Why white clover?

The benefits of clover can be broken into 2 main categories:

1. Animal
   - Dry matter intake
   - Feed quality
   - Animal performance
2. Sward
   - Herbage growth
   - Nitrogen use

Michael Egan, Soil Fertility Conference, Kilkenny 17th October
Why white clover?

- Little or no clover in majority of Irish grass swards
- Renewed interest in the use of white clover
  - Higher cost of fertiliser

Fertiliser N:Milk price ratio

![Graph showing the fertiliser N:Milk price ratio from 1990 to 2010. The ratio increases over time.](image-url)
What do we want – best of both worlds

- Increased outputs from reduced inputs
  - Economically and environmentally sustainable
- How much clover do you need?

- Animal Performance > 20%
- Nitrogen Fixation > 25%
- Herbage Production > 30%
Increased animal performance

- Milk Solids yield (kg/cow/day)
- Sward clover content (%)

Graph showing the milk solids yield and sward clover content over different months from 16-Feb to 16-Nov.
The white clover plant
Sward white clover content

Spring: 5% white clover
Summer: 26% white clover
Autumn: 52% white clover

Autumn: 52% white clover
Sward white clover content

Summer: 26% white clover
Sward white clover content

Autumn: 52% white clover
Nitrogen Fertiliser

- Nitrogen kills clover
- It is generally accepted that the application of N fertiliser results in a reduction in sward clover content (Reid 1970; Frame & Newbould 1986; Davies 1992; Enriquez-Hidalgo 2014).

Effect of high rates of nitrogen fertiliser on white clover growth, morphology, and nitrogen fixation activity in grazed dairy pasture in northern New Zealand

White clover or nitrogen fertiliser for dairying?

S. L. Harris & D. A. Clark

Nitrogen fertiliser effects on white clover in dairy pastures

S.L. HARRIS, D.A. CLARK, C.D. WAUGH and F.H. CLARKSON

Agronomy Society of New Zealand Special Publication No. 11 / Grassland Research and Practice Series No.
What is actually happening?

- White clover can utilise N fertiliser similar to grass – much slower uptake (Ledgard & Saunders 1982)
- Uneven uptake of N fertiliser – accelerating grass growth rates
- Leading to taller plants and increased competition for light, water and nutrients
  - Shading
What is actually happening?

- Overall herbage yield can increase
  - Masks a reduction in clover yield
How do we promote clover growth?

- What dose white clover need for growth and persistence?
- Fertile soils
  - Soil temperature > 8°C
  - Sunlight
- Good grassland management promotes clover growth
  - Graze to 4 cm
  - Frequent grazing – 18 – 21 day rotation mid-season
  - 1200 – 1500 kg DM/ha pre grazing herbage mass
Nitrogen Fixation

Legume based cropping system

N\textsubscript{2}

Crop residue

Mineral Nitrogen

Biological Nitrogen Fixation

Decomposition

Michael Egan, Soil Fertility Conference, Kilkenny 17\textsuperscript{th} October
Nitrogen Fixation

- Clover can fix between 10 to 185 kg N/ha/yr
  - Average sward clover content > 20% - peak 45%
- Symbiotic relationship between clover and rhizobia
  - They benefit each other – nothing for nothing in this world
- Each 1 g of N fixed requires 6 g of Carbon
  - BNF very energy demanding
- Swards reliant solely on BNF are N deficient
N fertiliser application and sward type

Grass production - 4 year average

- **Grass only**
- **Grass clover**

<table>
<thead>
<tr>
<th>N application rate (kg N/ha)</th>
<th>Grass Production (t DM/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 N</td>
<td>4.2 t DM/ha</td>
</tr>
<tr>
<td>20 N</td>
<td>13.1 % clover, 49% BNF</td>
</tr>
<tr>
<td>180 N</td>
<td>1.8 t DM/ha</td>
</tr>
<tr>
<td>180 N</td>
<td>8 % clover, 24% BNF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clover content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 N</td>
</tr>
<tr>
<td>60 N</td>
</tr>
<tr>
<td>120 N</td>
</tr>
<tr>
<td>180 N</td>
</tr>
<tr>
<td>240 N</td>
</tr>
</tbody>
</table>

| N fixation (kg N/ha; 2011 - 2013)¹ | 220 | 205 | 148 | 122 | 112 |

¹ Calculated using the N difference method, Enriquez-Hidalgo et al., Grass Forage Science, 2016
### Moorepark & Clonakility Research

#### Pasture DM Production

<table>
<thead>
<tr>
<th></th>
<th>Grass (t DM/ha)</th>
<th>Grass+clover (t DM/ha)</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture DM production</td>
<td>15.4</td>
<td>16.5</td>
<td>↑ 7 %</td>
</tr>
</tbody>
</table>

#### Sward Clover Content (%)

<table>
<thead>
<tr>
<th></th>
<th>Grass</th>
<th>Grass+clover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sward clover content (%)</td>
<td>-</td>
<td>27</td>
</tr>
</tbody>
</table>

#### Clover DM Yield (kg DM/ha)

<table>
<thead>
<tr>
<th></th>
<th>Grass</th>
<th>Grass+clover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clover DM yield (kg DM/ha)</td>
<td>-</td>
<td>4.5</td>
</tr>
</tbody>
</table>

**Diagram Details:**
- **Grass-only** line starts low and increases sharply in spring, then decreases gradually through summer and autumn.
- **Grass-clover** line starts higher than the grass-only line, showing no difference in spring growth, a slight increase in mid-season (+15 kg/ha/day), and a decrease over winter (-2.5 kg/ha/day).

**Legend:**
- Red line: Grass-only
- Blue line: Grass-clover
Where to now?

- White clover has a huge role to play in Irish Agriculture
  - Production
  - Cost
  - Environmental

- Grass and clover swards need Nitrogen
  - How much?
  - When?
Strategic use on Nitrogen

- N fixed from clover may not be sufficient for intensive production systems
- However, including clover under high levels of N reduced BNF
- Clover can contribute to intensive milk production systems (2.75 cows/ha) receiving 120 – 150 kg N/ha/yr
  - 70% applied by mid-May
Reduced nitrogen use
Grass-clover 150 kg N/ha = 14.4 t DM/ha vs. Grass-only 250 kg N/ha = 14.5 t DM/ha

Michael Egan, Soil Fertility Conference, Kilkenny 17th October
**Fertiliser application**

- **Grass**: 250 kg
- **Clover**: 150 kg

- Mid-January
- Mid-March
- April (2nd rot)
- May (3rd & 4th rot)
- June (5th rot)
- July (6th & 7th rot)
- August (8th rot)

**Fertiliser application**

Michael Egan, Soil Fertility Conference, Kilkenny 17th October
Take home

- Nitrogen doesn’t kill clover
  - It can lead to a reduction in sward clover content
- Clover utilises N similar to grass
- BNF is highly energy demanding on the plant
- Improved grazing management can somewhat negate the negative effect of N on clover
Conclusion

- Clover has a significant role in Irish Agriculture
- Including clover in grass swards
  - Strategically reduce Nitrogen fertiliser across the year
  - Apply 120 to 150 kg N/ha
- Improved grazing and Nitrogen management to maintain sufficient sward clover content
Thank you for your attention