

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.

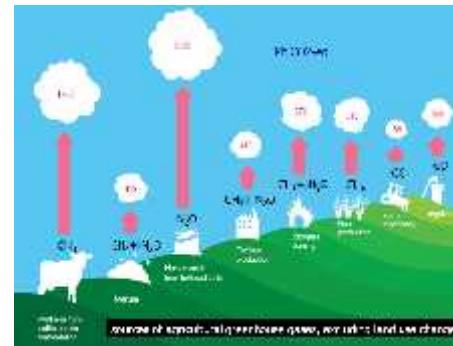


- Conclusions & future work.
- Acknowledgements.
- Questions.



Role of nitrification inhibitors in agriculture

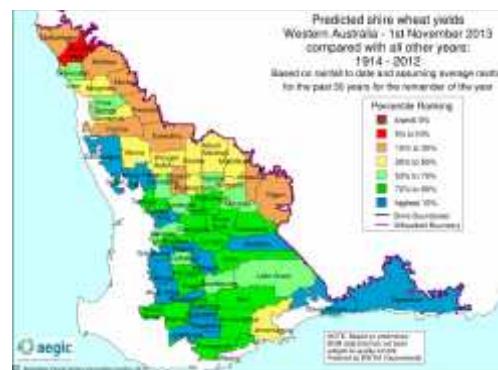
- N fertilisers essential aspect of modern agriculture.
- For most crops accumulation of N is inefficient <50%.
- N losses detrimental – environmentally & economically.



- 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 $\text{NH}_4^+ \rightarrow \text{NO}_2^-$.
- NH_4^+ less mobile than $\text{NO}_3^- \rightarrow$ 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

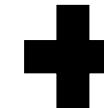


Tenosol
pH = 5.4
Org C = 2.2%
Sand = 85%

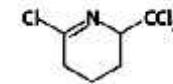


Hydrosol
pH = 4.0
Org C = 3.0%
Sand = 90%

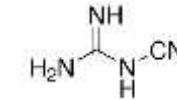
2 Wheatbelt soils



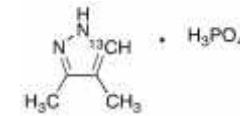
4 fertiliser treatments
(100 mg N kg⁻¹ soil)



Nitrapyrin



Dicyandiamide
(DCD)



3,4, dimethylpyrazole
phosphate (DMPP)

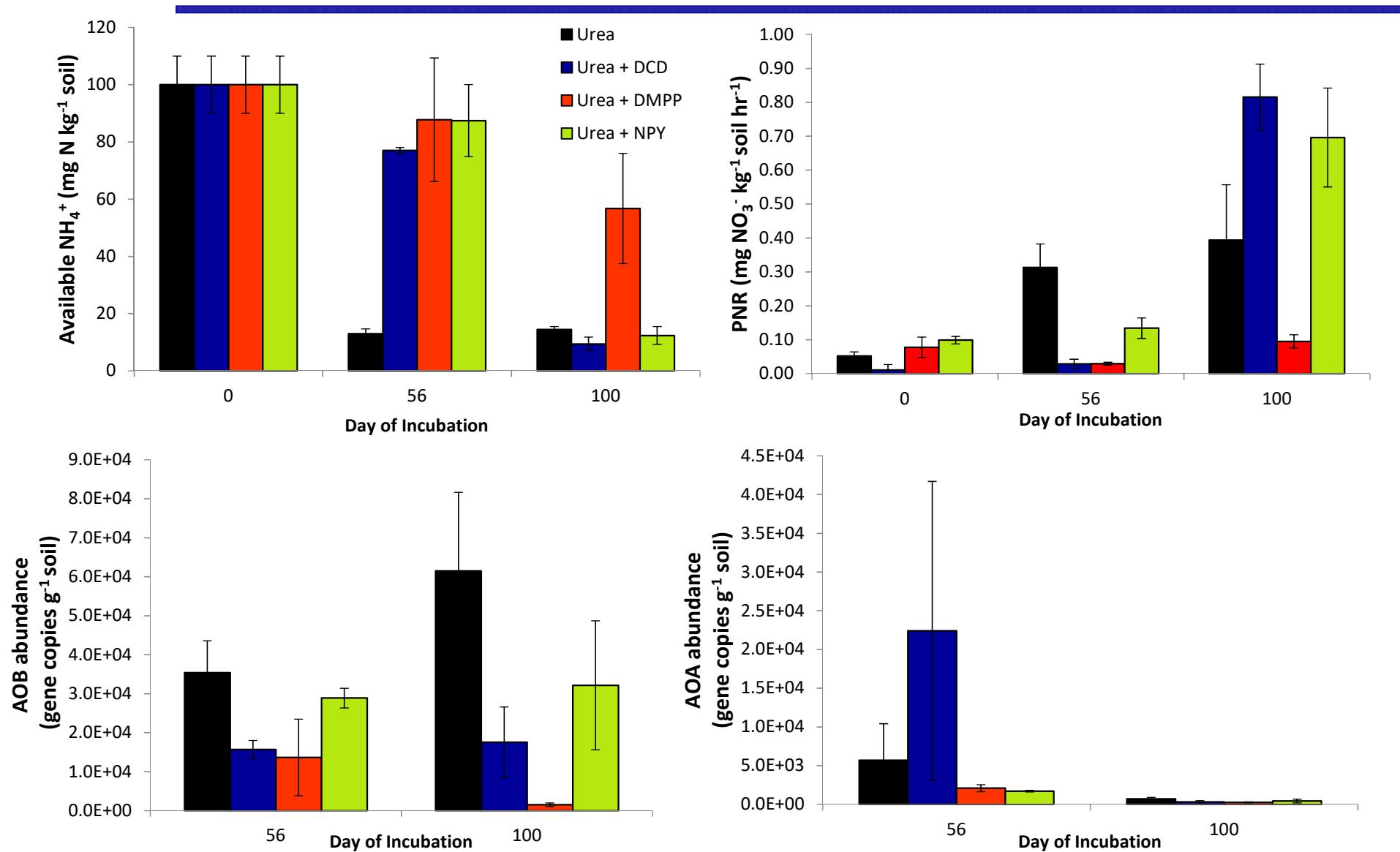


Laboratory Incubation
(20 °C, 100% field capacity, 100 days)

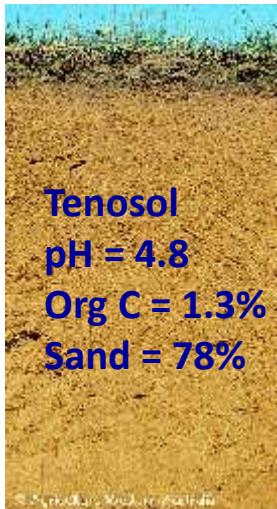


N species, PNR, AOA/AOB abundances measured

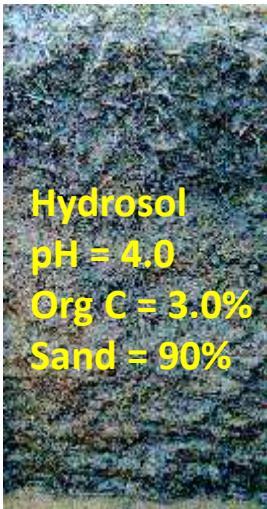
Laboratory soil incubations



Glasshouse pot trials



Tenosol
pH = 4.8
Org C = 1.3%
Sand = 78%



Hydrosol
pH = 4.0
Org C = 3.0%
Sand = 90%

2 Wheatbelt soils



Wheat - *Triticum aestivum* cv. Mace

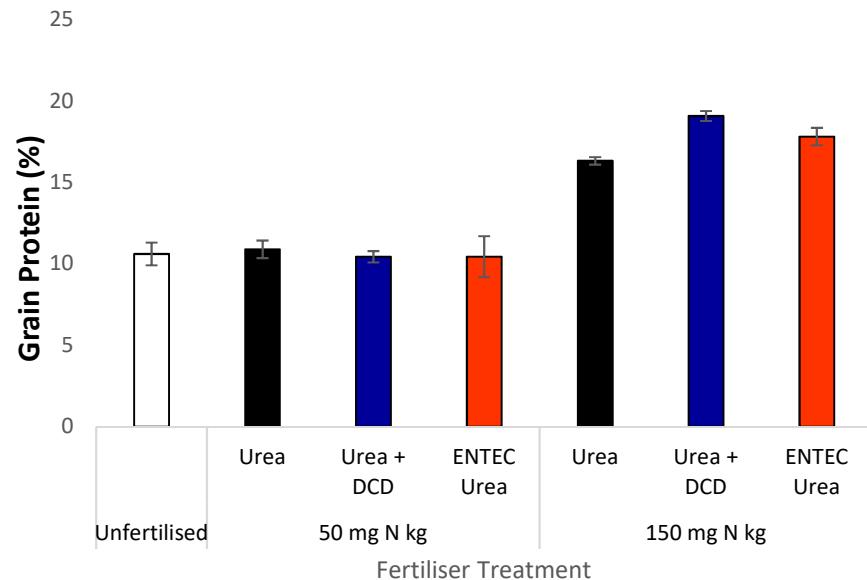
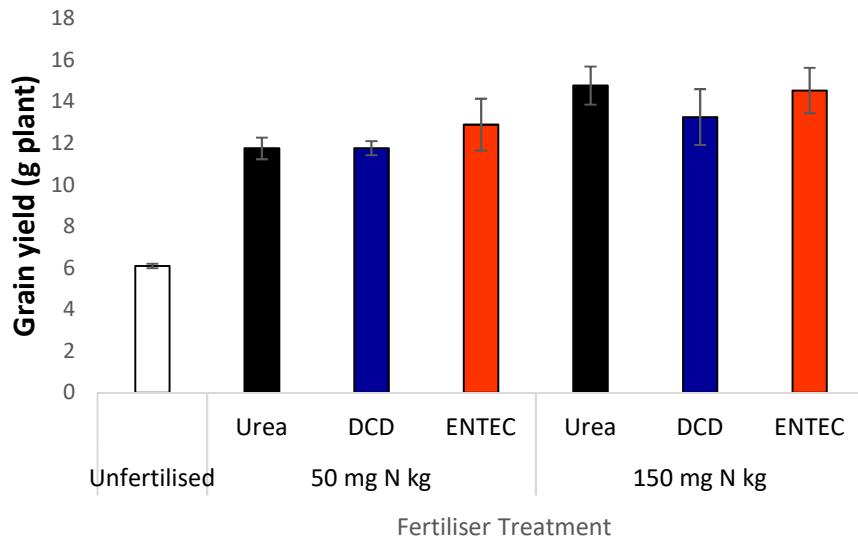
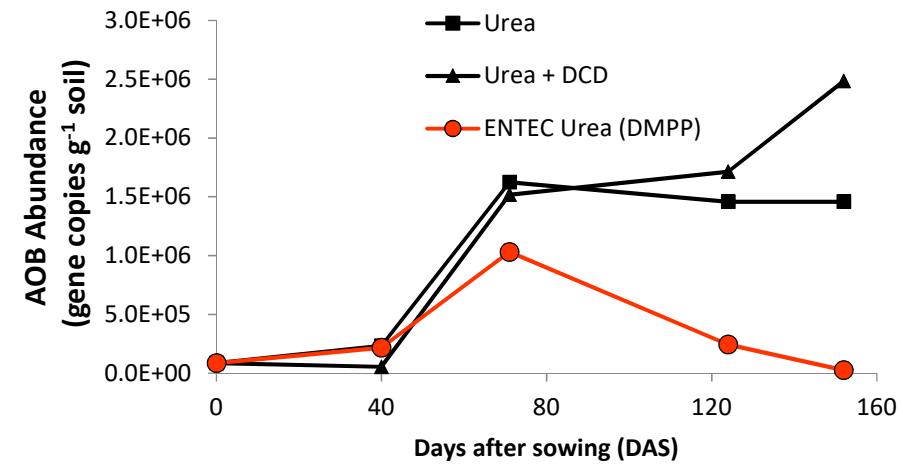
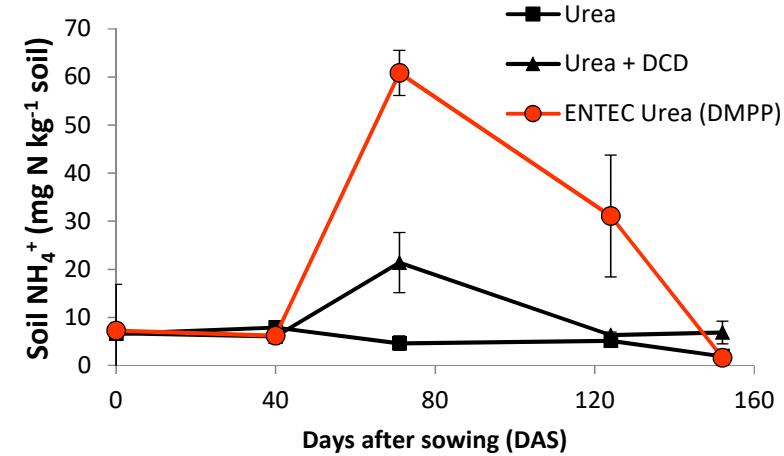


3 N fertilisers - Urea, DMPP, DCD
2 rates (50 & 150 mg N kg⁻¹ soil)



Grain yield, protein (%) and NUE determined

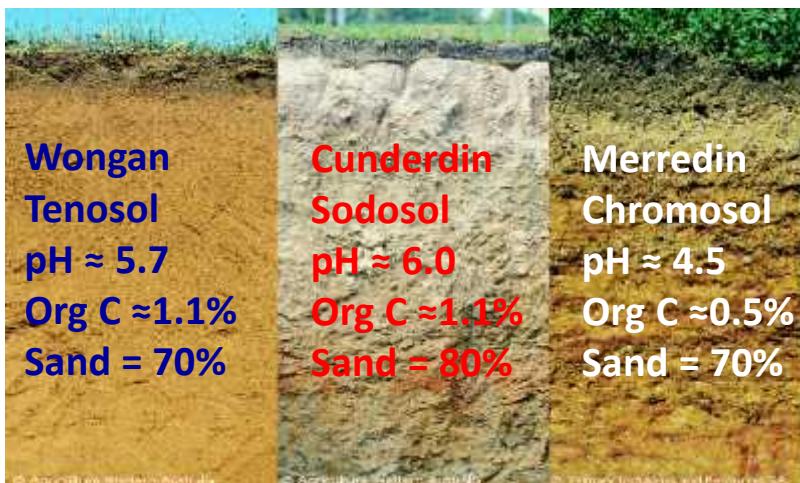
Glasshouse pot trials



Field Trials



Triticum aestivum cv. Mace – 80 kg ha⁻¹

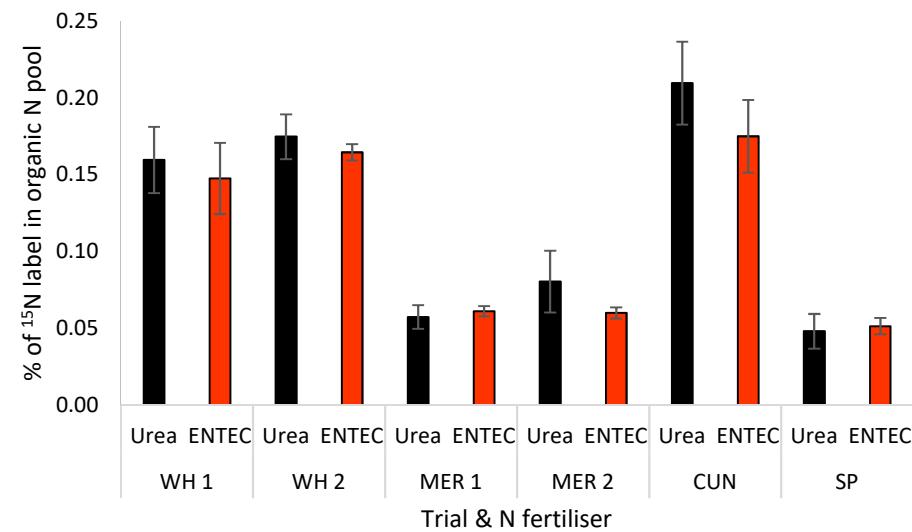
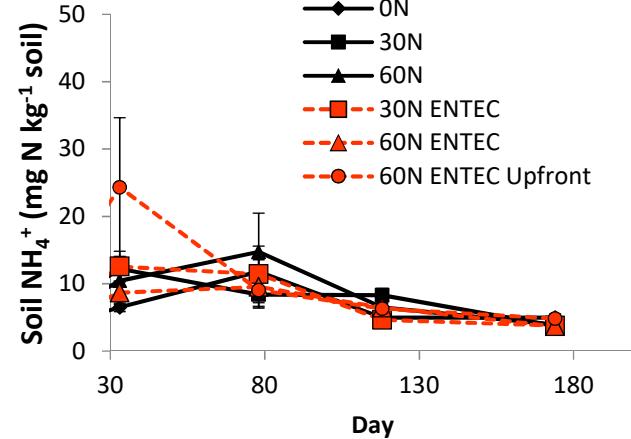
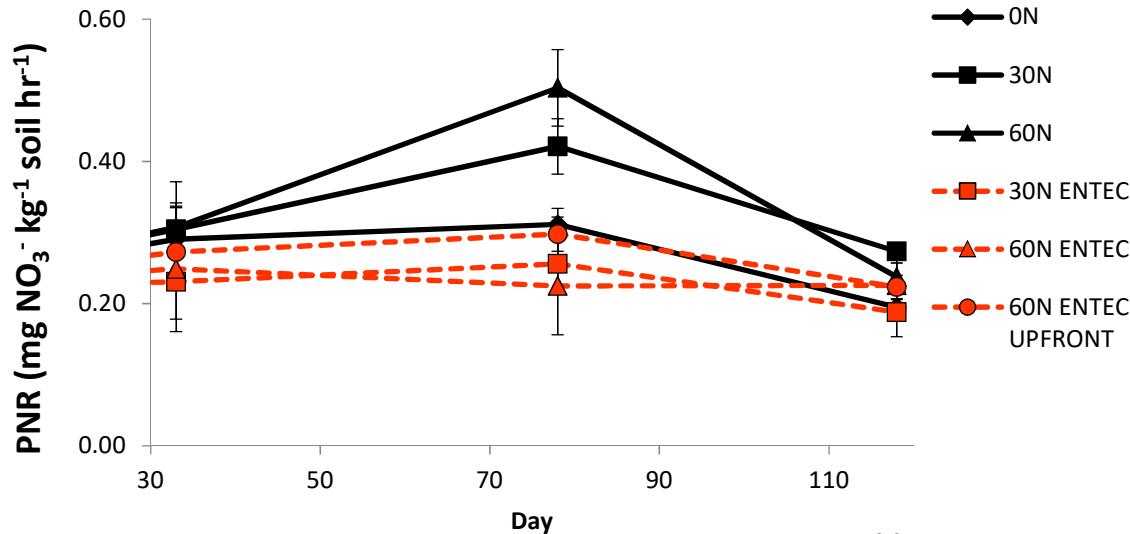


6 field trials

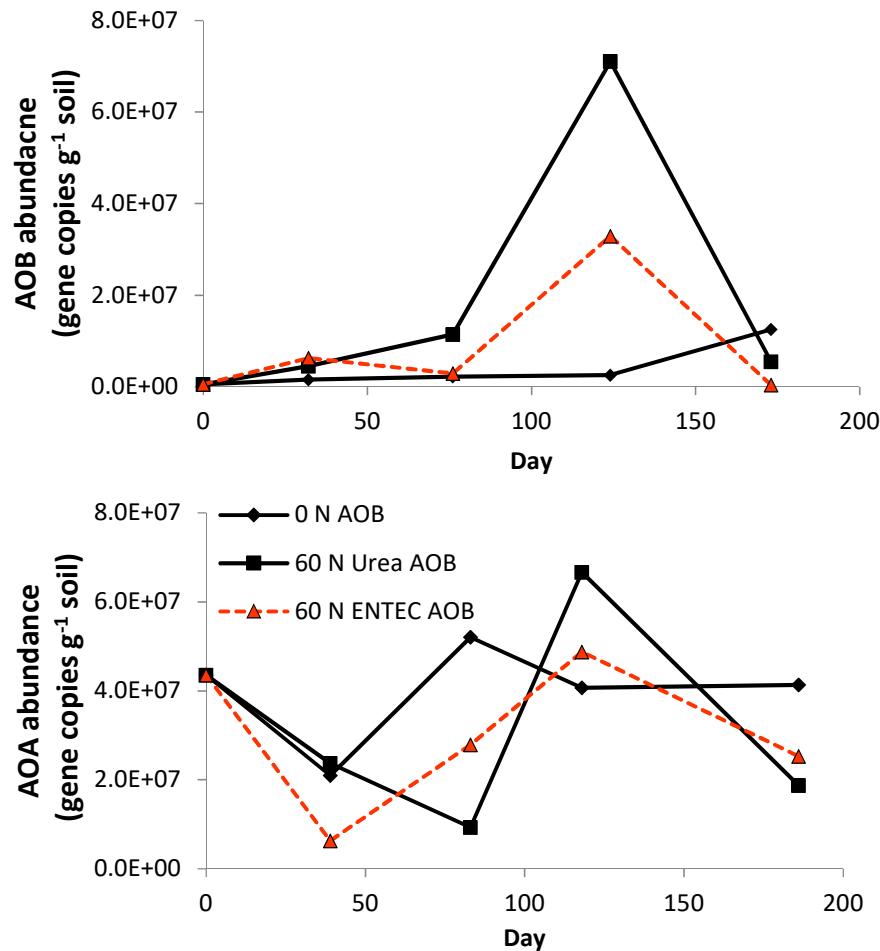


2 N fertilisers - Urea, DMPP,
2 rates (30 & 60 kg N ha⁻¹)
Split vs Upfront application

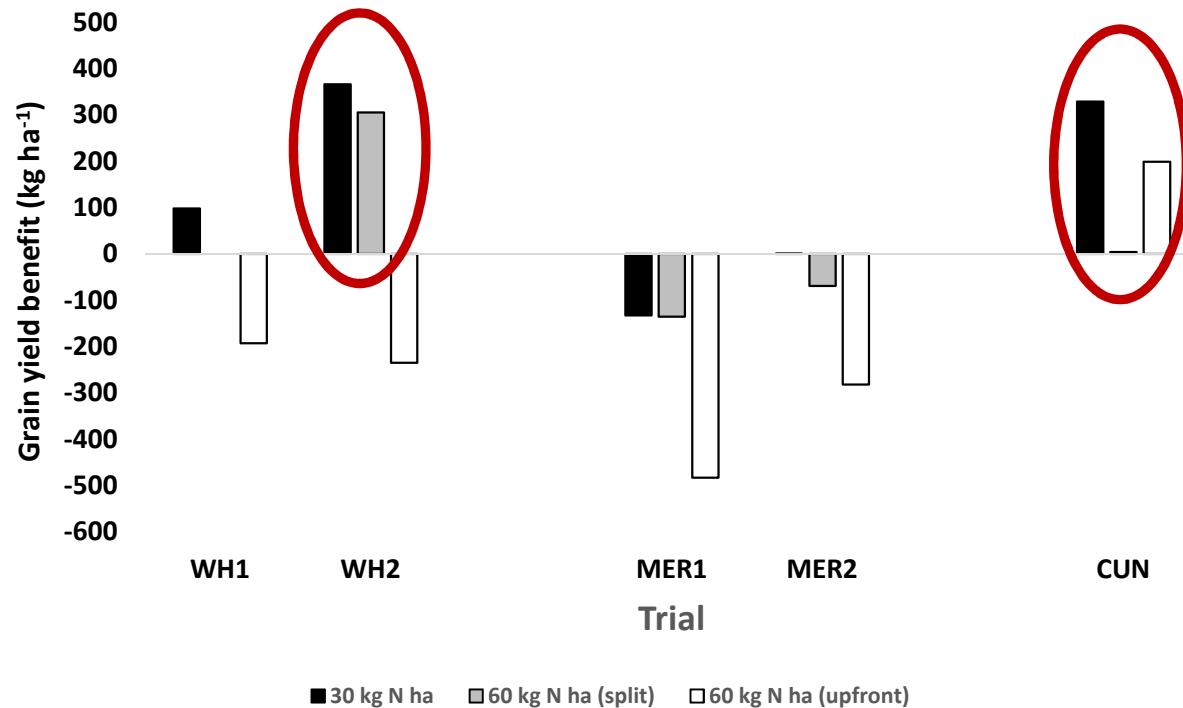
Field Trials – N conservation

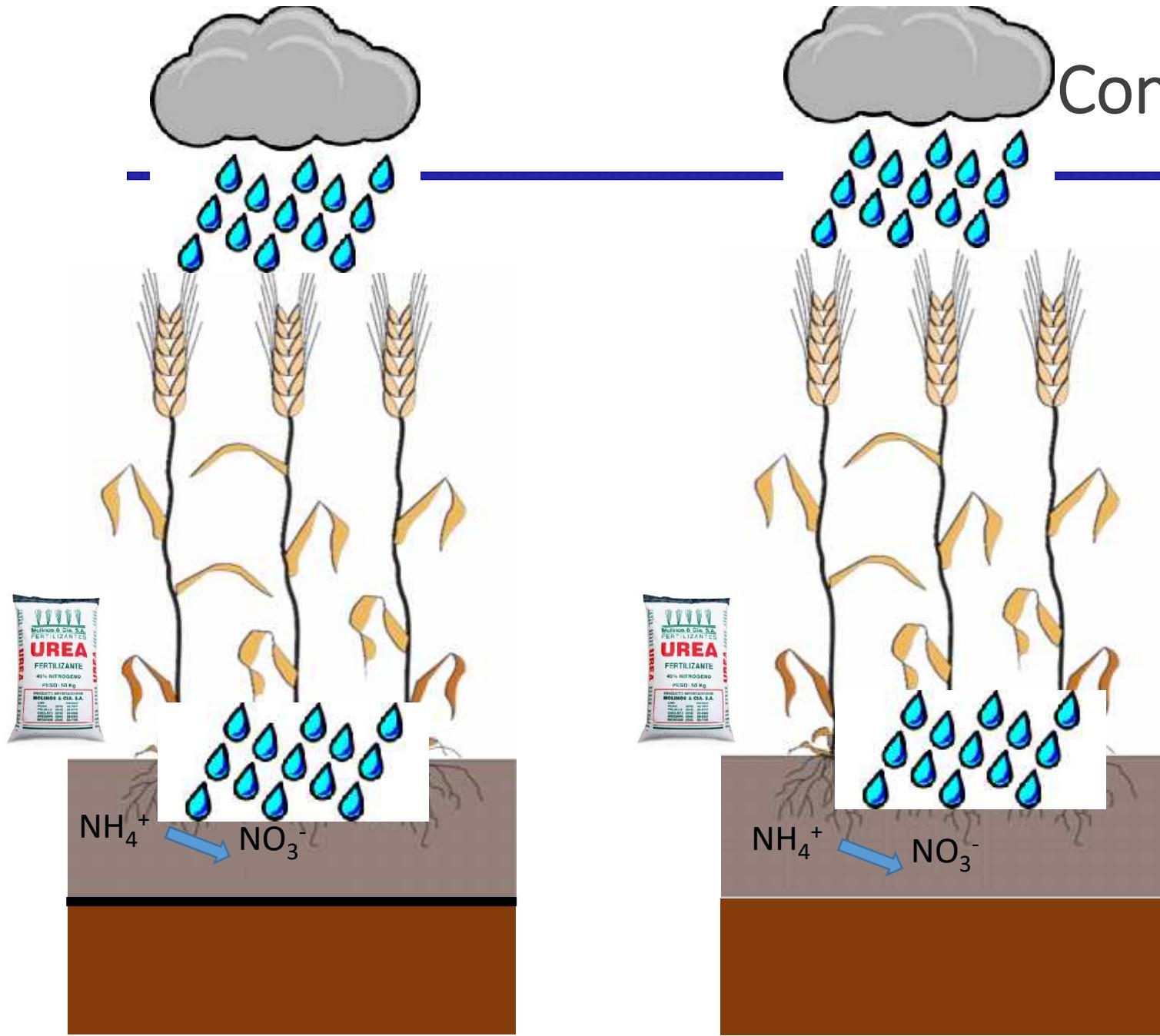


Field Trials – AO abundances



Field Trials- Crop performance





Conclusions

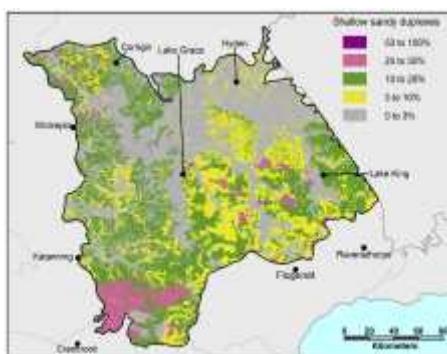
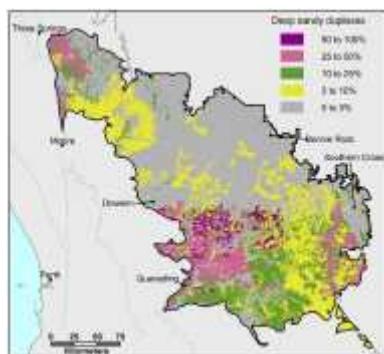
Future work



Wongan Hills 1
<100 kg ha⁻¹ yield benefit



Wongan Hills 2
> 400 kg ha⁻¹ yield benefit



PERGAMON

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

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Brassicaceae Tissues as Inhibitors of Nitrification in Soil

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