Potential impact of N_2O mitigation options for sugarcane production in Australia

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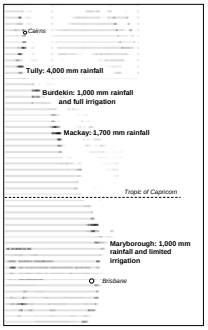
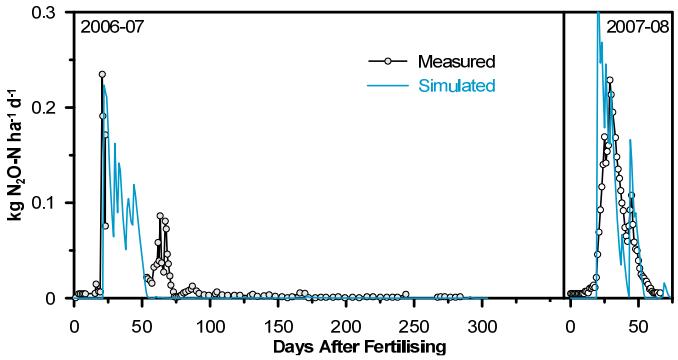
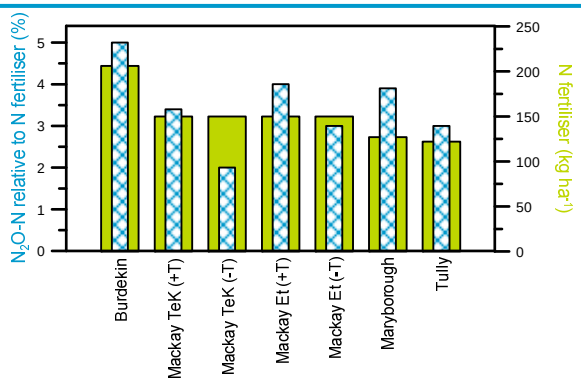
Introduction

- Measurements of N_2O emissions from sugarcane suggest they are equivalent to 2 to 5% of N fertiliser applications, higher than expected compared with other cropping systems. Substantial amounts of N fertiliser (~150 kg ha^{-1}) is applied to sugarcane so total emissions may also be high (e.g. ~5 kg N_2O-N ha^{-1}).
- These emissions are of general concern because of their high impact on global warming. They are of also particular concern for sugarcane production because of the wide interest in the crop for biofuel production.
- Aims:
  - To see how widely applicable previously measured emissions are by simulating (1) those experiments and (2) emissions from a sugarcane production systems, differing in management of irrigation, trash, etc.
  - Explore the economic tradeoffs between N_2O emissions and farm profitability resulting if emissions trading causes increased N fertiliser prices.

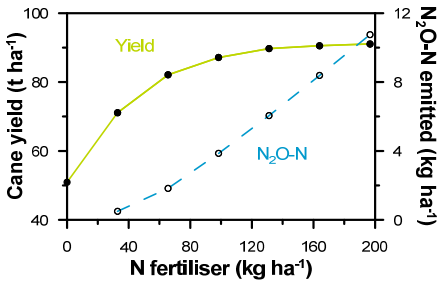


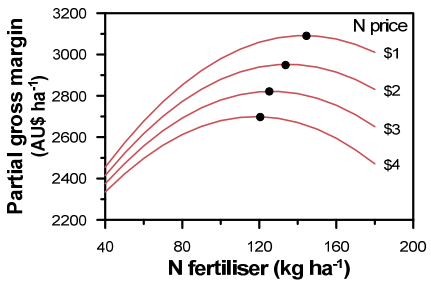


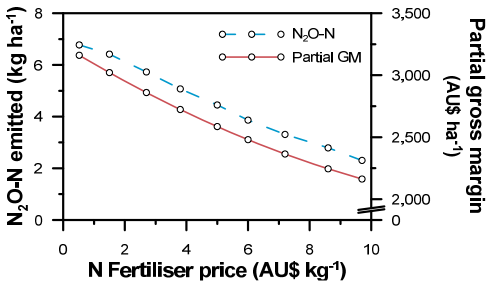
1. Model predictions agreed with independent measurements of N_2O emissions made at Te Kowai in Mackay over a whole crop in 2006-07 (Denmead et al. 2008) and for the 1st 60 days of another crop in 2007-08 (Macdonald et al. 2009).



2. Simulated, long-term average N_2O-N emissions (hatched bars) as % of N fertiliser applications (solid bars) varied between regions and within a region (Mackay) in different districts Te Kowai (TeK) and Eton (Et) or with trash (crop residues) retained (+T) or removed (-T).







3. N_2O emissions are predicted to increase with increasing N fertiliser applications for Te Kowai in Mackay (with trash retained). In this example, reducing N rates from past levels (~170 kg ha^{-1} in this region) to current recommendations (~120 kg ha^{-1}) would reduce N_2O emissions by ~40%

4. As N fertiliser prices increase, farm profitability (indicated by partial gross margins) reach maximums at lower N rates (example for Te Kowai in Mackay with crop residues retained). But the maximum profitability itself is also reduced.

5. If higher N prices cause farmers to apply less N, N_2O emissions will reduce, as will farm profitability (example for Te Kowai in Mackay with crop residues retained).

At a carbon price of AU$20 t^{-1} CO2-e, the value of reduced N_2O emissions is AU$4.25 ha^{-1} per unit increase in N price. But the equivalent decrease in PGM is ~AU$98 ha^{-1}.

Conclusions

- We predict that the few measurements of N_2O emissions from Australian sugarcane are generally applicable.
- If the predictions are generally applicable, global warming potential of world-wide sugarcane production may be equivalent to 60-100 Mt CO_2-e $year^{-1}$, which is 2-3% of global warming potential attributed to N_2O emissions from all fertilised croplands
- Adopting new N fertiliser recommendations will reduce N_2O emissions from sugarcane, e.g. by ~40% at Te Kowai in Mackay.
- Increased price of N fertiliser may cause farmers to apply less N, which would reduce N_2O emissions and farm profitability.
- At commonly discussed carbon prices (e.g. AU$20 t^{-1} CO2-e) the value of lost farm profitability may be an order of magnitude greater than the value of N_2O emissions.

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References

Denmead OT et al. (2008) Whole-of-season greenhouse gas emissions from Australian sugarcane soils. *Proceedings of the Australian Society of Sugar Cane Technologists* **30**, 105-114.

Macdonald BCT et al. (2009) Emissions of nitrogen gases from sugarcane soils. *Proceedings of the Australian Society of Sugar Cane Technologists* **31**, 85-92.

Further information

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