Fertiliser Efficiency - a member’s perspective
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Incitec Pivot Fertilisers

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Overview - Fertiliser Efficiency Gains

- Application efficiencies
  - Easier / faster / cheaper
  - Precision application
- Agronomic efficiencies
  - Matching of supply to demand
  - Application methods
  - Better products???
    - “Enhanced efficiency fertilisers”
    - EEF’s

Enhanced Efficiency Fertilisers

“Fertiliser products with characteristics that allow increased plant uptake and reduce the potential of nutrient losses to the environment such as gaseous losses, leaching, or runoff, as compared to an appropriate reference product.” (Stewart 2010, IFA EEF conference)

Products that:
- Are chemically altered e.g. urea formaldehyde
- Have a physical barrier e.g. polymer coated
- Carry a biological inhibitor e.g. Green UreaTM
- Use sequestration as a means of reducing chemical sorption in soils e.g. AVAIL®
How Do EEF’s Work?

- Retain fertiliser within a protective barrier until ready for plant use
- Release nutrients at a rate better aligned with plant demand
- Maintain nutrients in a form that are not susceptible to loss mechanisms
- Sequester elements that are likely to react with fertiliser nutrients
- Present nutrients in a form that plants prefer

**Figure 1**: The relationship between growth stage and N uptake in whole tops in high yielding wheat crops


**Pros and Cons of Using EEF’s**

**PROS**

- Reduce losses to environment:
  - leaching
  - denitrification
  - volatilisation
  - run off
- Better crop yield and / or quality per unit of nutrient
- Disease benefits in certain situations
- Possibility of using less nutrients
- Reduce number of applications

**CONS**

- Will not always get production improvements
- Not always effective in extremes of Australian environment
- Additional cost per unit of nutrient
Rye grass dry matter production (kg/ha) and cost per additional kg of production (cents/kg) after two cuts following a single application of product at Tocal, NSW, July - September 2009

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Urea rate kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Urea</td>
<td>1,467</td>
</tr>
<tr>
<td>Green Urea</td>
<td></td>
</tr>
<tr>
<td>Twin N®</td>
<td>1,433</td>
</tr>
<tr>
<td></td>
<td>(negative)</td>
</tr>
<tr>
<td>Pro Gibb®</td>
<td>1,513</td>
</tr>
<tr>
<td></td>
<td>(45,5)</td>
</tr>
</tbody>
</table>

Treatments applied 8/7/09, harvests taken 12/8/09 & 22/9/09

Source: N Griffiths, NSW I & I, 2009
Cumulative N losses from an application of 40 kg N/ha on ryegrass pasture at Murroon, SW Victoria April 2010

- After 15 days:
  - 29% urea lost
  - 7% Green Urea
- By using Green Urea:
  - Saved 8.8 kg of N
  - Potential gain 170 kg dry matter

Source: University of Melbourne, Murroon, Vic, 2010

Cumulative volatilisation loss of nitrogen (%) applied as fertiliser to the surface of an alkaline soil containing 7% CaCO3, relative to the total N loss from urea after 18 days.

All products were applied to the soil surface at 100 kg N/ha. Urea ammonium nitrate and ammonium nitrate were applied as liquids, all others as solids. All points are means of three replications of each treatment with standard error bars showing the variation.

Source: Schwenke and McMullen, NSW I & I, 2009
Improving the efficiency of urea in Australian agriculture using the urease inhibitor NBPT – 15 wheat case studies (*Triticum aestivum*)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield t/ha</th>
<th>Protein %</th>
<th>N fertiliser recovery in grain %</th>
<th>kg grain/kg N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>3.01</td>
<td>10.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urea top-dressed @ GS31</td>
<td>3.26</td>
<td>11.6</td>
<td>25.9</td>
<td>5.1</td>
</tr>
<tr>
<td>Urea + 0.1% NBPT @ GS31</td>
<td>3.40</td>
<td>11.9</td>
<td>32.1</td>
<td>7.9</td>
</tr>
<tr>
<td>l.s.d.</td>
<td>0.090</td>
<td>0.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.v.</td>
<td>7.7%</td>
<td>5.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Incitec Pivot Ltd

Nitrous oxide emissions reduction

*In all trials DMPP (Entec) has given a sig reduction in N₂O emissions*

*Trials in dairy, sugar and cropping*

Source: University of Melbourne, Dookie 2009
Reduction in nitrate entering waterways

Figure 3: Difference in nitrate-N concentrations in irrigation runoff water between ENTEC and standard fertiliser

Source: Milla et al 2009

Improving the efficiency of urea in Australian agriculture using the nitrification inhibitor DMPP - 26 wheat case studies (Triticum aestivum)

<table>
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<tr>
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<th>Yield t/ha</th>
<th>Protein %</th>
<th>N fertiliser recovery in grain %</th>
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</thead>
<tbody>
<tr>
<td>Control</td>
<td>3.40</td>
<td>10.5</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Urea banded at sowing</td>
<td>3.80</td>
<td>11.7</td>
<td>22.4</td>
<td>6.5</td>
</tr>
<tr>
<td>Urea with DMPP banded at sowing</td>
<td>3.90</td>
<td>11.7</td>
<td>28.4</td>
<td>8.3</td>
</tr>
<tr>
<td>l.s.d.</td>
<td>0.09</td>
<td>0.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. v.</td>
<td>8.13</td>
<td>4.93</td>
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</table>

Source: Incitec Pivot Ltd
Enhanced efficiency P fertilisers

<table>
<thead>
<tr>
<th>Product</th>
<th>P rate</th>
<th>¾ district rate</th>
<th>¾ district rate</th>
<th>District P rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAP</td>
<td>2.52</td>
<td>2.82</td>
<td>2.97</td>
<td>3.05</td>
</tr>
<tr>
<td>MAP + AVAIL®</td>
<td>2.78</td>
<td>2.92</td>
<td>3.21</td>
<td></td>
</tr>
</tbody>
</table>

Average of 9 trials located at (district P rate indicated in brackets):
* NSW: Tyngong (25) x 2; Oranup (25); Temora (20); Rand (20); Collembarry (28)
* Vic: Birchip (10); Narrabiel (15); Dunkeld (20)

Source: Incitec Pivot Ltd

Conclusions

* EEF’s are commercially available in Australia
* Some are not scientifically validated
* It appears likely that certain technologies will fit with specific crops and conditions
* Trained/skilled agronomists will be required to recommend where to and where not to use such products.
* Adoption is slow:
  * Farmers get few if any incentives to reduce off target losses of nutrients
  * Cost is a barrier
* Silver bullets on offer confuse farmers; therefore skilled/trained agronomists are needed
* The future - wider adoption driven by:
  * Potential to trade carbon credits
  * Lower cost as volume increases / patents lapse
  * Legislation
  * Better trained agronomists