The Signpost Series
‘Pointing the way to a low emissions agriculture’

Protected Urea

Dr Patrick Forrestal & Dr David Wall

Teagasc, Crops, Environment and Land-Use Programme, Johnstown Castle, Co Wexford
Sources of N?

- Biological fixation from legumes
- Manure – mineral and organic N
- Fertilisers
- Atmospheric deposition
Nutrients including N fertiliser: Where are the signs pointing over the next decade?

The **Farm to Fork Strategy** is at the heart of the **European Green Deal**

States the EU Commission’s intention to:

“act to reduce nutrient losses by at least 50%”

**Signals** “will reduce the use of fertilisers by at least a 20% by 2030”

**Why?**

Because, as outlined, nutrients not absorbed by plants are a

“major source of [air, soil] and [water pollution] and of [climate impacts]”

and

“It (fertiliser) has [reduced biodiversity] in rivers, lakes, wetlands and seas”

Source: EU Commission, 2020, Communication – A Farm to Fork Strategy for a fair, healthy and environmentally friendly food system
Why Protected Urea Now?

We need to show progress towards reduced emissions
Protected urea is the largest single tool on the table

• Yield – grows top yields ✓
• Cost – costs less than CAN ✓
• Greenhouse Gas – reduces emissions ✓
• Ammonia – holds onto N to grow grass ✓
• We get credit for reduced emissions ✓
What is protected N/urea?

- Urea N fertiliser made safe from ammonia gas loss with a urease inhibitor on surface or in melt

Ammonia

\[ \text{NH}_3 \]

Schematic of the mode of action of a urease inhibitor

Credit: BASF

Dr. Patrick Forrestal & Dr. David Wall
Teagasc Signpost Series 22-05-2020
### Urease inhibitors

- Three urease inhibitors are registered under the EU fertiliser regulations
  - NBPT (from: Koch & others)
  - NBPT+NPPT (from: BASF)
  - 2-NPT (from: SKW)
- Department of Ag. will be carrying out surveillance to check that regulatory levels are met at the point of sale
There are plenty of options: 18 options from 6 fertiliser companies on the Teagasc List.

<table>
<thead>
<tr>
<th>Company</th>
<th>Product Name</th>
<th>Inhibitor Type &amp; Name</th>
<th>N %</th>
<th>P %</th>
<th>K %</th>
<th>S %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grassland Fertilisers (Kilkenny) IFI</td>
<td>IFI Topper N-Sure</td>
<td>NBPT + NPPT (LIMUS)</td>
<td>46</td>
<td>-</td>
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<tr>
<td></td>
<td>IFI Super Topper N-Sure</td>
<td>NBPT + NPPT (LIMUS)</td>
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<td></td>
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<td></td>
<td>Eco N 38</td>
<td>NBPT + NPPT (LIMUS)</td>
<td>38</td>
<td>-</td>
<td>-</td>
<td>7.6</td>
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<tr>
<td></td>
<td>Eco 29-0-14 +S</td>
<td>NBPT + NPPT (LIMUS)</td>
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<td>14</td>
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<td></td>
<td>Alzon Neo-N</td>
<td>2-NPT + MPA</td>
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<tr>
<td></td>
<td>Alzon Neo-N + S</td>
<td>2-NPT + MPA</td>
<td>40</td>
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<tr>
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<td>NBPT (Agrotain)</td>
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<td></td>
<td>Sustain / KaN</td>
<td>NBPT (Agrotain)</td>
<td>38</td>
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<td>7</td>
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<tr>
<td></td>
<td>Sustain / KaN</td>
<td>NBPT (Agrotain)</td>
<td>29</td>
<td>-</td>
<td>14</td>
<td>3.5</td>
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<tr>
<td>NitroFert</td>
<td>Nitro Guard</td>
<td>NBPT + NPPT (LIMUS)</td>
<td>46</td>
<td>-</td>
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</tr>
<tr>
<td></td>
<td>Nitro Guard</td>
<td>NBPT + NPPT (LIMUS)</td>
<td>38</td>
<td>-</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Nitro Guard</td>
<td>NBPT + NPPT (LIMUS)</td>
<td>30</td>
<td>-</td>
<td>15</td>
<td>2</td>
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<tr>
<td>Target Fertilisers</td>
<td>UreaMax</td>
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<tr>
<td></td>
<td>UreaMax + S</td>
<td>NBPT + NPPT (LIMUS)</td>
<td>38</td>
<td>-</td>
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<td>29-0-14+4% S Max</td>
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<td>29</td>
<td>-</td>
<td>14</td>
<td>4</td>
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<tr>
<td></td>
<td>Yara Vera AMIPLUS</td>
<td>NBPT (AMIPLUS)</td>
<td>46</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Teagasc urea + NBPT Research - Gases

Ammonia

Nitrous oxide

Urea: EMEP/EEA emission inventory value used in Irish NH3 inventory
CAN and Urea+NBPT: by applying NH3 abatement of Forrestal et al., 2016 Soil Use & Mgt. 32: 92-100

Indirect N2O from NH3
Direct N2O: Hartly et al., 2016 Science of the Total Environment 563-564: 576-586
Indirect N2O from NH3 based on EMEP, Forrestal et al., 2016 Soil Use & Mgt. 32: 92-100 & IPCC default EF

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Teagasc urea + NBPT Research – Grass Production

Yield

Dry matter yield (kg/ha)

- Control
- CAN
- Urea
- Urea + NBPT

No significant fertiliser N effect on yield $P=0.087$

Pooled standard error of the mean = 94 kg DM/ha

N recovery

Nitrogen off take (kg/ha)

- Control
- CAN
- Urea
- Urea + NBPT

Pooled standard error of the mean = 5 kg N/ha

Forrestal et al. (2017) Soil Use & Management 33: 243-251
Protection from Ammonia loss in dry summer weather

Will a urease inhibitor protect urea from loss in dry summer conditions?
Yes, this is what it is what protected urea products are designed to do.

What happens to N response with High and climbing Soil Moisture Deficit?
Nitrogen is not a substitute for water (think 2018) growth response to protected urea and other N forms will be disappointing until Deficits decline, adding more N won’t change this.
Will protected urea cost more?

Work it out per kg/unit of N not per tonne

- E.g. Protected urea @ 385/t ÷ 460kgN/t = €0.84/kg N
- E.g. CAN @ 240/t ÷ 270kgN/t = €0.89/kg N

<table>
<thead>
<tr>
<th>Fertiliser</th>
<th>CAN</th>
<th>Protected urea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big bag (kg)</td>
<td>500</td>
<td>375</td>
</tr>
<tr>
<td>Nitrogen (%)</td>
<td>27</td>
<td>46</td>
</tr>
<tr>
<td>Big bag (kg N)</td>
<td>135</td>
<td>172.5</td>
</tr>
<tr>
<td>At 30 kg N/ha covers (ha)</td>
<td>4.5</td>
<td>5.7</td>
</tr>
<tr>
<td>At 24 units/ac covers (ac)</td>
<td>11.1</td>
<td>14.1</td>
</tr>
</tbody>
</table>
If the Greenhouse Gas and Ammonia abatement from fertiliser identified by Teagasc is to be availed of substantial change in fertiliser selection will be need.

Source: DAFM

2019 Fertiliser Sales Breakdown
c. 367,366 tonnes N costing c. 358 million euro

Source: DAFM
Nutrient advice?

One soil does not fit all!
Fertiliser N Requirement by Grass Swards

Typical Grass N Uptake rates over the season

Fertiliser N requirement

Background Soil N release rates from the SOM
Well-drained soils

Grass Growth (kg/ha/day)

Pro Urea = Urea + Urease Inhibitor

D.P. Wall, 2017
Grass Growth (kg/ha/day)

Spring

1

Summer

2

Autumn

3

4

Poorly-drained soils

Jan     Feb     Mar     Apr     May     Jun     Jul     Aug    Sep

Pro Urea = Urea + Urease Inhibitor

P: Build-up

K: Build-up

Lime

Sulphur

D.P. Wall, 2017
**Protected Urea - Grazing Fertiliser Programmes**

*Example fertiliser programmes integrating protected urea during the growing season for dairy and drystock farms at different stocking rates and soil test levels*

<table>
<thead>
<tr>
<th>Dairy</th>
<th>Table 1. Recommended rates of N, P &amp; K (kg/ha) &amp; fertiliser products (kg/ha).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm stocked at 210kg Org N/ha or <strong>2.5LU/ha</strong>. Soil P &amp; K levels assumed to be <strong>index 1</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Advice</th>
<th>Feb</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June / July</th>
<th>Sept</th>
<th>Total kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product (kg/ha)</strong></td>
<td>55 kg/ha Pro-Urea</td>
<td>310 kg/ha 18-6-12+S Pro-Urea</td>
<td>125 kg/ha Pro-Urea</td>
<td>310 kg/ha 18-6-12 Pro-Urea</td>
<td>60 kg/ha Pro-Urea</td>
<td>55 kg/ha Pro-Urea</td>
<td>248</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>250</td>
<td>25</td>
<td>56</td>
<td>58</td>
<td>56</td>
<td>28</td>
<td>25</td>
</tr>
<tr>
<td><strong>P</strong></td>
<td>39</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td><strong>K</strong></td>
<td>95</td>
<td>37</td>
<td>37</td>
<td>37</td>
<td>37</td>
<td>37</td>
<td>37</td>
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<tr>
<td><strong>S</strong></td>
<td>15</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td><strong>Cost €/ha</strong></td>
<td>21</td>
<td><strong>115</strong></td>
<td>48</td>
<td><strong>115</strong></td>
<td>23</td>
<td>21</td>
<td><strong>€343/ha</strong></td>
</tr>
</tbody>
</table>

*Pro-Urea = Urea 46% + NBPT / 2-NBPT, Cost/tonne = €380/t, Pro-Urea+S (40% N & 6% S)= €380/t, 18-6-12+ 3% S = €370, To convert units/ac to kg/ha multiply by 1.25. Apply 125kg/ha of MOP 50% once every 4 years.*

Further information available on the Teagasc Website

[https://www.teagasc.ie/crops/soil--soil-fertility/protected-urea/](https://www.teagasc.ie/crops/soil--soil-fertility/protected-urea/)

*Note: Complete a farm fertiliser plan to determine max. N &P allowances as per Nitrates Legislation*
Summary: why Protected Urea Now?

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