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New mobile, field based continuous-flow isotope ratio mass spectrometer system for automated denitrification studies

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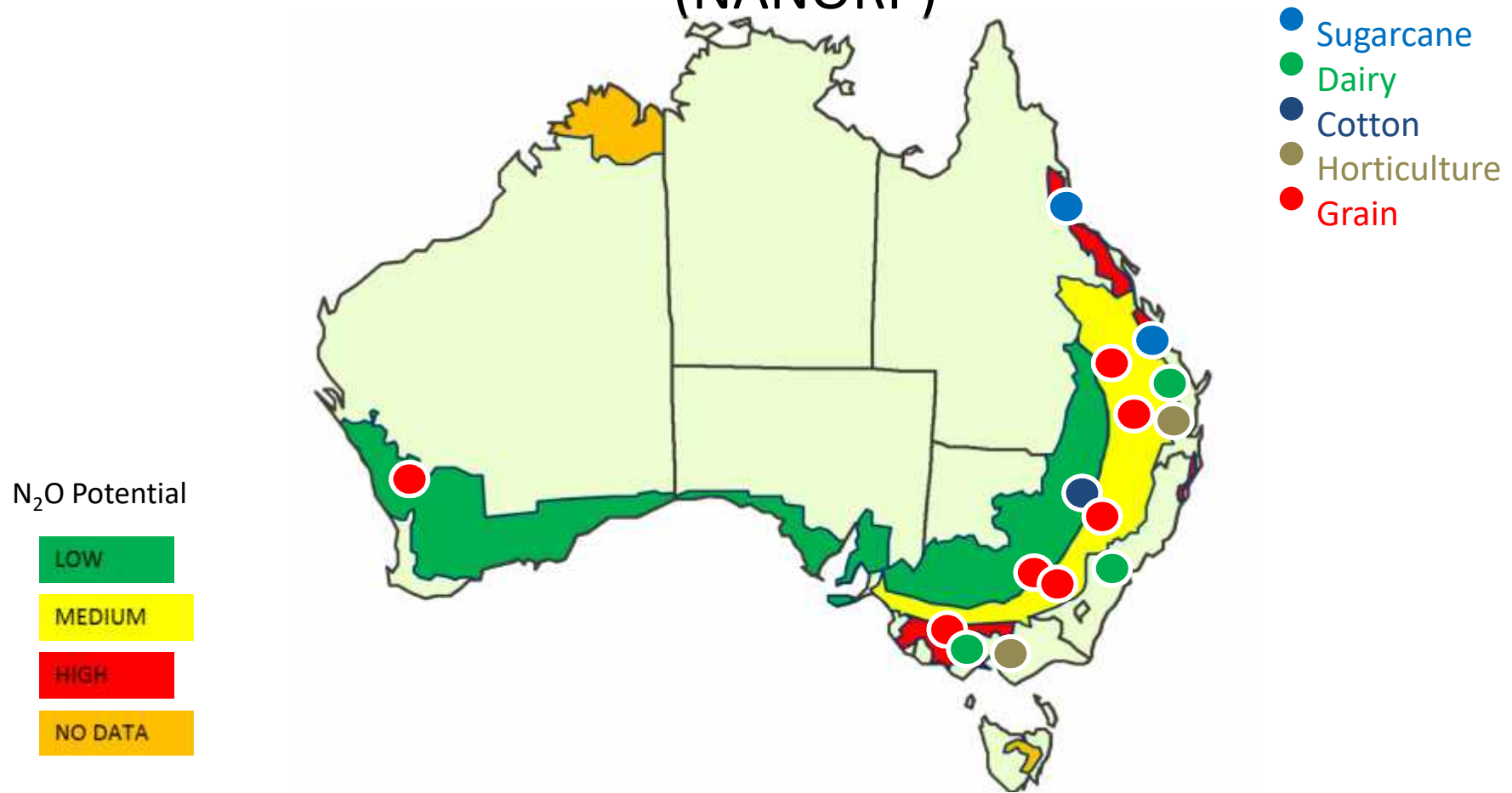


Australian Government

Objective

- Globally a focus on N_2O but magnitude of di-nitrogen (N_2) losses are virtually unknown for majority of agricultural systems.
- Abatement of all N gaseous losses from denitrification – provide the agricultural sector with both environmental and economic benefits.
- High temporal resolution and simultaneous datasets of N_2 and N_2O emissions are limited by the logistics of manual sampling, and subsequent transport and analysis of the samples.

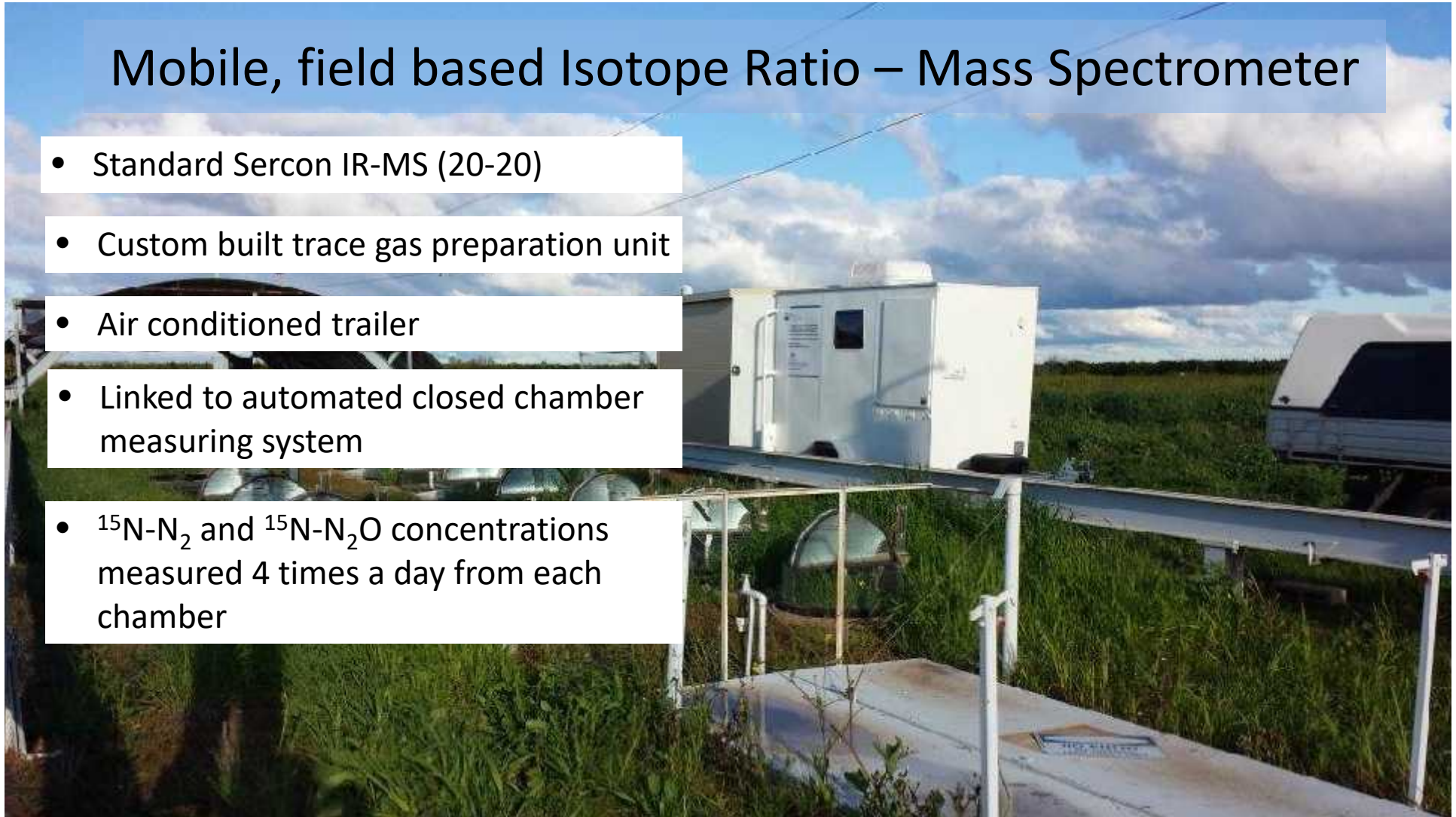
National Agricultural Nitrous Oxide Research Program (NANORP)

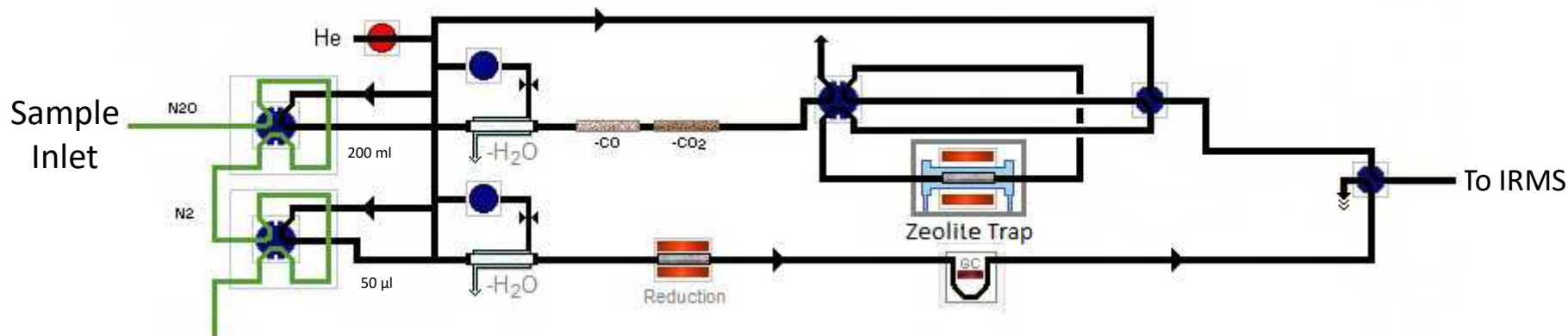




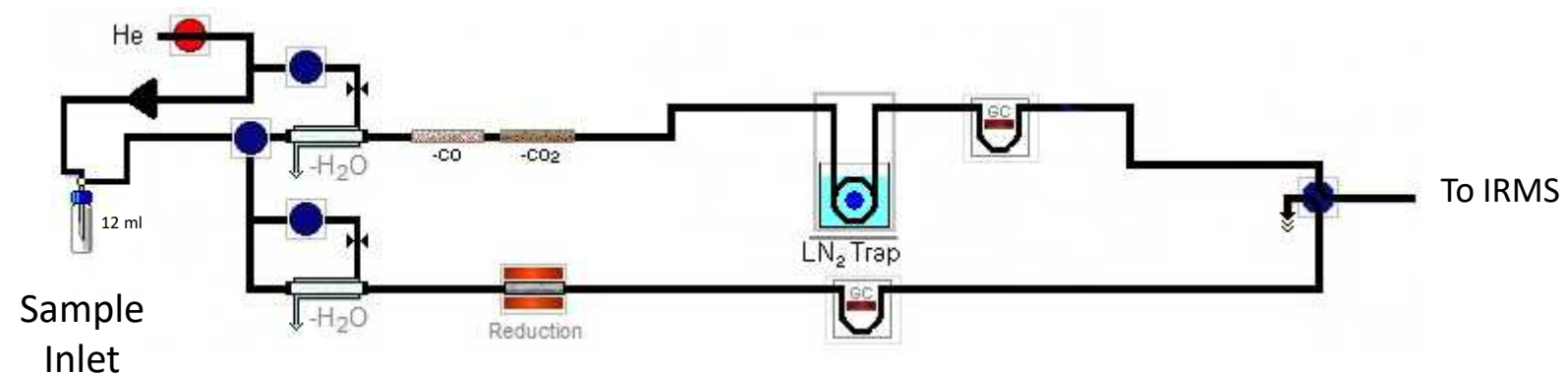
Mobile, field based Isotope Ratio – Mass Spectrometer

- Standard Sercon IR-MS (20-20)
- Custom built trace gas preparation unit
- Air conditioned trailer
- Linked to automated closed chamber measuring system
- $^{15}\text{N-N}_2$ and $^{15}\text{N-N}_2\text{O}$ concentrations measured 4 times a day from each chamber





Field based custom made gas preparation unit with zeolite trap replacing LN₂ trap



Commercial laboratory based Cryo-prep system with LN₂ trap

Experiment 1

NANORP sub-tropical grain cropping sites on high clay soils:

Vertosol (Kingsthorpe) and Ferrosol (Kingaroy).

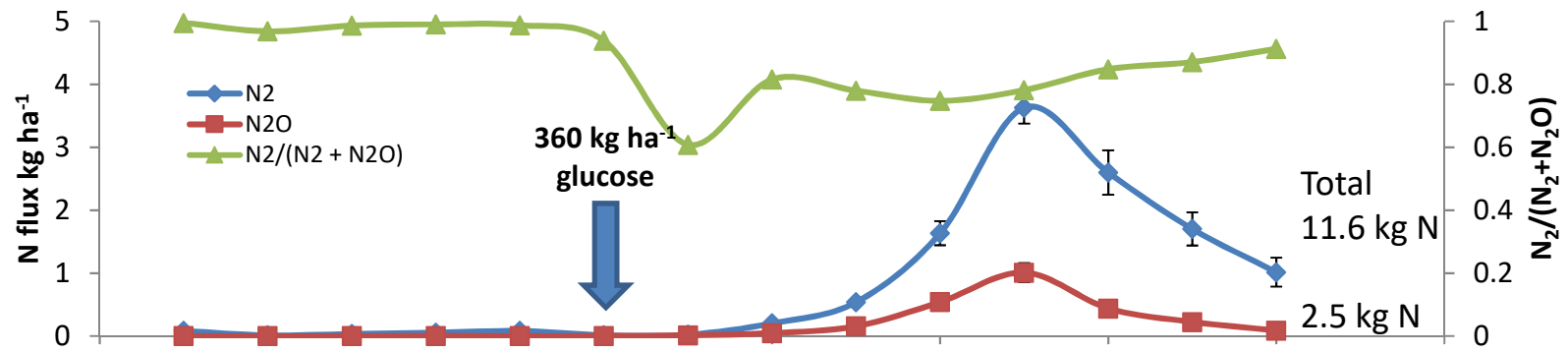
Soils were repacked into soil frames of the automated chambers and incubated under field conditions (4 replicates)

Treatment:

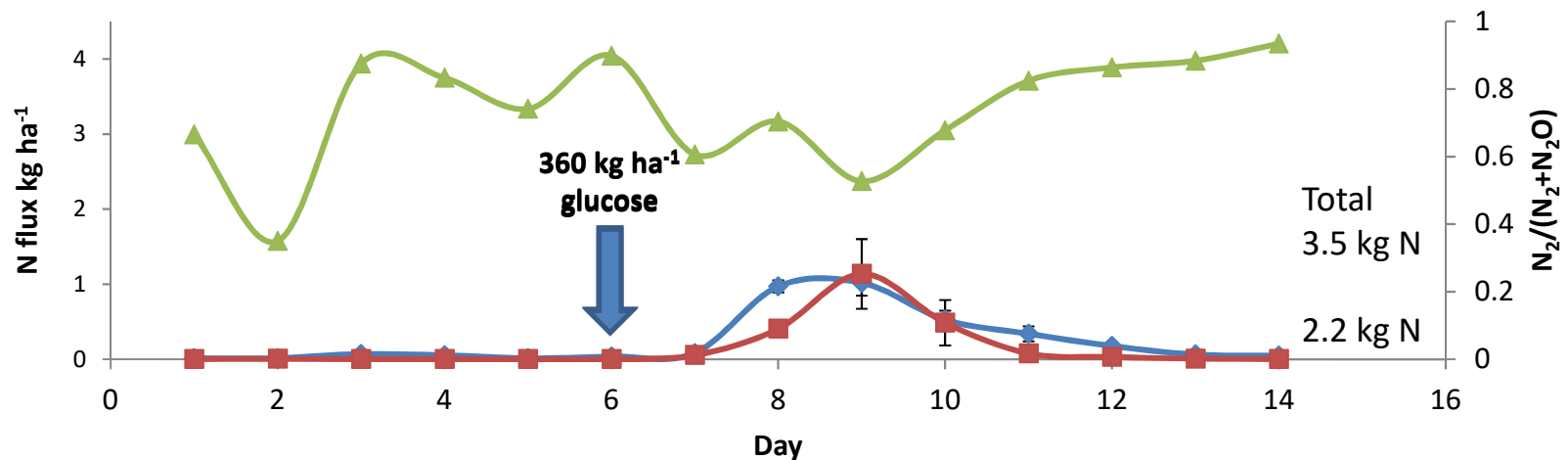
- Soil (no crop) + 100 kg N labelled KNO_3 (60% ^{15}N) + 100% WFPS
- Day 7 application of 360 kg ha^{-1} glucose (labile carbon)



Kingaroy Ferrosol

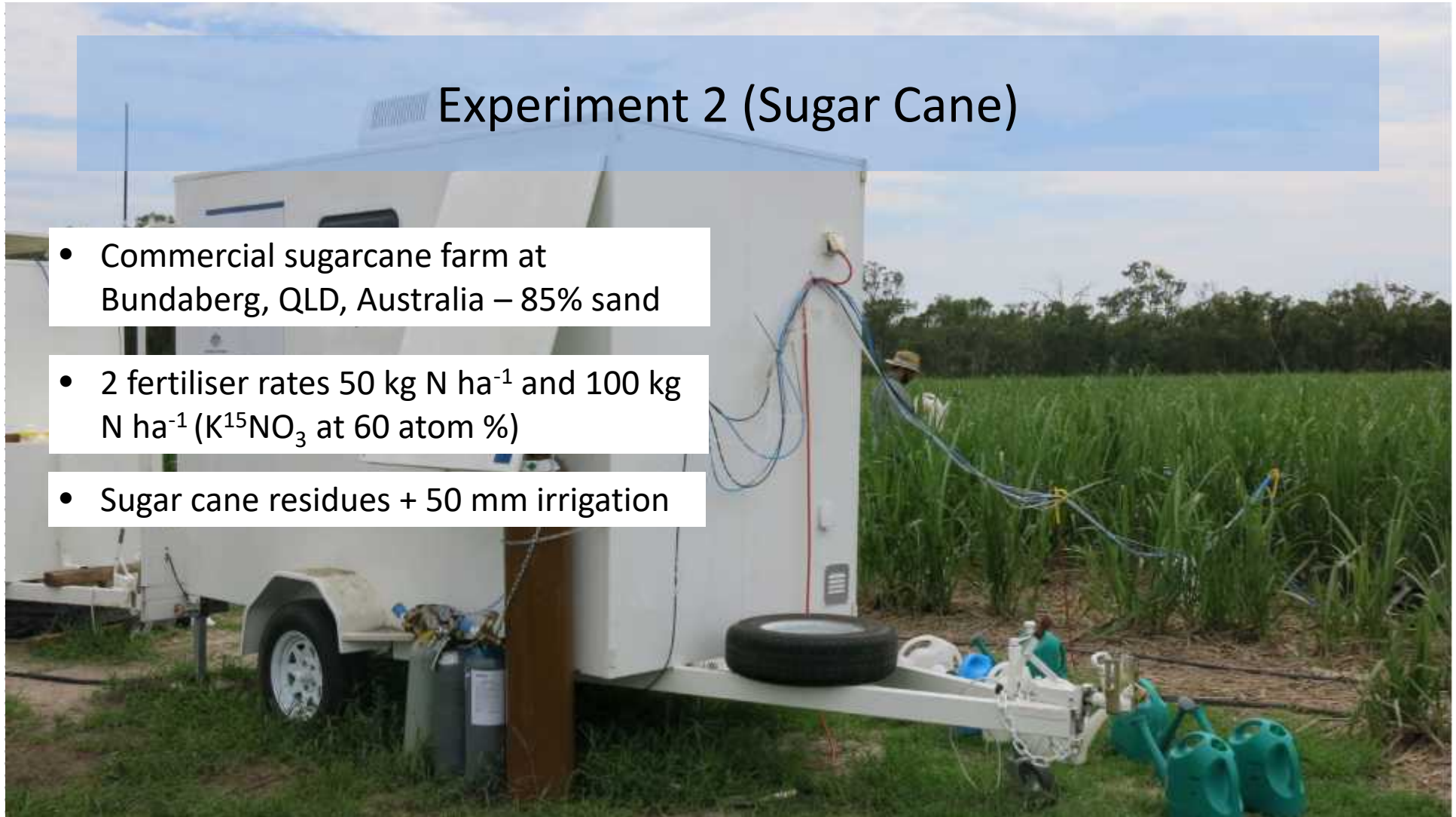


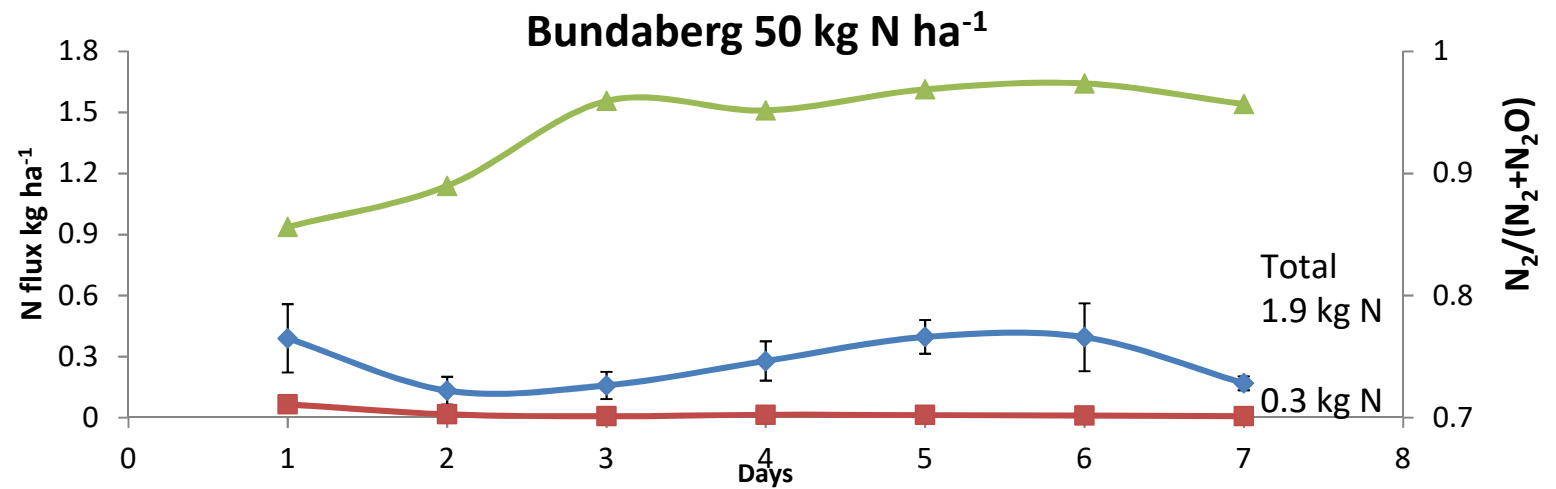
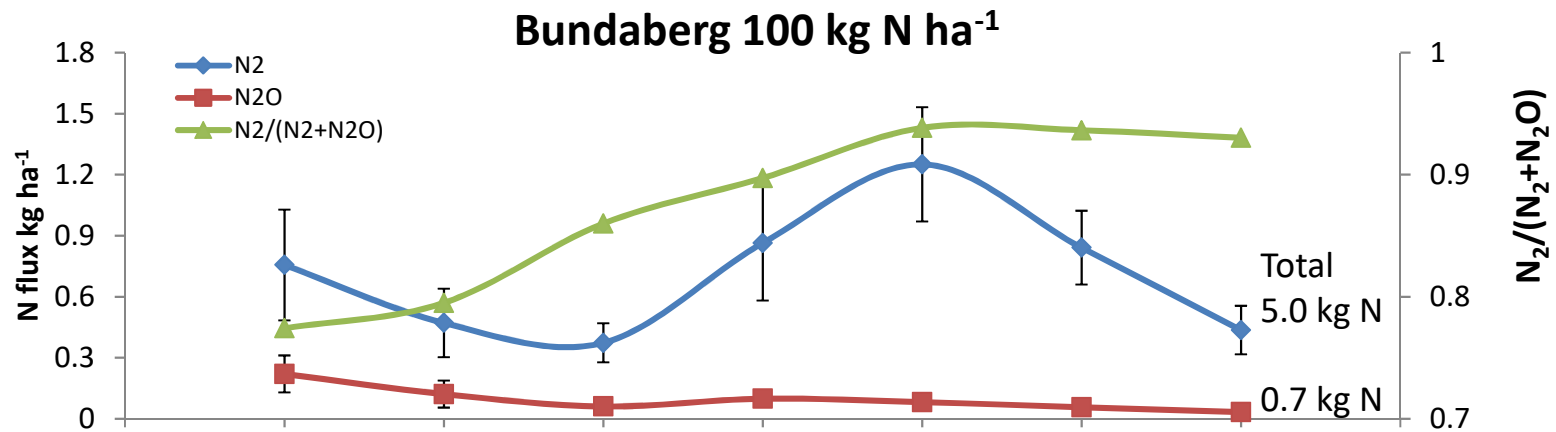
Kingsthorpe Vertosol



Experiment 2 (Sugar Cane)

- Commercial sugarcane farm at Bundaberg, QLD, Australia – 85% sand
- 2 fertiliser rates 50 kg N ha⁻¹ and 100 kg N ha⁻¹ (K¹⁵NO₃ at 60 atom %)
- Sugar cane residues + 50 mm irrigation





Conclusions

- In saturated, high nitrate soils with no carbon limitation, we confirmed that N_2 is the main product of denitrification in a field situation.
- Denitrification losses in subtropical grains of $5 \text{ kg N ha}^{-1} \text{ day}^{-1}$.
- Custom-built IR-MS system allows for simultaneous analysis of N_2 and N_2O emissions with high analytical precision.
- Fully automated sampling eliminate any errors associated with the manual extraction, transport and injection of gas samples.
- This outcome confirms the potential of this portable system to improve our understanding of terrestrial denitrification under realistic field conditions.
- n2o.net.au

Thank You!

