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The Case For White & Red Clover



Livestock farmers are on the receiving end of volatile market prices for meat and milk. Alongside this, feed and fertiliser, the two key variable costs of production have risen dramatically in cost in recent times. This means that many farmers will not see a real rise in profits unless higher gross margins can be achieved.

There are a growing number of farmers now seeking to reduce the cost of production by using less fertiliser and by reducing the amount of purchased feed. It is predicted that many dairy, beef and sheep farmers will choose to grow high clover leys and adopt a lower cost production system. High clover leys require little or no nitrogen fertiliser and are a good source of protein. Whilst there are many benefits from clover leys, some farmers will have reservations about their use. In order to address some of these concerns and to give greater confidence on the subject, this article provides information from relevant research and advice from practical experience.

Why clover?

Clover grown in forage leys offer a cheap alternative to nitrogen fertiliser and provides a homegrown source of protein. Clover plants are able to extract nitrogen from the air, which itself is three quarters nitrogen, indirectly into the soil via bacteria in nodules on plant roots. Red and white clovers are the two key forage legumes and these, at high proportions in grass leys, can fix 150-250kg of useable nitrogen per hectare per year. Scientific trials at research institutes such as IGER and SAC have shown that high clover leys are capable of producing reasonable yields at very low cost and therefore offer a real alternative to the more expensive fertilised grass-only leys. Clover plants are also high in protein and therefore can reduce the need for bought in feed. When sown with grass, clover increases the protein content of forage by about 20%.

There are also concerns about the effects of increasing diesel costs which affect the very application of fertiliser itself. Coupled with this is the burden of record keeping and even the disposal of polypropylene and plastic bags. Finally, NVZ regulations mean that grass farmers will be restricted by a further reduction of 30kgN per hectare.

For all of these reasons, and ever increasing oil and agricultural commodity prices, the move to clover is likely to accelerate.

How much nitrogen can clover fix?

Pure clover crops can fix as much as 250-400 kg N/ha. But as red and white clovers, the two most important forage legumes in the UK, are planted with grass the amount of nitrogen fixed reduces to between 150-250 kg N per hectare. Red clover usually fixes more nitrogen than white clover during the first two years but beyond this both types are similar. There is much scientific evidence to support the case for clover as a nitrogen fertiliser replacement. The LEGSIL Project, for example, which was carried out between 1997 and 2001 concluded that red clover yields were comparable to grass receiving 200 kg N/ha.

To fix enough nitrogen it is necessary to have sufficient clover in the sward. IGER have consistently maintained that leys need to contain between 30-50% clover to effectively produce high levels of nitrogen. Breton dairy farmer André Pochon, who modeled the French high clover system for beef

production, also held the same opinion. Leys with low clover contents will not provide an alternative and will only offer high yields to achieve reasonable stocking rates if they receive artificial nitrogen fertiliser.

The cost of nitrogen fertiliser

In order to compare conventionally fertilised grass against a high clover ley it is necessary to calculate the cost of nitrogen fertiliser. The amount of nitrogen fertiliser required for grass-only leys depends largely on stocking rates. Other factors such as soil type, previous cropping and availability of other sources of nitrogen such as slurry, FYM and waste products will affect application rates. For the purposes of comparison stocking rate figures and N application rates have been drawn from John Nix (Farm Management Pocketbook).

Dairy: nitrogen fertiliser requirement

Those with two cows per hectare will need around 220 kg N to provide sufficient grass from a ryegrass-only sward for grazing and silage. At a higher intensive stocking rate of 2.5 cows per hectare 350 kg N would be necessary to provide enough grass.

Sheep and beef: nitrogen fertiliser requirement

For lowland sheep and beef production 14 ewes or 1.8 cattle per hectare have been used as average stocking rates for these calculations. To provide sufficient forage from grass 200 kg N will be required.

Cost of N fertiliser per hectare at varying stocking rates

Fertiliser Price	Dairy 2.0 cow/ha 220kg N	Dairy 2.5 cows/ha 350kg N	Sheep/Beef 14 ewes/1.8 beef/ha 200kg N
£150/tonne	£96	£152	£87
£300/tonne	£191	£304	£174
£500/tonne	£319	£507	£290

Protein sources

After the 1996 BSE crisis when mammalian animal products were withdrawn from the market, farmers had to find alternative sources of protein. In those difficult years there existed relatively cheap and good supplies of soya, fishmeal and other specialised grains which were readily bought by farmers. Today, again we see protein as a restricting factor with gross margins under pressure. One solution put forward by many farmers is to grow high protein crops and therefore become more self sufficient with less need for bought-in feed. Almost 90% of home grown protein comes from grass silage (ref R Jones, IGER). The remainder is mainly from maize, whole crop silage and lucerne and it is unlikely that there will be any more new protein crops becoming available.

So, improving the protein content of grazed grass and silage is likely to be the best way of increasing profitability in the immediate future. This can be done by growing mixtures of grass with clover instead of pure stands of grass. Clovers are rich in protein and when included in a ley at high levels the forage will typically contain 20% more protein than a grass-only crop. Additionally, according to Jones, the available protein in legume silage is much greater. His work showed losses in ensiled grass leave only 40% available protein, the rest being degraded, but with a well fermented clover rich silage the amount left in an available form is 60%.

Digestibility and palatability

Clovers are more digestible than grass and this is one reason why livestock perform well when fed clover. Clovers are generally found to be palatable to sheep and cattle. This is important as it enables productive animals to consume more forage. More forage intake with a high protein content leads to greater live weight gain and milk yields.

	White clover	Perennial ryegrass
Crude Protein %	27	17
Digestibility (% D-Value)	75-82	66-75
Amount eaten by sheep (DM intake kg/day)	1.9	1.4

Choosing between red and white clover

Clovers come in different forms and the first decision to make when deciding to grow clover is which one to grow. From an agricultural perspective there are two main forms; red and white clover. These account for more than 90% of the current clover seed sold. They grow successfully on most soils throughout the UK, are drought resistant, high in protein and fix nitrogen. (Other forage legumes such as lucerne, sainfoin, birdsfoot trefoil, crimson and alsike clovers are available for specialist use but for the purposes of clarity will not be discussed further here.)

Red clover is for silage

This has a high yield of around 15t DM/ha and is most commonly used for silage production. It is an upright plant which can yield up to 30% more than white clover. Red clover leys are cut for silage at the end of May. Two or three more cuts follow throughout the summer and autumn. It is sown in leys to last between 1 and 4 years. Red clover grows well on most soils and is drought resistant.

There is a wealth of published scientific research on the subject. John Frame, a past President of the British Grassland Society was an authority on red clover having done some classic research work on it while working for SAC. This work was carried out during decades of agricultural intensification and has now become an extremely valuable reference to those now looking to exploit legumes. Additionally, the LEGSIL trials, which ran for four years at many European institutes including IGER, showed red clover to have the lowest cost of production making it a very economical crop to grow.

Types of red clover

Red clovers can be broken down into two distinct types: early and late flowering. There is a difference of around 10-14 days between the two with the earlier types flowering (67D) in England at the end of May. Generally the early varieties e.g. Milvus, Merviot and Global are the most commonly used for silage as they re-grow well to provide a second cut. The late varieties e.g. Altaswede can be used on late or wet ground or where just a single cut is required. Late red clovers are more suited to grazing.

Typical red clover seed mixtures

It is important to obtain the correct balance between the grass and clover. One quarter of the seed mixture should be red clover with the remainder grass. The overall sowing rate should be 12-14 kg per acre (30-35 kg per hectare). Red clover is very competitive and is best grown with aggressive, high-yielding short term grasses such as the Italian or hybrid forms of ryegrass. When grown with clover these high yielding grasses significantly increase yield and this is the reason why red clover is not sown alone. When red clover is sown at high proportions in a ley and with less productive grasses such as late heading ryegrasses, meadow fescue or timothy, red clover can create a canopy and dominate the sward.

One-Two Year Red Clover Mixture

3.00 kg red clover
3.00 kg tetraploid Italian ryegrass
3.00 kg Italian ryegrass
3.00 kg tetraploid Italian ryegrass

12.00 kg per acre (30 kg/ha)

Three-Four Year Red Clover Mixture

3.00 kg red clover
3.00 kg tetraploid hybrid ryegrass
3.00 kg tetraploid hybrid ryegrass

3.00 kg tetraploid perennial ryegrass

12.00 kg per acre (30 kg/ha)

Making red clover into silage
Red clover is low in dry matter and contains a low amount of water soluble carbohydrates. This means that for satisfactory fermentation to take place it will need to be properly wilted. It is usually worthwhile fine chopping the wilted material and applying an effective additive. Red clover can also be made into hay. Leaf loss can be a problem if hay is on the ground for too long.

Place in rotation
When red clover was at the height of popularity thirty years ago some farms had a problem with 'clover sickness'. This was a combination of the soil-borne disease sclerotinia and the pest stem eelworm. To avoid these problems red clover leys should have a gap of five years. As with many crops, problems can build up if the same species follow too closely in a rotation.

White Clover is for Grazing
White clover is a low growing, persistent plant that is lower yielding than red clover. It is therefore principally used for grazing leys which are expected to last for two years or more. When grown with perennial ryegrass, yields can be expected to be in the region of 10-13t DM/ha. It was thought that white clover grows later in the spring than grass receiving N fertiliser. This situation changed during the 1990's with the successful introduction of earlier growing varieties of clover such as Aberherald. Trials over eight years by J Bax on SAC's Acrehead System Study at Crichton Royal Farm showed that there was only a 2.4 day difference in the date of turnout between clover/grass and grass only swards. Also, where necessary for very early spring growth, 30kg N (artificial) can be 'tactically' applied without significantly damaging or reducing clover content. Alternatively, an area of grass plus N could be maintained specifically to provide very early grass.

Types of white clover
White clover is classified by leaf size. Broadly speaking there are three categories: very small, medium and large leaved clovers. The very small, low yielding but extremely persistent type is known as 'wild white'. These little clovers fill the base of the sward and can be grazed hard especially with sheep. Original varieties such as S184 and Kent which have been used for over fifty years are still very popular today. Medium leaved varieties such as Aberherald and Crusader are more modern introductions and offer yields well in excess of the wild whites. They are also more competitive, persistent and offer good early spring growth than older varieties such as NZ Huia. The large leaf types such as Barblanca and Alice are the highest yielding. However, these large leaved varieties do not survive well when grazed hard with sheep. Therefore these are best sown in silage or cow grazing leys only. For most situations it is best to sow a mixture of types to allow for grazing and/or silage.

Typical white clover seed mixture
White clover seed is about half the size of red clover and is included at a lower weight for this reason. At an inclusion rate of 1.5kg per acre (3.75kg per hectare) the white clover content of the sward should be between 30-50%.

'POCHON' Type Two-Four Year White Clover Silage/Grazing Ley
2.00 kg tetraploid hybrid ryegrass
3.00 kg tetraploid perennial ryegrass
2.50 kg perennial ryegrass
3.00 kg tetraploid perennial ryegrass
0.60 kg white clover
0.60 kg white clover
0.30 kg white clover

12.00 kg per acre (30 kg/ha)

'POCHON' Type Long Term White Clover Grazing Ley

2.50 kg perennial ryegrass
2.50 kg perennial ryegrass
3.00 kg tetraploid perennial ryegrass
2.50 kg tetraploid perennial ryegrass
0.60 kg white clover
0.60 kg white clover
0.30 kg wild white clover

12.00 kg per acre (30 kg/ha)

Sometimes red clover is sown with white clover leys. Red clover is quicker to get established and is more productive during the first two seasons. It must not be included at more than 1kg per acre (2.5kg per ha) or it may become dominant.

Sowing clover seed mixtures
Clover seed can be sown much in the same way as grass-only seed mixtures except more attention must be paid to timing and depth of sowing. Clover requires at least 7°C before satisfactory germination and therefore sowing should take place from mid March in most districts. Clover can be sown at any point through the summer provided that sufficient soil moisture is available but it must not be sown too late in the autumn. Mid September is considered by most to be the latest safe time but not clovers can grow later if warm conditions allow. Ryegrass-only leys can often be sown later than this with satisfactory results. Clover will not germinate satisfactorily if it is sown too deep.

Clover leys can be sown directly or undersown to spring cereals. (If undersown it is important to reduce the cereal rate to two thirds so that the cereal is not too competitive.) The seed can be broadcasting or drilled. Although very accurate, cereal drills should be used with care as they can bury the seed too deeply.

Lack of consolidation at sowing time can result in poor establishment. Too frequently, it can be observed that headlands and wheelings have establishing clovers, but elsewhere there may be none. This is often attributed to a lack of consolidation. Clover seeds are smaller than most grasses and need to be sown into a well prepared and consolidated seedbed so that moisture can travel from soil particles to the seed. Clovers are more vulnerable to drought after sowing than grasses. This is because grasses have several root tips which emerge at different times whereas clovers have just one. It is therefore essential to roll before and after sowing for a successful take. Robert Handy of Andoversford, Cheltenham had three golden rules when it came to sowing clover leys. 1. Roll. 2. Roll and 3. Roll again. Robin Hill of Cotswold Seeds claims that you should be able to ride a bicycle across the seedbed prior to sowing. These illustrate the requirement to roll.

Over-Seeding
A further method of utilising clover is to introduce it into existing grass without re-seeding. The main advantages are that there is not much interruption to the use of the field and with seed costing in the region of £15 per acre (£37.50 per hectare) clover content can be increased at minimal expense. Timing is important. It is best to avoid sowing when the existing grass is growing vigorously during May and June, so either sow March-April or July-September. If there is excess growth on the existing grass this should be removed by grazing or cutting before sowing.

The seed can be drilled or broadcast. Comb harrows with seeders such as the ‘Opico’ or Einbock’ give good results and are widely available. Alternatively, a grass drill such as the ‘Moores’ or ‘Aitchison’ may be used. Heavy direct drills with discs designed for cereals do not produce such good results. If the seed is to be broadcast a little tilth should be obtained by harrowing first. For low sowing rates, a suitable applicator will be needed. The electronically driven spinners e.g. ‘Stocks’ are good for applying these low rates and will distribute clover seed 10-12 metres. Once the seed is sown it should be rolled in with a heavy roll or stocked heavily but for a short time with sheep. (If left on too long, sheep can overgraze clover seedlings.) Good results have also been obtained from set stocking with low numbers of cattle until the clover has established. Nitrogen applications should be ceased.

Fertiliser requirements for new clover leys
Phosphate and potash levels need to be at an index of 2. Clover production will be severely restricted if these elements are too low.

Newly sown clover leys can benefit from a small amount of applied N (30kg per hectare) especially when following a cereal rotation. Although not essential, this promotes initial growth on both clover and grass until the clover plants become established and start to fix N. For high clover levels, soil pH will need to be adequate (minimum 5.8 – 6.0 for mineral soils).

Grazing Clover
There should be an interval between grazing white clover as this allows the full expression of the plant. If set stocked and over grazed the amount of clover and subsequent N fixation is reduced (ref. Pochon). The amount of time required varies between 21-35 days. Pochon considered that at a 35 day grazing interval was the ideal period. Bloat, he believed, was avoided by allowing the clover to mature.

Clover dominance
The balance of clover to grass will vary through the growing season. There may be times, particularly during July and August, when swards become too rich in clover. This can be beyond the 30-50% target and is most often seen in rotationally grazed white clover swards. If the clover content is very high it can be reduced by cutting for silage and the aftermath grazed hard. It is also possible to reduce clover content with a tactical application of N fertiliser. However, the current high cost will not make this an attractive option.

Bloat
This condition is caused by a build up of gas in the rumen which is not able to be expelled by belching. Serious cases can be fatal and this is of major concern to livestock producers. Bloat can be caused by a lack of ruminal contractions, an obstruction in the oesophagus or by the presence of persistent foam in the rumen. It is the latter cause that can be induced by grazing lush grass or clover rich swards. Ironically, it is a high concentration of a plant protein, leaf fraction 1 protein (ref. Mueller-Harvey), which is naturally present in lush grass and clovers that can cause problems. Bloat is an issue for animals grazing fresh grass or clover. It is not considered a problem of conserved forage.

The way to avoid bloat from rich swards is to ensure that animals are not turned out 'hungry' onto them. Buffer feeding prior to turnout usually minimises any risk. Experienced farmers growing high clover leys understand this requirement and experience few problems. However, in the event of bloat, treatment involves the administration of oral drenches or in severe cases canulation may be required to release the pressure.

Legumes such as sainfoin and birdsfoot trefoil never cause bloat. It has been reported that feeding small quantities of the non bloating legume sainfoin with bloat causing lucerne can significantly reduce the risk (ref. McMahon et al). This may lead farmers in future to include such legumes in seed mixtures.

Oestrogen
Red clover contains oestrogen which increases disease resistance within the plant. However, oestrogen can, if fed at the wrong time and at high levels, reduce conception rates of breeding animals. It is a potential problem for breeding ewes grazing red clover leys and, to a lesser extent cattle, as they generally receive less red clover in the ration in the form of silage. It has little or no effect on male animals. The best way to avoid any potential problems is not to graze or feed silage made from red clover to females at or around conception. For ewes, this means not using forage with a high content of red clover six weeks before and after conception. In practice, it is unusual to come across cases and avoidance at conception minimises the risk.

Weed control
The most commonly used method of reducing weed burden is to use stale seed beds combined with

the timely application of the herbicide glyphosate in the lead up to re-seeding a new ley. However, the seed bank in the soil contains millions of seeds and some of these will germinate as a result of the preparation of a seedbed. Many weeds will succumb to the competing sown grasses and clovers or by careful light grazing during the establishment phase. However, there may be some pernicious weeds such as docks and thistles which may require a post emergence herbicide.

Chemical weed control is simple when a single species is sown. However, when clover is added to grass this causes a complication because any herbicide used has to be ‘clover safe’ whilst still being effective against weeds. There are some recommended herbicides for new clover leys e.g. ‘Squire’ (Dow) and ‘Alistell’ (United Phosporus). These only control young weeds and are more expensive than herbicides suitable for grass only leys. (Detailed advice should be sought from an agronomist.)

Alternatively, clover seed is sometimes left out of a seed mixture and sown the following year once weeds have been controlled. This can provide reasonable results provided the clover seed is sown whilst the sward is still ‘open’. This allows the use of more effective herbicides such as ‘Pastor’ (Dow) for dock and thistle control. If this method is chosen then follow the over-seeding recommendations as laid out earlier in this publication.

Conclusion

We at Cotswold Seeds have for many years promoted the use of legumes. They are now widely used and are of particular relevance at this time of inflated costs, especially of nitrogen fertilisers, which have tripled in price.

Self Sufficiency will be the keynote of profitable farming from now on; as those in farming have always known.

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