White clover: Improving Nitrogen use efficiency

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Overview

- Introduction – new challenges
- White clover – performance results (herbage and animal)
- White clover – Nitrogen (N) use efficiency
- Establishing white clover on farms
- Take home messages
Why white clover?

- Business as usual is not an option for the future
- Nitrates Derogation
  - Grass seed mixtures must contain clover
- Nitrogen source
  - Biological N fixation - 0 – 170 kg N/ha
- Animal and system performance
  - Industry economic gain - €60 million/year
- Sward white clover content is key (target 20%)
Relationship between fertiliser N, white clover content and BNF

Enriquez-Hidalgo et al., 2016
## White clover & managing N fertiliser

<table>
<thead>
<tr>
<th>White clover content</th>
<th>Visual assessment</th>
<th>Fertiliser management</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td><img src="image1.png" alt="Grass" /></td>
<td>N fertiliser after each grazing event (up to max allowed under Nitrates e.g. 250 kg N/ha)</td>
</tr>
<tr>
<td>25%</td>
<td><img src="image2.png" alt="Grass" /></td>
<td>N fertiliser in spring, reduce N fertiliser to $\frac{3}{4}$ or $\frac{1}{2}$ rate from May onwards</td>
</tr>
<tr>
<td>50%</td>
<td><img src="image3.png" alt="Grass" /></td>
<td>N fertiliser in spring, reduce N fertiliser to $\frac{1}{2}$ rate or less from May onwards</td>
</tr>
</tbody>
</table>
White clover farm systems research

- Moorepark experiment (2013 – 2016)
  - Grass only 250 kg N/ha/year
  - Grass + white clover 250 kg N/ha/year
  - Grass + white clover 150 kg N/ha/year
  - Stocking rate - 2.74 LU/ha (20 cows per treatment)

- Clonakilty experiment (2014 – 2017)
  - Tetraploid grass-only sward
  - Diploid grass-only sward
  - Tetraploid + white clover sward
  - Diploid + white clover sward
  - Stocking rate - 2.75 LU/ha (30 cows per treatment)
  - Nitrogen fertiliser application rate – 250 kg N/ha
## Benefits of white clover

<table>
<thead>
<tr>
<th>Moorepark Experiment (2013 – 2016)</th>
<th>Grass-only 250 kg N/ha</th>
<th>Grass-clover 250 kg N/ha</th>
<th>Grass-clover 150 kg N/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk yield (kg/cow)</td>
<td>6,108</td>
<td>6,498</td>
<td>6,466</td>
</tr>
<tr>
<td>Milk solid yield (kg/cow)</td>
<td>460</td>
<td>496 (+ 7.5%)</td>
<td>493</td>
</tr>
<tr>
<td>Herbage production (t DM/ha)</td>
<td>13.6</td>
<td>14.0</td>
<td>13.6</td>
</tr>
<tr>
<td>Sward white clover content (%)</td>
<td>-</td>
<td>23</td>
<td>27</td>
</tr>
</tbody>
</table>

- + 11.0%
- + 7.7%
Moorepark Exp. - N use efficiency

<table>
<thead>
<tr>
<th></th>
<th>Gr250(^1)</th>
<th>Cl250</th>
<th>Cl150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk solids yield (kg MS/ha)</td>
<td>1,261(^a)</td>
<td>1,373(^b)</td>
<td>1,337(^b)</td>
</tr>
<tr>
<td>Fertiliser applied (kg N/ha)</td>
<td>229</td>
<td>232</td>
<td>156</td>
</tr>
<tr>
<td>Total N input (kg N/ha)</td>
<td>249(^a)</td>
<td>250(^a)</td>
<td>175(^b)</td>
</tr>
</tbody>
</table>

\(^1\)Gr250 = Grass-only 250 kg N/ha; Cl250 = Grass-clover 250 kg N/ha; CL150 = Grass-clover 150 kg N/ha
On-farm white clover study

- Evaluate white clover on commercial dairy farms
- Diverse geographical locations and soil types
- Clover over-sown on farms in 2016
  - Immediately after grazing
  - Over a 4 week period on each farm
  - Clover stitched in
Average on-farm sward clover content: 2017-2019

<table>
<thead>
<tr>
<th>Farm</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>12%</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>13%</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>14%</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>18%</td>
</tr>
</tbody>
</table>
How to establish a white clover sward?

- Can be established using two methods
  - Direct reseeding or Over-sowing

- **April/May** - best time - adequate soil moisture
- Grazing management post-sowing is critical
Management for white clover to work

- Currently – 18% of farms capable of establishing clover
  - Only 18% dairy farms at optimum soil fertility

- Spring N  (Enriquez-Hidalgo et al., 2014; Laidlaw 1980)
- Early spring grazing  (Woodfield and Clark, 2009; Burdon, 1983)
- Appropriate covers  (Harris and Clark, 1996, Woodfield and Clark, 2009)
- Residuals  (Harris and Clark, 1996, Woodfield and Clark, 2009)
- Reduced summer N  (Ledgard et al., 2001; Enriquez-Hidalgo et al., 2016)
- Close high white clover content paddocks late  (Black et al., 2009)
Take home messages

- White Clover: major opportunity to improve efficiency of grazing
  - 7% to 11% increase in animal performance
  - Reduce N fertiliser use
  - Increase N-use efficiency

- White clover can be successfully over-sown on-farms
  - Improvement need in soil fertility
  - Timing and management are key

- Business as usual is not an option!!
Thank you!

Questions?