Enhancing the Role of Red Clover for Sustainable UK Agriculture

Raymond Jones, Michael Abberton and Richard Weller

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Interest in alternative forage crops is increasing as farms are striving to reduce both their feed input costs and their reliance on purchased high protein concentrates. The current focus on agricultural sustainability is to improve livestock production from home-grown forage crops and to reduce imported chemicals applied to crops.

Red clover is a well established legume that meets these new demands and provides a high protein forage. The plant is usually grown in a mixed grass/clover sward but can be grown as a pure stand. The objectives of this article are to encourage the use of red clover as a valuable farm resource, whilst minimising some perceived problems. We aim to do this by advocating appropriate management and by breeding for better varieties.

Benefits
The benefits of red clover include the conversion of atmospheric nitrogen into a plant usable form, so reducing N fertiliser use; improved soil fertility; improved soil structure; high yield (10 -15 tonnes DM/ha), and flexibility (can be harvested for high quality silage; quality aftermath for finishing lambs or beef; suitable for conventional & organic systems; valuable in arable rotations).
Establishment and management

Red clover can be established by conventional ploughing, direct seeding, tine harrow application or broadcast seeding. It is preferable to sow red clover from April to August ensuring that soil pH is approximately 6.0 with a P and K index of 2+. Seed rate for mixed swards of red clover and grass should be 7 kg/ha (3 kg/acre) red clover and 22 kg/ha (9 kg/acre) of Italian or hybrid ryegrass. Good establishment can be achieved when red clover is undersown in a spring barley crop.

Red clover is best suited as a conservation crop with 3-4 cuts of silage taken each year allowing 6-8 weeks between cuts. A cutting height should be chosen to avoid damaging the growing crown. The lighter autumn re-growth can be grazed for finishing lambs or beef cattle. Within this framework, some of the perceived concerns of feeding red clover to sheep (bloat and reduced fertility) can be adequately managed. Bloat can be minimised by avoiding putting hungry stock into clover rich fields. Risk of bloat is negligible from feeding red clover silage. Red clover can contain phyto-oestrogens which can reduce ovulation rates in sheep. Providing breeding ewes are removed from grazing red clover 6 weeks before and 6 weeks after tupping then the risk of reduced fertility is negligible.

Harvesting for silage

Crops should be ensiled at 25 - 35% DM to avoid losses during wilting. Excess wilting leads to leaf shatter and lower feed quality. Red clover has a high buffering capacity and low soluble carbohydrate content. Good fermentation can be achieved when ryegrass/red clover crops are ensiled using an inoculant additive. Typical analysis results for red clover/ryegrass silage are shown in table 6.1.

Red Clover for Lamb Finishing

A recent experiment conducted at IGER with Suffolk cross Mule lambs grazing either red clover or ryegrass from weaning until they reached fat-class 3L highlights the nutritive benefits from red clover (Table 6.2). By grazing lambs on red clover growth rates can be increased and time to finish reduced without compromising carcass quality compared to those grazed on grass only. In addition, lambs grazing red clover have heavier carcasses due to a higher killing out percentage.

Red clover in organic systems

Red clover is an important conservation crop on many organic livestock farms and is mainly sown in a mixture with either Italian or hybrid ryegrass to provide forage for conservation as silage. On organic farms red clover is often undersown in spring barley crops and, once established, provides three silage cuts per year.

### Table 6.1 Typical analysis of red clover/ryegrass silage

<table>
<thead>
<tr>
<th></th>
<th>Red Clover</th>
<th>Ryegrass</th>
<th>s.e.d</th>
<th>Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metabolisable Energy</td>
<td>9.8 - 11.4 M J/kg DM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crude Protein</td>
<td>14 - 19 %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>4.0 - 4.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ammonia - N</td>
<td>&lt;5% of total nitrogen</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 6.2 Lamb performance from grazed red clover or ryegrass

<table>
<thead>
<tr>
<th></th>
<th>Red Clover</th>
<th>Ryegrass</th>
<th>s.e.d</th>
<th>Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth rate (g/day)</td>
<td>229</td>
<td>182</td>
<td>20.3</td>
<td>*</td>
</tr>
<tr>
<td>Days to finish</td>
<td>40</td>
<td>49</td>
<td>2.7</td>
<td>**</td>
</tr>
<tr>
<td>Eye muscle depth (mm)</td>
<td>27.1</td>
<td>25.9</td>
<td>0.68</td>
<td>ns</td>
</tr>
<tr>
<td>Subcutaneous fat depth (mm)</td>
<td>4.1</td>
<td>3.9</td>
<td>0.31</td>
<td>ns</td>
</tr>
<tr>
<td>Cold carcass weight (kg)</td>
<td>18.8</td>
<td>17.7</td>
<td>0.38</td>
<td>*</td>
</tr>
<tr>
<td>Killing out %</td>
<td>51</td>
<td>48</td>
<td>0.7</td>
<td>*</td>
</tr>
</tbody>
</table>
Red clover is a reliable crop for organic systems and via N-fixation contributes to the N-requirement of both the current and succeeding crops. It is adaptable to different soils and regions and has a deep rooting system that is beneficial in organic rotations. To maintain soil P and K status, two applications of slurry are normally applied during the growing season. To avoid the risk of disease problems (e.g., stem eelworm) red clover should not be continuously grown in the same field. A red clover crop would typically be maintained in a portion of the farm for 3 years. Thereafter, there should be a 5-6 year gap before the next red clover sward is established. As indicated above, red clover should be managed such that it is grown principally for silage making from May to September. Thereafter, the crop can be grazed in the autumn period under careful management to avoid problems with bloat and damage to plant crowns.

Weeds (primarily docks) are not normally a problem when red clover swards are grown in a rotation on organic farms, providing an adequate seed rate/acre is used (e.g. 8 kg of ryegrass + 3.5 kg red clover + 1/2 kg of Timothy) to ensure good establishment.

In many organic systems there is a shortage of protein in the winter. To overcome this problem red clover is now being successfully grown as a monoculture, leading to the production of silage with a crude protein content of 19.5%. However, silage, whether ensiled from mixed clover/grass swards or from pure red clover crops, is a palatable forage for organic livestock and has the potential to increase both feed intake and animal performance.
Red clover breeding

The resurgence in interest in the use of red clover led in 1998 to DEFRA funding for the re-commencement of a red clover breeding programme at IGER after a gap of more than fifteen years.

The main objectives of this breeding programme are:

(i) Higher yields in the third year and beyond. At the moment yields beyond the second year are unreliable and inconsistent although good yields can be obtained under some circumstances.

(ii) Enhanced grazing tolerance. The ability of current varieties to withstand aftermath grazing by sheep is limited in many cases. Improvements in this area will allow farmers greater flexibility in their use of red clover and reduce the chances of crop failure.

(iii) Pest and disease resistance. The major pest of red clover is the eelworm or stem nematode. Eelworm infected plants are stunted with swollen and distorted stems and/or flowers. The most important disease is clover rot caused by a fungus (Sclerotinia). Both can cause devastating yield losses and contributed to the decline in the use of red clover in the 1960s.

Additionally, we are focusing on aspects of red clover as a quality feed. In particular we have produced red clover varieties that have reduced levels of the major phyto-oestrogen. These compounds can reduce fertility, particularly in ewes, and a variety with lower levels would increase the versatility of the crop.

Evaluation of plant material is carried out initially as single plants to be followed by assessment of performance in plots. This is underpinned by experiments to increase our understanding of the physiological bases of important agronomic traits. To this we will add the development of molecular approaches to facilitate greater speed and precision of selection and the incorporation of new traits relating to nutritional value and environmental impact into the germplasm improvement programme. This programme has already led to the submission of candidate varieties for National List testing.

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