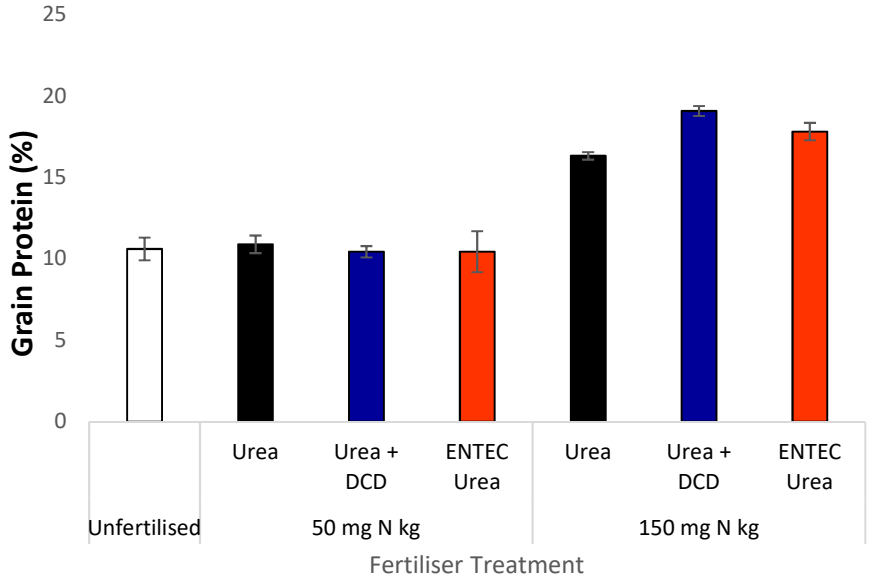
Grain yield, protein (%) and NUE determined

Glasshouse pot trials



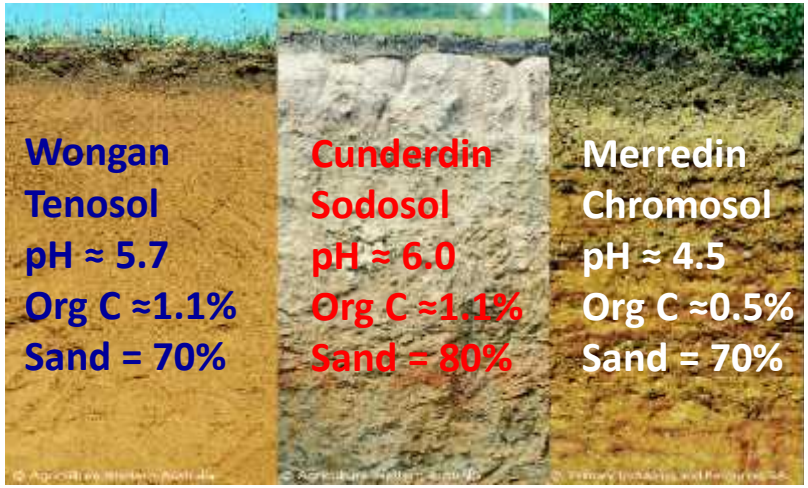






Field Trials

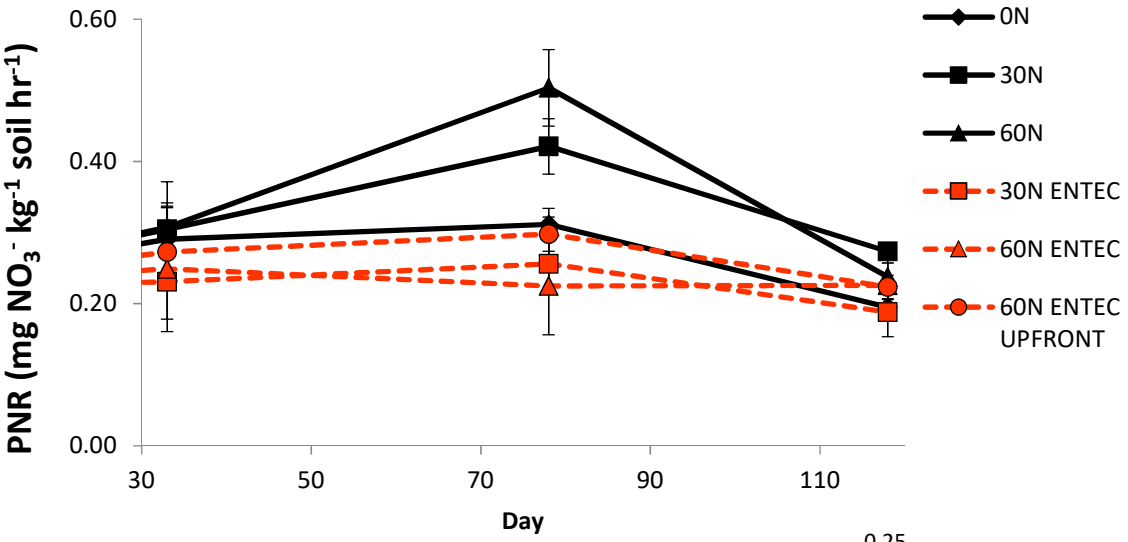
Triticum aestivum cv. **Mace – 80 kg ha^{-1}**

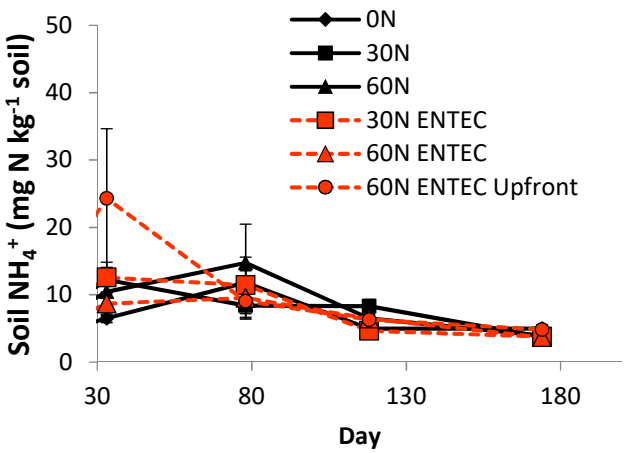


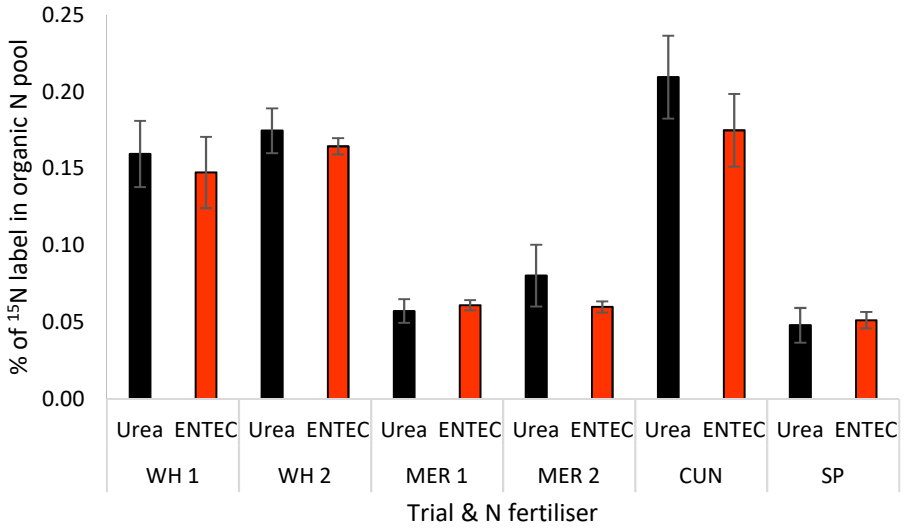
6 field trials

2 N fertilisers - Urea, DMPP,
2 rates (30 & 60 kg N ha^{-1})
Split vs Upfront application

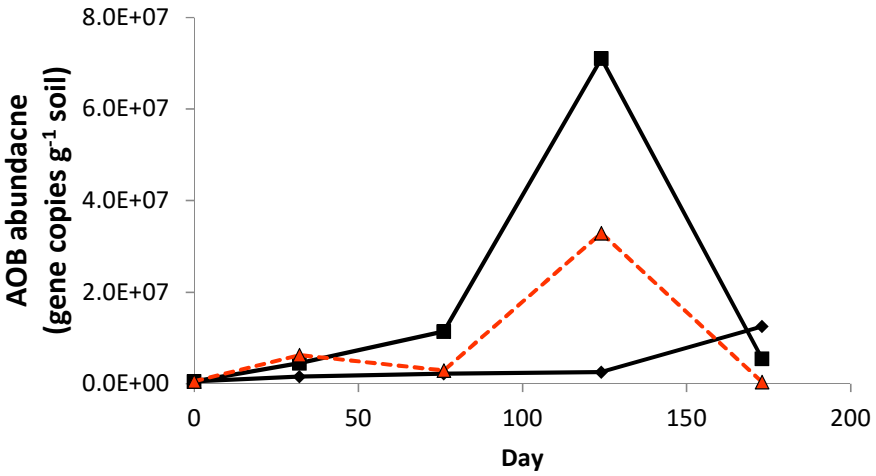
Field Trials – N conservation

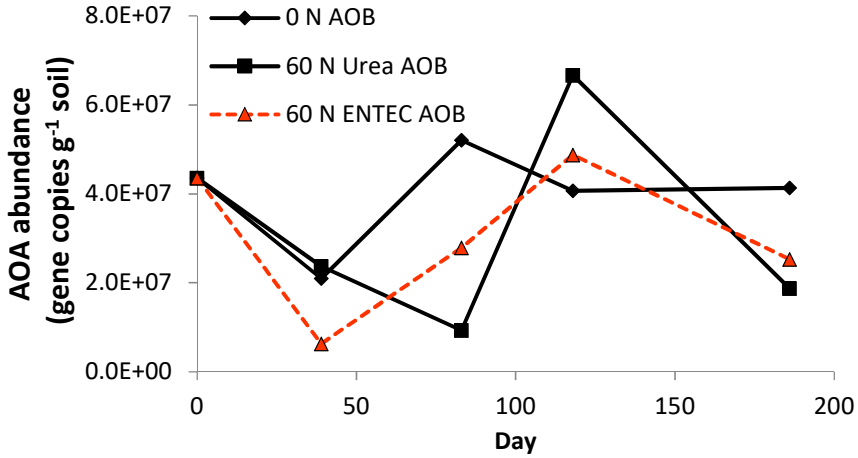




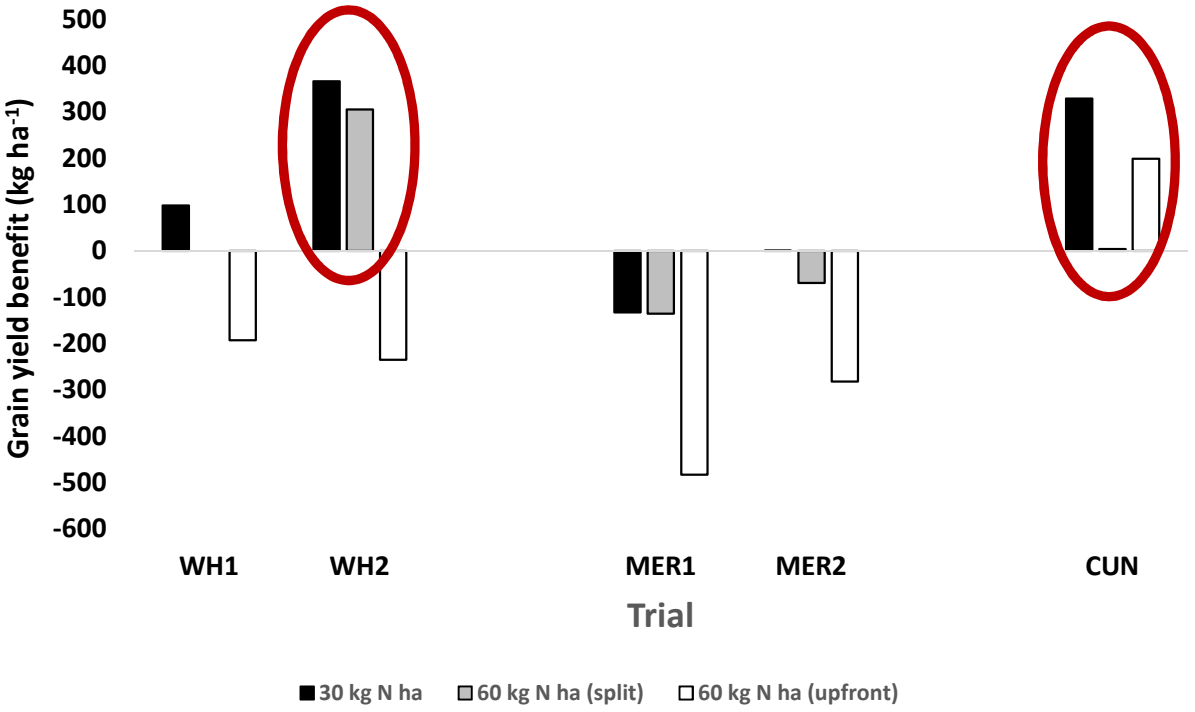


Field Trials – AO abundances

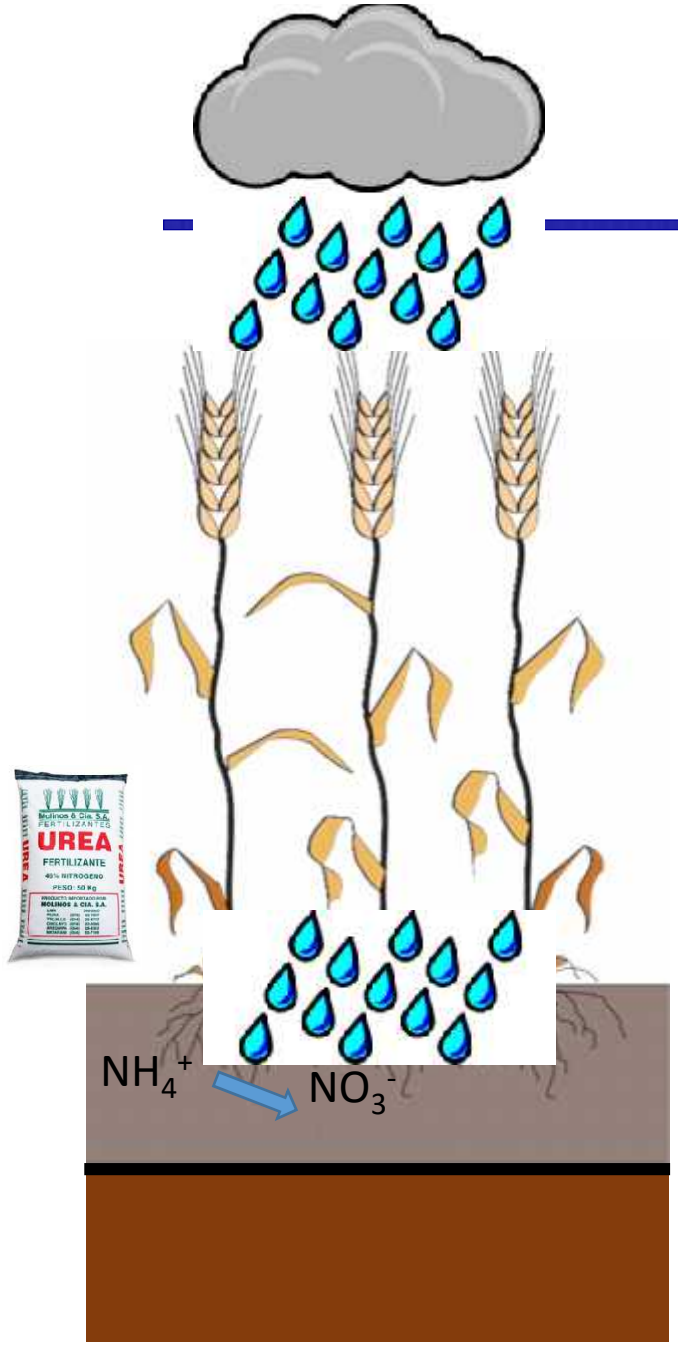


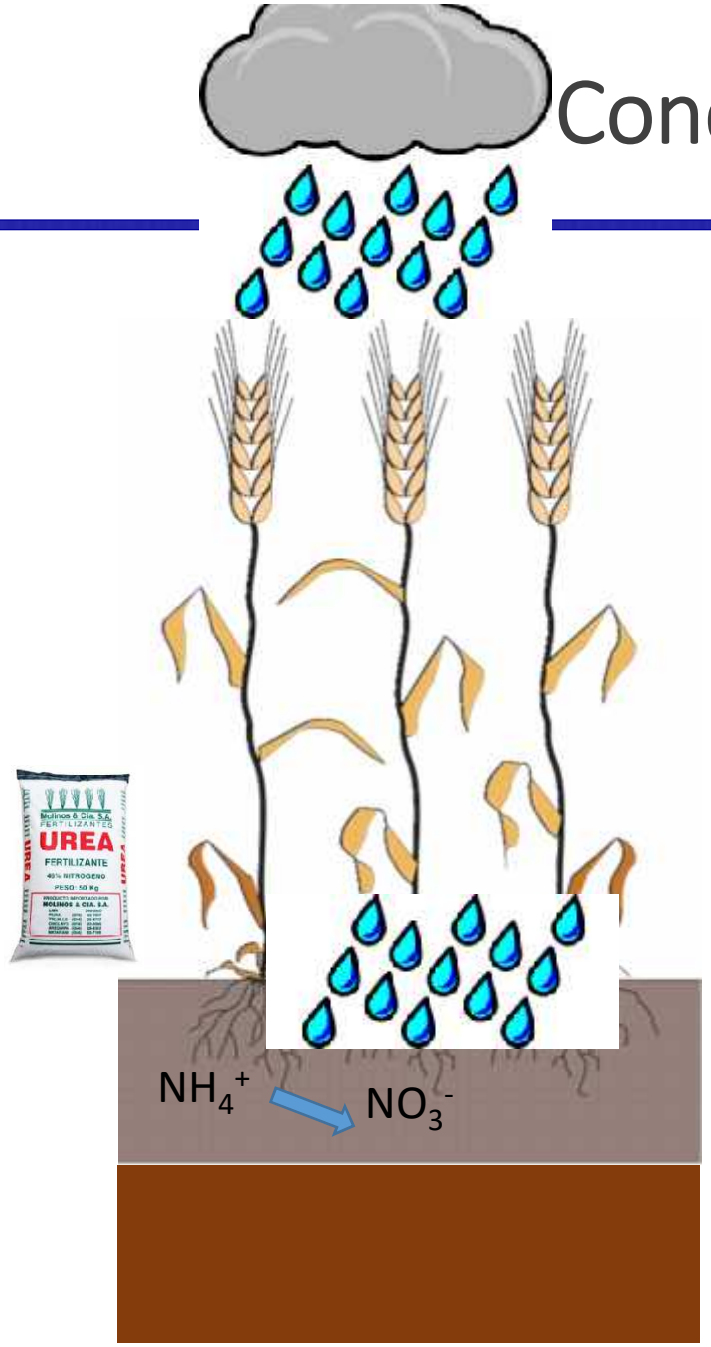


Field Trials- Crop performance



Conclusions

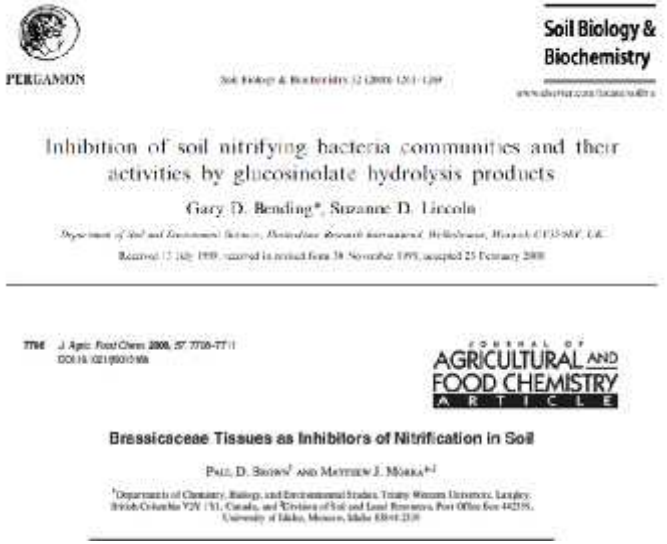




Future work

Wongan Hills 1
<100 kg ha^{-1} yield benefit

Wongan Hills 2
> 400 kg ha^{-1} yield benefit



PERGAMON

Soil Biology & Biochemistry

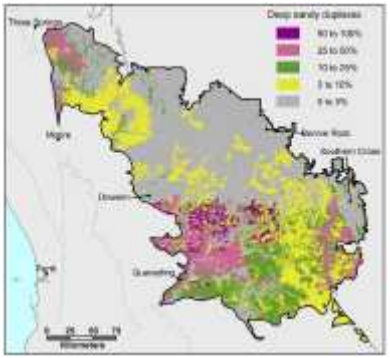
Inhibition of soil nitrifying bacteria communities and their activities by glucosinolate hydrolysis products

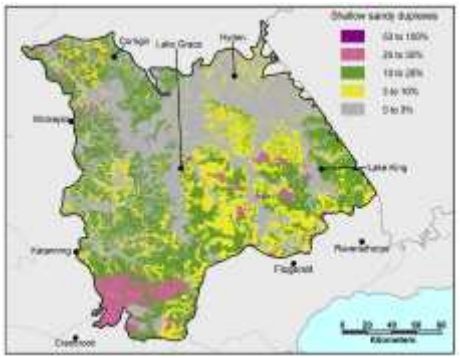
Gary D. Bending*, Suzanne D. Lincoln

7766 J. Agric. Food Chem. 2000, 48, 7766−7771

JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY ARTICLE

Brassicaceae Tissues as Inhibitors of Nitrification in Soil





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