Abatement Options for Nitrogen Fertiliser

Introduction

• Nitrogen Fertiliser
  – World food success story
  – >1 billion tonnes of N per year
  – Environmental concerns
    • Ammonia (NH₃) volatilisation
    • Nitrate (NO₃) leaching
    • Nitrous oxide (N₂O) emissions
National Greenhouse Gas Emissions

Agricultural sector
16.5% (88.1 Mt CO₂-e) of national GHG

DCC 2009

Agricultural Greenhouse Gas Emissions

- Agriculture
  - 59% of all methane
  - 86% of all nitrous oxide
- Enteric Methane
  - 10.6% of National emissions
- Nitrous Oxide from soils
  - 2.8% of National emissions

DCC 2009
Methane and Nitrous Oxide sources

- **Denitrification**
  - Warm, water-logged soils
  - Higher rainfall/irrigated
    - 1 - 3% of N
- **Nitrification**
  - Warm, aerobic soils
  - Minor losses
  - Low rainfall
    - 0.01 to 0.4 % of N
- **Inefficient use of nitrogen**
  - >60% N lost from grazing
  - >30% N lost from cropping

- Total N loss
  - 10 kg N/ha
- **BUT:**
  - GWP = 310 x CO₂
  - 10 kg N₂O-N = 5 t CO₂e/ha

DCC 2008
Nitrous Oxide Emission Sources

Indirect Emissions (41%)
- Nitrogen Leaching and Run-Off 17%
- Atmospheric Deposition 24%

Direct Fertiliser Emissions (19%)
- Synthetic Fertilisers 19%
- Animal Waste Applied to Soils 5%
- Nitrogen Fixing Crops 4%
- Crop Residue 5%
- Cultivation of Histosols 0%

Excretion (26%)
- Nitrogen Excretion on Pasture Range and Paddock 26%

International Policy Context

Copenhagen Accord
- Non-legally binding agreement
  - Deadline of 2010 for binding agreements
  - No mention of agriculture

- Global Research Alliance for agriculture
  - Address issues of Food security vs Mitigation
### Australian Policy Context

- **Federal government**
  - Offsets markets for agriculture
- **Victorian government**
  - Legislate 20% less GHG by 2020
  - Establish Victorian Carbon Exchange
    - Creation & purchase of offsets

### Labour Policy

- **Citizens Assembly**
  - National consensus
- **CPRS post-2013**
  - Subject to international commitments
- **Offsets for agriculture**
Coalition policy

- Direct Action Plan on the Environment and Climate Change
  - Emissions Reduction Fund ($2.55B)
  - Boost agricultural R&D
  - Green Carbon Initiative
    - $10M to reduce emissions and increase carbon
  - Feral animal control program

National Nitrous Oxide Research Program (NORP)

- Funded by
  - DAFF, GRDC, DA, SRDC
  - Led by Prof Peter Grace, QUT
  - Coordinated by GRDC

- Sites/projects
  - Cotton/grain – NSW/QLD
  - Sugar cane – QLD
  - Winter cereals/legumes - NSW
  - Legume/wheat – Vic
  - Dairy - Vic
  - Wheat – WA
  - Fertiliser efficiency – Uni Melb
Abatement Options

- Nitrogen Fertiliser
  - Rate, source, timing, placement
- Water management
  - Drainage, irrigation
- Soil Management
  - Compaction, tillage
- Crop/Pasture Management
  - Stubble management, fallow, nutrients
- Animal Management
  - Stocking density, diet, effluent

Mitigation of Nitrous Oxide

- Nitrogen Fertiliser Rate and Timing
  - Match rate & timing to plant demand

![Graphs showing productivity and environmental impact of nitrogen fertiliser rate](Image)
• Source
  – Wet soils
    • N₂O from NO₃-N source
  – Drier soils
    • NH₃ from urea
    • Indirect N₂O loss

• Placement
  – Band, ridges
  – Within paddock

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• Fertiliser formulation
  – Urease inhibitors
    • Reduces NH₃ loss
    • eg. Agrotain®, Green Urea™
  – Nitrification inhibitors
    • Reduces N₂O and NO₃ loss
    • Temperature sensitive
    • eg. DCD, Nitrapyrin, DMPP
Mitigation of Nitrous Oxide

- Controlled Release/Coated Fertilisers
  - N encapsulated in a polymer or oil-based coating
  - Controlled pattern/rate of release

  - Slow Release Fertilisers
    - Reduced solubility
      - Chemical
      - Physical mixing
    - Slower release of N

Summary

- Challenge to reduce N losses
  - Advice to improve NUE
  - Products to improve NUE

- Opportunity to capture offset/emission credits
  - As an industry or company
  - Use this revenue to make products more competitive
In conclusion

- We are facing an emissions constrained future
- There are no policy drivers currently
  
  **BUT**
- Will the fertiliser industry be proactive or reactive?
  - There appear to be business opportunities by being proactive