The effects of inhibitor use and urea fertiliser application on pasture production and nitrous oxide emissions

Kevin Kelly and Graeme Ward
Aim

- To evaluate the mitigation potential of inhibitor coated inorganic fertiliser applied to pastures
Design

- Replicated field study (2 sites)

- Treatments
  1) Nil
  2) Urea
  3) Urea + DCD - UAN (years 2&3)
  4) Urea + DMPP
  5) Urea + nBTP

50 kg N/ha after every second DM harvest
Measurements

- DM yield (3 years)
- Static chambers for N$_2$O flux estimation
  - Glenormiston
    1) July 2012 – July 2013
    2) June 2014 - April 2015
  - Terang
    1) May 2013 – May 2014
    2) May 2014 – April 2015
Sites

Glenormiston (Dermosol)  
Terang (Chromosol)

Long term average rainfall

735 mm  
780 mm
Initial conditions

**Total nitrogen content (%)**

- Depth (m)
- Terang
- Glenormiston

**Organic carbon content (%)**

- Depth (m)
Pasture production

Glenormiston 2012-2013

DM yield (t DM / ha)

Terang 2012-2013

Nil
Urea
Urea+DCD
Urea+DMPP
Urea+nBPT

Terang 2013-2014

Nil
Urea
UAN
Urea+DMPP
Urea+nBPT

Glenormiston 2013-2014

Terang 2014-2015

Nil
Urea
UAN
Urea+DMPP
Urea+nBPT

Glenormiston 2014-2015

Terang 2014-2015
N$_2$O emissions - Glenormiston (Dermosol)
N₂O emissions - Glenormiston (Dermosol)

Flux (kg N₂O-N/ha/day)

Nil
Urea
Fertiliser applied

Water filled pore space (%)

Nil
Urea
Fertiliser applied

Rainfall (mm/day)

0
10
20
30
40
50

0
25
50
75
100

Jul 12 Sep 12 Nov 12 Jan 13 Mar 13 May 13 Jul 13
Jun 14 Aug 14 Oct 14 Dec 14 Feb 15 Apr 15
**N₂O emissions - Glenormiston (Dermosol)**

- **Flux (kg N₂O-N/ha/day)**
  - Nil
  - Urea
  - Urea + DMPP
  - Fertiliser applied

- **Water filled pore space (%)**
- **Rainfall (mm/day)**
  - 0
  - 10
  - 20
  - 30
  - 40
  - 50

- **Date Range**:
  - Jul 12 to May 13
  - Jun 14 to Apr 15

The graphs illustrate the flux of N₂O emissions from June 2014 to April 2015, showing the effects of different fertiliser applications on water-filled pore space and rainfall.
### N₂O emissions – Glenormiston (Dermosol)

<table>
<thead>
<tr>
<th></th>
<th>Days</th>
<th>Nil</th>
<th>Urea</th>
<th>Urea +DCD</th>
<th>Urea +DMPP</th>
<th>Urea +nBPT</th>
<th>l.s.d. (p=0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N₂O-N (kg N/ha)</strong></td>
<td>351</td>
<td>0.44</td>
<td>0.75</td>
<td>0.56</td>
<td>0.60</td>
<td>0.80</td>
<td>0.203</td>
</tr>
<tr>
<td><strong>Emission factor (2012-2013)</strong></td>
<td></td>
<td></td>
<td>0.31%</td>
<td>0.12%</td>
<td><strong>0.16%</strong></td>
<td><strong>0.36%</strong></td>
<td></td>
</tr>
<tr>
<td><strong>N₂O-N (kg N/ha)</strong></td>
<td>299</td>
<td>0.32</td>
<td>0.48</td>
<td>0.42</td>
<td>0.50</td>
<td>0.46</td>
<td>0.083</td>
</tr>
<tr>
<td><strong>Emission factor (2014-2015)</strong></td>
<td></td>
<td></td>
<td><strong>0.16%</strong></td>
<td><strong>0.10%</strong></td>
<td><strong>0.19%</strong></td>
<td><strong>0.14%</strong></td>
<td></td>
</tr>
</tbody>
</table>
$N_2O$ emissions - Terang (Chromosol)

![Graph showing $N_2O$ emissions with data points for different fertilizers and rainfall graphs for Jul 13 to May 15.]

- Flux (kg $N_2O-N/ha/day$)
- Rainfall (mm/day)
- Water filled pore space (%)

### Fertiliser applied:
- Nil
- Urea
- Urea + DMPP

### Dates:
- Jul 13
- Sep 13
- Nov 13
- Jan 14
- Mar 14
- May 14
- Jul 14
- Sep 14
- Nov 14
- Jan 15
- Mar 15
- May 15
**N₂O emissions - Terang (Chromosol)**

- **Flux (kg N₂O-N/ha/day)**
  - Nil
  - Urea
  - Urea + DMPP
  - UAN
- **Fertiliser applied**
  - Jul 13
  - Sep 13
  - Nov 13
  - Jan 14
  - Mar 14
  - May 14
  - Jul 14
  - Sep 14
  - Nov 14
  - Jan 15
  - Mar 15
  - May 15

- **Rainfall (mm/day)**
  - 0
  - 10
  - 20
  - 30
  - 40
  - 50

- **Water filled pore space (%)**
  - 0
  - 25
  - 50
  - 75
  - 100

- **Graph**
  - X-axis: Dates (Jul 13 to May 15)
  - Y-axis: Flux (kg N₂O-N/ha/day)
  - Rainfall (mm/day)
  - Water filled pore space (%)
## N₂O emissions – Terang (Chromosol)

<table>
<thead>
<tr>
<th></th>
<th>Days</th>
<th>Nil</th>
<th>Urea</th>
<th>UAN</th>
<th>Urea +DMPP</th>
<th>Urea +nBPT</th>
<th>l.s.d. (p=0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N₂O-N (kg N/ha)</strong></td>
<td>308</td>
<td>0.23</td>
<td>0.38</td>
<td>0.45</td>
<td>0.31</td>
<td>0.38</td>
<td>0.114</td>
</tr>
<tr>
<td><strong>Emission factor (2013-2014)</strong></td>
<td></td>
<td></td>
<td><strong>0.09%</strong></td>
<td><strong>0.13%</strong></td>
<td><strong>0.04%</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>N₂O-N (kg N/ha)</strong></td>
<td>327</td>
<td>0.50</td>
<td>0.73</td>
<td>0.82</td>
<td>0.59</td>
<td>0.68</td>
<td>0.189</td>
</tr>
<tr>
<td><strong>Emission factor (2014-2015)</strong></td>
<td></td>
<td></td>
<td><strong>0.18%</strong></td>
<td><strong>0.21%</strong></td>
<td><strong>0.06%</strong></td>
<td></td>
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</tr>
</tbody>
</table>
Change in N$_2$O emissions from urea with DMPP

![Graph showing change in N$_2$O emissions with water filled pore space. The graph indicates a decrease in N$_2$O emissions with increasing water filled pore space. The data points are labeled for Terang and Glenormiston.]
Summary

- Pastures were responsive to N fertiliser addition
- No positive or negative effect of inhibitors on pasture production
- $N_2O$ emission for N fertiliser 0.09 to 0.31% of applied N
- Emissions from fertiliser reduced by 0-65% by use of nitrification inhibitors
Acknowledgements

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Landholders
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