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Red Clover – Worth a Try

With its high yielding ability, forage quality and suitability for silage, red clover could play a more important role than at present in environmentally-friendly, sustainable systems of grassland farming. Dr John Frame, a past president of the British Grassland Society, is an authority on red clover, having done some classic research work on it while working for SAC. In this article he outlines the key management guidelines for its successful exploitation:

The main advantages of red clover are:

- superiority to grasses in nutritional value and voluntary intake by animals, the net affect of which leads to enhanced animal performance in different classes of stock.
- adaptation to a wide range of soil and environmental conditions.
- ability to 'fix' atmospheric nitrogen in the root nodules, thus offering an alternative natural source of N to manufactured N fertilser.
- tolerance to drought due to its deep rooting characteristic, and to winter cold because of its inherent winter hardiness.
- suitability in conventional and organic farming as a break crop to improve soil structure and fertility, and as a supplier of organic matter.

Varieties

Early-flowering varieties have two main growth flushes during the growing season and start growth in spring earlier than late flowering varieties. The latter produce more of their annual yield at the main first growth flush and are more persistent. Most of the varieties currently available on the market were bred many years ago when much more red clover seed was used in seed mixtures than now. However, there are breeding programmes in some European countries and recently a renewed program was started at the Institute for Grassland and Environmental research, Aberystwyth. Increased resistance to clover rot disease and to stem eelworm has been a notable achievement by plant breeders.

In recent years, varieties with improved production and persistence have been released from Switzerland. Milvus is one such variety. Interestingly, in an attempt to improve the tolerance of red clover to grazing, varieties with stoloniferous growth habit are being developed in Australia and New Zealand.

Seed mixtures

For silage, red clover can be sown in monoculture at 5 to 6 kg/acre, but a mixture with grasses is preferable since this gives higher total forage yield, dry matter (DM) content, water soluble carbohydrate (WSC) concentration, digestibility and metabolisable energy, through lower content of protein and some minerals such as calcium and magnesium. Mixtures can arise from grass-dominant types e.g. 9 kg/acre grasses and 3 kg/acre red clover, to red clover-dominant types, e.g. 6 kg/acre red clover and 2 kg/acre grasses. For production over two years, an excellent grass component is Italian ryegrass ± hybrid ryegrass, but for over three years, hybrid ryegrass ± perennial ryegrass is a better option. To allow full expression of the red clover, it is best to use tetraploid varieties of the ryegrass since they tiller less densely than diploids; their early-season ear emergence patterns should

also coincide with the flowering pattern of the red clover so that the stage of maturity, and hence digestibility, are similar.

Establishment

For sound establishment, a well-cultivated, firm level seedbed is needed to ensure that the small seeds with their limited food reserves are drilled uniformly at shallow depth, 10 to 15 mm. A well-distributed seedling establishment with approximately 200 plants/m² not only leads to a red clover-rich sward but is a safeguard against the natural decline of red clover plants with increasing age of the stand. The competitiveness of red clover against weeds is low at the early establishment phase particularly if sown alone. Topping is of value and 'clover-safe' herbicides are available, though they can check red clover development to some degree.

Sowing red clover directly in early to mid season gives greater yields of forage during the establishment year and following full harvest year than late-season sowings. Forage yields in the establishment year of spring sown swards is circa 60 per cent of that possible in the first harvest year. Red clover mixtures can be undersown in an arable silage crop, or after a cereal grain crop provided there is enough time for the plants to develop sufficiently to tolerate winter cold.

Oversowing techniques, with or without agro-chemical suppression of grasses, and using various machines such as tine or rotary strip seeders, have been devised to introduce red clover into existing grass sward. The key guidelines for success are: reduction of competition from the existing grass sward, by grazing or cutting for example, before and after the introduction; correction of soil fertility shortcomings; timing when there is adequate soil moisture; achievement of good seed-soil content; pest control – usually against slugs.

Rhizobial inoculation of seed is rarely advocated or carried out since there is no evidence of any benefit on those soils likely to be sown with red clover. Nonetheless, given the decline in the growing of red clover in recent decades it could be beneficial to inoculate red clover seed where it is sown onto land without a previous history of growing it. The development of inoculants with predictable effectiveness would be welcome.

Soil fertility

Red clover is adapted to a wide range of soil conditions and fertility but will perform best, in both forage production and nitrogen fixation, on well drained, fertile soils with a pH of 6.0 to 6.6, and non-limiting in soil moisture. Adequate phosphate (P_2O_5) and potash (K_2O) in the seed bed are necessary for vigorous seedling growth and development, particularly a readily available, water soluble form of P_2O_5 e.g. superphosphate type. Soil analysis will provide a guide to the rates required. A small 'starter' N application of 40 kg/ha will encourage early plant development when sown in soils of low N status, after a succession of cereal crops for example. Following the removal of silage crops from established swards, annual replenishment of P_2O_5, and especially K_2O, is needed in order to maintain plant persistence and sward yield. Around 80 to 90 per cent of annual yield is obtained from the two cuts taken by late July/early August and the fertilizer should be applied for these cuts. Typical annual requirements based in soils of moderate fertility (MAFF Index 2) and an annual removal of 12 tonnes/ha DM – equivalent to about 60 tonnes/ha fresh material – would be 100-150 kg/ha P_2O_5 and 250-300 kg/ha K_2O. Cattle slurry is a valuable supplementary source of nutrients, rich in K_2O in particular.

Red clover-rich swards do not require fertilizer N, though when the red clover population thins out, N application to boost the grass component can sustain total forage production. This remedy may be needed by a third harvest year depending on red clover plant abundance and is commonly practiced by Swedish farmers. The total yield is increased but the red clover component is markedly reduced (see Table 1).

Table 1.	Effect of fertiliser N application on forage yield from a red clover/grass sward			
		t/ha DM		
Harvest Year	**Annual N rate (kg/ha)**	**Total Forage**	**Red clover**	**Red clover (%)**
1	0 180	12.7 13.1	8.9 6.8	70 52
2	0 180	10.8 12.6	6.4 2.7	59 21
3	0 180	7.9 12.7	1.5 0.4	19 3

Nitrogen Fixation
Annual levels of N fixation can vary widely due to factors such as weather and soil conditions, rhizobial effectiveness, and vigor of plant growth and development. Published worldwide estimates are in the range of 75-390 kg/ha, but the UK level is likely to be in the middle of this range. The residual fertility value of red clover when used as a break crop in arable farming is well documented.

Forage Yield
Forage yields usually decline with sward ageing. In past trials with a standard cutting management of two ‘silage’ cuts and an aftermath cut, DM yields in successive harvest years were in the ranges, 9 to 18, 9 to 15 and 4 to 14 tonnes/ha. Data is scarcer for third harvest years since due to natural decline and pest and disease, red clover often did not persist or yield well in the third year. Cutting more frequently than three times a year results in higher forage quality but markedly lower yield. . On farm yield data is sparse but could be 75 per cent more of experiment yields depending upon the standard of overall management. In other method of yield assessment red clover-rich stands give yields, over three successive full harvest years, equivalent to those from pure-sown grass swards receiving fertiliser N at annual rates of 250,210 and 140kg/ha respectively.

Silage
An erect growth habit and good plant response to infrequent defoliation make red clover a highly suitable species for conservation cropping. In red clover dominant swards, first and second cuts for silage may contribute 50-60 per cent and 30-40 per cent, respectively, of the annual yield. Wheel tracking damage to swards is a hazard but can be reduced by minimising wheel traffic as far as possible.

Red clover has low DM and WSC contents and these characteristics are allied to a high buffering capacity, i.e. ability to resist the fall in pH needed during ensiling on account of its chemical make-up. Thus, a satisfactory silage fermentation of red clover rich forage requires good wilting of the cut crop to concentrate the DM and WSC, fine chopping and the insurance application of an effective additive; formic acid was the mainstay additive but there are now also effective biological additives available. A typical silage analysis is shown in Table 2.

Red clover-rich swards are also suitable for hay cropping, a use still popular in some countries abroad. The main hazard is shattering and loss of nutritious leaf if haymaking is prolonged due to adverse weather. Mechanical conditioning speeds up curing but conditioned hay loses soluble carbohydrates and minerals.

Grazing

When red clover swards are grazed some form of rotational grazing suits the plant best since continuous stocking at high grazing pressure reduces the plant population due to the combination of foliage removal and plant crown damage by hoof trampling. Late-flowering varieties are more tolerant of grazing than early flowering varieties as the growth buds on the plant crowns are more numerous. Over-frequent grazing of aftermaths in autumn should be avoided since it reduces carbohydrate and nitrogen reserves in the roots and this, together with some natural decline over winter, adversely affects plant population and subsequent yield.

Feeding value

This is largely determined by the stage of growth at the time of utilization, since feeding values fall with increased maturity and the associated increase in stem/leaf ratio. Figure 1 shows the typical fall in digestibility, expressed as D-value, of primary growths of red clover in relation to other forage legumes. The protein and mineral richness of red clover is well documented. Tetraploid varieties generally have higher digestibility, and concentrations of protein and WSC than diploids, but tetraploidy alone is not a guarantee of superiority for all situations, and so individual varieties should be chosen for seed mixtures on the basis of their overall characteristics.

Red clover is highly acceptable to livestock whether as hay, silage or when grazed at a young leafy growth stage. In common with other forage legumes, it has a higher voluntary intake than grasses because of the low structural fibre/soluble plant cell content ratio; also there is a faster breakdown of consumed forage in the rumen and a faster clearance of particles from the rumen because of the physical structure of the leaves. The net influence of these characteristics is improved animal performance in dairy cows, beef cattle and sheep.

Forage Matters

by Dr John Frame SAC

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