The Case for Clover: Benefits and Blueprints

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SAC

Soil Association Climate Change Programme: Grass & Clover Management, Blairgowrie, 22nd September 2011
Outline

• Why you shouldn’t bother with fertilizer N for grassland
• White and red clover: where and why
• White and red clover: blueprints
• Nutrient Management
• Weed issues
Response of grass-only and grass-clover swards to fertiliser N (Source: UK GM23 trial results)

Fertiliser N equivalent of Grass/white clover is almost 200kgN/ha
FERTILISER USE ON GRASSLAND
SCOTLAND 2010 (Source: The British Survey of Fertiliser Practice)

<table>
<thead>
<tr>
<th>Management</th>
<th>N</th>
<th>P$_2$O$_5$</th>
<th>K$_2$O</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Kg/ha</td>
<td></td>
</tr>
<tr>
<td>Grazed only</td>
<td>45</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Silage only</td>
<td>119</td>
<td>30</td>
<td>42</td>
</tr>
<tr>
<td>Silage/grazed</td>
<td>122</td>
<td>29</td>
<td>43</td>
</tr>
<tr>
<td>Hay/grazed</td>
<td>88</td>
<td>21</td>
<td>29</td>
</tr>
<tr>
<td>All grass</td>
<td>64</td>
<td>16</td>
<td>19</td>
</tr>
</tbody>
</table>
Nutrients (1) applied (kg/ha) to crops and grass: 1986-2010

- kg/ha of Nitrogen (N)
- kg/ha of Phosphate (P2O5)
- kg/ha of Potash (K2O)

(1) Inorganic fertilisers only - excludes organic fertilisers such as sewage sludge and farmyard manure.

(2) The survey year runs from autumn (previous year) to autumn (given year), e.g. 2009 relates to the period September 2008 to August 2009.
Estimated percentage increase in profitability per hectare from growing and feeding a legume or grass/legume silage, relative to grass receiving 200kgN/ha/ann\(^1\) (Legsil, UK results)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Percent</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Clover</td>
<td>17.8</td>
<td>4</td>
</tr>
<tr>
<td>Red Clover</td>
<td>29.2</td>
<td>1</td>
</tr>
<tr>
<td>Lucerne</td>
<td>20.7</td>
<td>3</td>
</tr>
<tr>
<td><strong>High legume content</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grass-White Clover</td>
<td>16.5</td>
<td>5</td>
</tr>
<tr>
<td>Grass-Red Clover</td>
<td>22.5</td>
<td>2</td>
</tr>
<tr>
<td>Grass-Lucerne</td>
<td>12.9</td>
<td>7</td>
</tr>
<tr>
<td><strong>Low legume content</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grass-White Clover</td>
<td>11.7</td>
<td>8</td>
</tr>
<tr>
<td>Grass-Red Clover</td>
<td>16.4</td>
<td>6</td>
</tr>
<tr>
<td>Grass-Lucerne</td>
<td>9.7</td>
<td>9</td>
</tr>
<tr>
<td>Grass(^2)</td>
<td></td>
<td>13</td>
</tr>
</tbody>
</table>

\(^1\)Ignoring any organic premium on milk

\(^2\)Grown conventionally, receiving 200kgN/ha/ann.
## Comparison of four silage options: cost of feed nutrients

<table>
<thead>
<tr>
<th></th>
<th>G/C (2 cut) 200kgN</th>
<th>G/WC (2 cut)</th>
<th>G/RC (2 cut)</th>
<th>Barley/pea</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (£/ha)</td>
<td>576</td>
<td>422</td>
<td>446</td>
<td>402</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silage yield (tDM)</td>
<td>7.4</td>
<td>6.4</td>
<td>7.4</td>
<td>7.1</td>
</tr>
<tr>
<td>Energy yield (GJ/ha)</td>
<td>81.8</td>
<td>70.1</td>
<td>81.8</td>
<td>73.5</td>
</tr>
<tr>
<td>Protein yield</td>
<td>967</td>
<td>829</td>
<td>1,116</td>
<td>952</td>
</tr>
<tr>
<td>(kgCP/ha)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cost of nutrients</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p/kg DM</td>
<td>7.7</td>
<td>6.6</td>
<td>6.0</td>
<td>5.6</td>
</tr>
<tr>
<td>p/MJ energy</td>
<td>0.70</td>
<td>0.60</td>
<td>0.54</td>
<td>0.55</td>
</tr>
<tr>
<td>p/kg crude protein</td>
<td>59.6</td>
<td>51.0</td>
<td>39.9</td>
<td>47.0</td>
</tr>
</tbody>
</table>
Milk yield of cows grazing ad lib perennial ryegrass or white clover (unsupplemented) between weeks 4 and 18 of lactation

Direct response: 300 litres
Residual response: 630 litres
Total lactation yield: grass: 4730 litres
white clover: 5660 litres
Liveweight gains of lambs grazed or fed on legumes or grasses (source: Greenhalgh)
Intake and performance of beef cattle given red clover or grass silage

<table>
<thead>
<tr>
<th></th>
<th>Perennial ryegrass</th>
<th>Red clover</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-value</td>
<td>72</td>
<td>61</td>
</tr>
<tr>
<td>DM intake (kg/hd/d)</td>
<td>7.2</td>
<td>7.9</td>
</tr>
<tr>
<td>Liveweight gain (kg/hd/d)</td>
<td>0.77</td>
<td>0.88</td>
</tr>
</tbody>
</table>
### Intake and Performance of Beef Cattle Given Red Clover or Grass Silage of Similar Digestibility

<table>
<thead>
<tr>
<th></th>
<th>Perennial ryegrass</th>
<th>Red clover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digestibility (%DMD)</td>
<td>71</td>
<td>70</td>
</tr>
<tr>
<td>DM intake (kg/hd/d)</td>
<td>5.6</td>
<td>7.8</td>
</tr>
<tr>
<td>Liveweight gain (kh/hd/d)</td>
<td>0.74</td>
<td>0.98</td>
</tr>
</tbody>
</table>
Importance of high clover content to achieve high total herbage yield (Source: Frame & Newbould,)

(a) NIL NITROGEN

Y = -0.213 + 0.76x (r = 0.80)

White Clover (t/DM ha)

Total Herbage (t/DM ha)
White and red clovers: Where and why
White clover: Where and why

- Stoloniferous plant ∴ very persistent
- Productive under both grazing and cutting
- Well adapted to any type of management
- Persistent
White clover
• Seed mixtures
  – Clover varietal type depends on purpose, duration of sward
  – Use tetraploid varieties of PRG
  – Use predominantly late varieties of PRG
  – Sow 3-5 kg/ha of clover seed

Small-leaved varieties for long-duration leys, sheep grazing;
Large-leaved varieties for shorter-duration leys, cutting management
Relationship between white clover leaf size and Dry Matter yield
Relationship between white clover leaf size and persistence

![Graph showing the relationship between white clover leaf size and persistence. The x-axis represents clover leaf size, and the y-axis represents persistence (% ground cover). Different varieties are plotted on the graph, categorized into small-leaved, medium-leaved, and large-leaved varieties.](image-url)
Establishment (*ploughed seedbed*)

- Well-drained fields
- Ensure satisfactory lime, phosphate and potash status in soil
- Direct sow or undersow with arable silage
- Fine, well-consolidated seedbed; roll *before* as well as *after* sowing
- Broadcast (or drill with coulters trailing on surface)
- Weed control by topping, or judicious grazing
Establishment of white clover: effect of cover crop, fertiliser N & sowing date

![Graph showing the number of clover growing points from April to November for different treatments: Undersown April (80kgN/ha), Undersown April (130kgN/ha), Direct sown April (130kgN/ha), Direct sown April (0kgN/ha), Direct sown August (30kgN/ha).]
Blueprint for white clover-based sward (3)

• Establishment (*oversowing*)
  – Well-drained fields
  – Ensure satisfactory lime, phosphate and potash status in soil
  – Success unlikely in very dense natural swards
  – Graze existing sward right down
    • before sowing and for rest of season
  – Sow early in spring
    • plentiful soil moisture
    • long season for seedlings to establish
  – Broadcast clover at 5kg/ha in mixture with PRG at 5kg/ha
Oversowing white clover into existing pasture: Results of EFFECT project

- Buntait A
- Buntait B
- Cannahars A

Percent clover ground cover over time:
- May/June '98
- Autumn '98
- Autumn '99
- Autumn '00
- Autumn '01
Blueprint for white clover-based sward (4)

• Maintenance
  – Ensure soil P, K and lime status is maintained
  – Alternate grazing with cutting during growing season if possible
  – Graze with sheep or youngstock October to December
Effect of sheep grazing in winter on clover content in subsequent seasons

<table>
<thead>
<tr>
<th>Grazing Method</th>
<th>1983</th>
<th>1984</th>
<th>1985</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard grazed in November</td>
<td>29</td>
<td>23</td>
<td>35</td>
</tr>
<tr>
<td>Hard grazed 3 times over winter</td>
<td>22</td>
<td>29</td>
<td>40</td>
</tr>
<tr>
<td>Not grazed in winter</td>
<td>29</td>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>
Effect of clover content and age of ley on estimated N-fixation

<table>
<thead>
<tr>
<th>Clover content (% ground cover)</th>
<th>10-29</th>
<th>30-49</th>
<th>&gt;49</th>
</tr>
</thead>
<tbody>
<tr>
<td>KgN/ha</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age of ley (years):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st, 2nd</td>
<td>80</td>
<td>157</td>
<td>248</td>
</tr>
<tr>
<td>3rd, 4th, 5th</td>
<td>47</td>
<td>84</td>
<td>128</td>
</tr>
</tbody>
</table>

Source: (Kristensen et al, 1995)
Red clover: Where and why

- Grows from a crown easily damaged
- Assume 2-3 years duration
- Very productive under cutting management
- Not well adapted to grazing management
- Oestrogen effects, bloat
- Specialist mixture for
  - Two cuts silage plus autumn grazing with lambs
Red clover
Fertiliser N equivalent value of red clover yields over time

(Source, Frame)
Blueprint for red clover sward (1)

• Seed mixtures
  – Broad Red high yielding but less persistent (e.g. Merviot, Milvus), Late Red lower yielding but more persistent:
  – Select varieties with good resistance to stem eelworm
  – Sow with Italian or hybrid ryegrass for high yield and moderate crude protein (CP) content
  – Sow with intermediate perennial ryegrass or no companion grass for lower yield but higher CP content
  – Seed rate
    • 8-10 kg/ha (plus companion) for productive two year sward
    • 12-15 kg/ha (plus companion) for productive three year sward
Blueprint for red clover sward (2)

• Establishment (*ploughed seedbed*)
  – Well-drained fields
  – Ensure satisfactory lime, phosphate and potash status in soil
  – Direct sow or undersow with arable silage
  – Do not sow with short variety of barley for grain crop
  – Fine, well-consolidated seedbed; roll *before* as well as *after* sowing
  – Broadcast (or drill with coulters trailing on surface)
Blueprint for red clover sward (3)

- **Maintenance**
  - Ensure soil P, K and lime status is maintained (a red clover silage sward can remove 280kg/ha potash per annum)
  - Take two (or three) cuts of silage annually – not hay, not grazing, except autumn aftermath grazing
  - Wilt crop to 30-35% if possible, otherwise use an additive
  - Avoid excessive vehicle traffic
  - Graze carefully with fattening lambs between October and December
Control of bloat

• Occurs mostly in mid-late season
  – Silage aftermaths, late season grazings

• Turn cattle onto aftermaths immediately after harvest (allows clover to grow to the cattle)

• Do not turn cattle onto rank (e.g. 10-15cm), clover-rich swards, especially if hungry

• If forced to do so, feed Bloat Guard from 2-3 days prior to entry
  – 2g per 100kgLW, mixed in carrier feed

• Feed straw in a ring feeder
Nutrient management

- Soil sample every 5 years
- Sample 2 years before reseeding
- Correct deficiencies
- Lime if necessary
- Phosphate build soil fertility & also apply soluble at sowing
- Potash – use FYM if available
- SAC Technical notes
N recommendations for clover

• Red Clover – no N
• Grass/WC – small applications up to mid season only
## P & K recommendations for clover (establishment)

<table>
<thead>
<tr>
<th></th>
<th>Low $P_2O_5$ Kg/Ha</th>
<th>Mod $P_2O_5$ Kg/Ha</th>
<th>Low $K_2O$ Kg/Ha</th>
<th>Mod $K_2O$ Kg/Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass/ High Clover</td>
<td>110</td>
<td>70</td>
<td>90</td>
<td>70</td>
</tr>
<tr>
<td>Grass</td>
<td>90</td>
<td>50</td>
<td>70</td>
<td>50</td>
</tr>
</tbody>
</table>
## Effect of pH on Plants

<table>
<thead>
<tr>
<th>Crop</th>
<th>Optimum</th>
<th>Tolerance Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>6 - 6.5</td>
<td>5.8 – 7.2</td>
</tr>
<tr>
<td>Oats</td>
<td>5.2 – 6.2</td>
<td>5.0 – 6.8</td>
</tr>
<tr>
<td>Rye</td>
<td>4.8 – 5.5</td>
<td>4.2 – 6.2</td>
</tr>
<tr>
<td>White Clover</td>
<td>6.0 – 6.8</td>
<td>5.5 – 7.8</td>
</tr>
<tr>
<td>Ryegrass</td>
<td>5.8 – 6.2</td>
<td>5.0 – 7.2</td>
</tr>
</tbody>
</table>

- Source: Soils by Ken Simpson
### Response of grass to spring phosphate

<table>
<thead>
<tr>
<th></th>
<th>No Phosphate</th>
<th>22.5kg/ha</th>
<th>45kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Very Low P</strong></td>
<td>100</td>
<td>121</td>
<td>127</td>
</tr>
<tr>
<td><strong>Low P</strong></td>
<td>100</td>
<td>107</td>
<td>112</td>
</tr>
<tr>
<td><strong>Moderate P</strong></td>
<td>100</td>
<td>101</td>
<td>103</td>
</tr>
</tbody>
</table>

- Scottish Agricultural Colleges 1984/5
Effect Of K Application On Per Cent Ground Cover Of White Clover

Year
Per cent clover ground cover

- 0 kgK2O/ha
- 180 kgK2O/ha
- 360 kgK2O/ha
## Fertiliser value of FYM

<table>
<thead>
<tr>
<th></th>
<th>Readily available N (kg/tonne)</th>
<th>Total P (kg/tonne)</th>
<th>Total Potash (kg/tonne)</th>
<th>Available N 20t/ha applied</th>
<th>Total P 20t/ha applied</th>
<th>Total Potash 20t/ha applied</th>
<th>Financial Value (£) 20t/ha applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle FYM (Fresh)</td>
<td>1.2</td>
<td>3.2</td>
<td>8.0</td>
<td>24</td>
<td>64</td>
<td>160</td>
<td>185</td>
</tr>
<tr>
<td>Cattle FYM ( Stored)</td>
<td>0.6</td>
<td>3.2</td>
<td>8.0</td>
<td>12</td>
<td>64</td>
<td>160</td>
<td>174</td>
</tr>
</tbody>
</table>
Minimising weed invasion in grassland
Minimising weed (dock) invasion in grassland

- **Regular reseeding** *(temporary leys)*
- **Avoid cutting same fields year after year**
- Topping
- Hand pulling/spading
- Surface rotavation and dessication
  - Followed by deep ploughing
- Plough, stone separate
- Goats/pigs
- Use a high seed rate at reseeding

**Prevention**

**Minimising spread**

**Control** *(desperation)*
Change in relative yield of dock-infested swards over time, under cutting or grazing management (extracted from Courteny, 1985)
Effect of summer rotavation, fallowing and ploughing on population of mature docks

- No cultivation
- Ploughing Sept
- Rotavate once July
- Rotavate twice July

Number of dock plants

Jun-06 Jul-06 Aug-06 Sep-06 Oct-06 Nov-06 Dec-06 Jan-07 Feb-07 Mar-07 Apr-07 May-07
Other weed issues

- Currently no effective clover safe herbicides
- Annual weeds – sheep grazing 1st autumn
- Spear thistles – summer topping
- Creeping thistles – continual topping will exhaust plants eventually.