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Muck and slurry
on clover swards
DairyCo

Contents

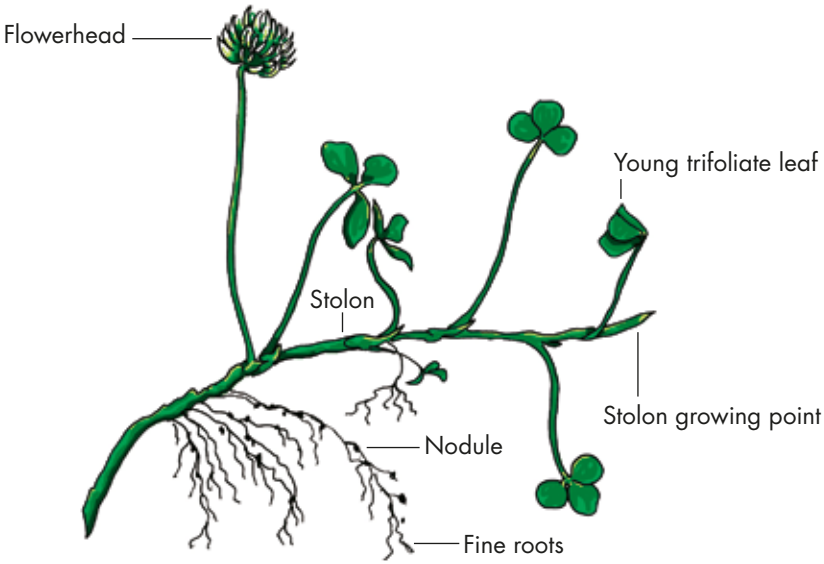
The importance of grass and clover

The cost of production per litre of milk or kg of liveweight gain is a major consideration for all livestock producers. One of the best ways to improve efficiency is to produce more feed on the farm, rather than buying it in.

There is huge potential on grassland farms to increase the amount and quality of grass and clover that is grown and eaten. While feed and fertiliser prices remain high, having a dependable source of home-grown protein such as clover in the fields, offers some protection from ever-rising input costs.

White and red clovers provide a good source of protein in ruminant diets, both when grazed and conserved and have high intake characteristics. There is the added benefit of nitrogen fixation by the clover plant, so less artificial nitrogen fertiliser is required for grass growth. Clover-rich swards fit well into forage or arable rotations and can benefit soil fertility and structure.

Why use white clover?



White clover is a perennial legume. The key to its survival and production potential is its multi-branched creeping stem called a stolon, which provides sites for new leaves, roots and flowers.

The stolon also stores carbohydrates and proteins, giving the plant the ability to overwinter and regenerate in spring.

Nitrogen fixation

Bacteria that live in nodules on clover roots convert nitrogen from the air into nitrates. These stored nitrates are released to the surrounding plants or subsequent crops after plant decay and act as a good source of nutrients.

In a well-balanced and stable grass/clover sward, it is estimated that the usable nitrogen generated through the fixation process is equivalent to 100-150kg N/ha.

Feed value

White clover has higher digestibility, protein and mineral contents than grass-only swards. Unlike grass, white clover retains its digestibility throughout the season, as there is continual renewal of leaves and little stem development. Clover will increase the crude protein content of first cut silage by 1% for every 10% increase in the amount of clover in the sward.

Soil structure

The root system of white clover can help tackle soil compaction. This results in more gaps between soil particles, which enhances movement of nutrients and water which can improve yields.

Different growth pattern

Clover starts growing when soil temperature is 8°C, as opposed to 5°C for grass, which means its growth pattern is different. Clover breeders have developed varieties that are more compatible with modern ryegrasses. Clover is particularly valuable during mid and late season when grass growth starts to fall away.

Establishing clover leys can be achieved either by:

Full re-seed

- Slot seeding/direct drilling
- Broadcasting following scarification.

Renovation (eg over-sowing)

Taking account of the points below

- Pasture improvement by management
- Soil pH 6.0-6.5. Any lime applied to correct pH should be done well in advance of sowing
- Nitrogen fertiliser on low N status soils
- Apply phosphate (P) and potash (K) if soil indices are below 2
- 5-10mm optimum seed depth
- Use slug pellets.

Sowing guidelines:

- Minimise competition from existing plants before sowing by heavy grazing and/or harrowing to open up the sward
- Sow between April and August
- Sow when soil has optimum nutrient/pH status
- Sow when grass is least vigorous (after flowering in July), as long as there is sufficient soil moisture – after a silage cut offers a good opportunity
- Ensure soil is sufficiently disturbed to allow seed to soil contact and coverage
- Use a higher seed rate (4 kg/ha) than conventional sowing to compensate for greater seedling loss
- Lower seed rates (from 2.5 kg/ha) may be used for a periodic top-up in long-term swards
- After sowing, graze hard in short intensive four to seven day periods every month, until clover is well established to reduce competition from other plants.

Clover-rich leys and varieties

Mixtures produce scientifically proven yield benefits, compared to the same varieties sown individually.

White clover has evolved to withstand being grazed or cut, so the choice of companion grass depends on the primary use of the sward, ie grazing or cutting.

The ideal grass is typically ryegrass, as it has good nitrogen-use efficiency. This means it can convert the nitrates produced by the clover successfully into plant yield.

Grasses, such as bent, fescue, meadow grass and Yorkshire fog have lower nitrogen-use efficiency and so do not make good companion grasses if production is the main objective.

Clover varieties

White clover varieties fall into four groups based on leaf size, this is closely related to the size of the stolons and dictates the livestock system to which it is best suited:

- Small leaf varieties – continuous hard sheep grazing
- Medium leaf varieties – rotational grazing
- Large or very large leaf varieties – lax cattle grazing or silage conservation.

The best variety for the 'job' that is required should be selected, ie silage, grazing, cattle or sheep and the desired longevity. Large or medium leaf size varieties are most suitable for dairy farms for silage or rotational grazing

The recommended grass and clover list, published by the National Institute of Agricultural Botany (NIAB), is updated annually, this gives the latest list of recommended white clover varieties. It is very useful to know the performance characteristics and how they will suit particular systems.

To optimise the sward, attention should be paid to cutting, grazing, soil management and nitrogen application rates.

Management guidelines to maintain 30% white clover:

- Avoid excessive stolon damage from poaching
- If clover content is too low – cut less frequently
- Keep grass at 4-6cm over winter to protect stolons from frost damage
- If clover content is too high – use intensive grazing.

To reach 30% clover, the sward needs to look more like there is 50-60% clover at its peak growth in August.

10% clover content

30% clover content

60% clover content

Potential problems

Bloat

Bloat is caused by an excessive build-up of gas (carbon dioxide and methane) inside the animal.

This causes distress and sometimes death, as the distended rumen exerts pressure on the diaphragm, heart and lungs. The problem is caused by rapid breakdown of clover protein.

Effective management can minimise or eliminate the risk of bloat in livestock grazing clover-dense swards.

- Limit access when stock is first introduced to the field
- Do not turn out hungry stock onto clover-rich pastures
- Feed fibre such as hay or straw, before turnout
- Provide fibre (hay/straw) in the field
- Take special care when the day is foggy or damp
- Feed an anti-bloat feed additive.

Clover Dominance

If clover becomes dominant through most of the season, and little grass is visible, it can unbalance the sward. This may increase weed infestations, as there is less ground cover during late autumn, winter and early spring, when clover growth has slowed or stopped.

If clover dominance is a problem:

- Avoid regular silage cutting, as the offtake of nitrogen and light falling on the growing points encourage clover growth
- Consider using smaller leaved clover varieties
- Graze more intensively, particularly with sheep
- Use tactical/heavy applications of nitrogen to inhibit clover growth.

Weed control options

- Sow into a clean seed bed to avoid competition from weed species during establishment
- Maintain soil fertility to ensure grass and clover can be competitive against weeds
- Sow grass seed first, then use a non-clover-safe herbicide to control weeds before white clover is introduced
- Most weeds in re-seeds can be controlled by management, ie grazing or topping and do not need herbicides
- If herbicides are needed, use a clover-safe product and only spray if clover plants are vigorous and well developed
- Use a weed-wiper to treat target weed species only
- Involve a BASIS-trained adviser.

Slurry

What is in it?

Generally, nitrogen, phosphorus and potassium (N, P and K) are the nutrients of most interest.

Nutrient content of manures and slurry is highly dependent on dry matter, storage and how the animals were fed.

In order to make an accurate decision on applying manure and slurry, and subsequent applications, the nutrient content should be estimated; laboratory analysis will give an accurate assessment. There is also equipment available for on-farm testing to give an instant assessment. In general, the thicker the slurry the more nutrients it will contain.

Research has shown that **Near Infra-red Reflectance Spectrometry (NIRS)** can provide low cost, rapid and reliable analysis of:

- Dry matter
- Total N
- Readily available N (can be taken up rapidly by the crop)
- Phosphate (P_2O_5)
- Potash (K_2O)
- Sulphur (as SO_3)
- Magnesium (as MgO)

Typical values (as stated in Defra's fertilizer manual RB209)

	Total Nutrients (Kg/tonne)				Available Nutrients (% of total nutrients)		
	Dry Matter %	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
	SOLID						
Cattle	25	6.0	3.2	8.0	*	60	90
Sheep	25	7.0	3.2	8.0	*	60	90
	SLURRIES						
Cattle	2%	1.6	0.6	2.4	0.9	50	90
	6%	2.6	1.2	3.2	1.2	50	90
	10%	3.6	1.8	4.0	1.3	50	90
Dirty Water	0.5	0.5	0.1	1.0	0.3	50	100

*Dependent on age of the manure, soil type and season in which it is spread.

Defra RB209, has information on grass / clover nutrient requirements in different scenarios; consult a FACTS qualified adviser for further advice.

How much should I apply?

Slurry needs to be applied at a sufficient rate to meet the phosphorus requirement of clover and optimise contribution to a mixed sward.

- The Defra fertiliser manual (RB209) provides guidance on slurry applications/additional fertiliser use.
- Compliance with the Defra Code of Good Agricultural Practice, Protecting our Water, Soil, and Air is also essential.

Nitrogen application, whether as fertiliser or slurry/manure, should match requirements for sward growth, for example, is it for three cuts of silage or for rotational grazing? It should also

take into account the need to allow for white clover nitrogen fixation. Clover will fix up to 150kg/N/ha/yr and performs best in a mixed sward with an average of 30% DM as clover. The proportion of clover growing is often overestimated, as its leaf lies face up compared to grass as dry matter.

When should I apply it?

Early growth and fixation from white clover is important in order to achieve a balanced sward. This means that N applications in early spring should be limited, later applications (July/August) of nitrogen should not be necessary in a clover-rich sward and would discourage nitrogen fixation.

Nutrient applications need to be carefully considered, due to the differences in growth patterns, ie grass grows earlier in the season than clover. Heavy applications of nitrogen early in the season have detrimental effects. Small strategic applications (up to 50kg/N/ha) can encourage grass growth without detrimentally affecting clover growth.

Not all nutrients in slurry/manure are available to the plant due to losses from leaching, run-off or to the atmosphere. Losses depend on manure type, dry matter, application time and soil type.

In summer, up to 90% of the available N is lost to the atmosphere as ammonia if it is surface spread. Injecting slurry into the soil enables the N to be more effectively used. In late winter/early spring, there are less atmospheric losses from surface-applied slurry so the economic benefits of injecting may be slightly reduced.

How should I apply it?

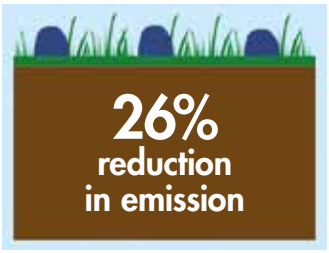
Avoid smothering grass and clover and minimise disturbance to clover stolons, particularly during the first 18 months after establishment.

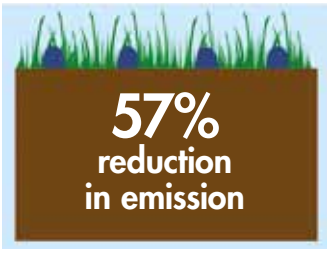
- Spreading slurry via **splash plate tanker** in summer often results in grass and clover leaves being covered in slurry, this can lead to lower intakes and the potential of undesirable bacteria, such as clostridia entering the silage clamp at second cut.
- **Injector systems** apply slurry evenly without contaminating field margins and minimal risk of surface run-off. Injectors also help in breaking up soil compaction while eliminating damage to soils and worm populations that can be caused when slurry puddles at the surface. Injection may be less suitable earlier in the season both from an economical view and because coulters cut through the clover stolon network leading to setback. Repeated use may have damaging effects. Slurries with less than 6% dry matter should be

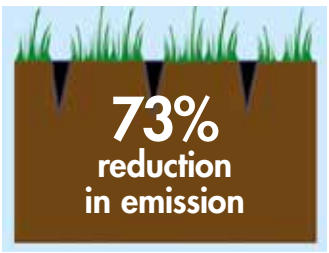
injected into the soil to make the most of the available nitrogen.

- Deep injection machinery can handle larger volumes of slurry but can often be restricted to certain soil types.
- **Band spreaders** apply slurry in strips on the surface. They are only effective when used on short swards and may leave the slurry vulnerable to losses. Trailing shoe machines operate with taller sward covers, slurry is distributed under the sward to prevent ammonia losses. Both the trailing shoe and band spreader can be used on any soils but, like the shallow injector, they are limited to applications below around 35m^3/ha (3200gl/acre).

Reduced ammonia emissions following land spreading







Misselbrook et al 2002

Injecting slurry at the maximum application rate of 35m^3/ha (3200gl/acre) of 6% dry matter during spring months, would mean a saving of 9kgN/ha compared to splash plate application. At a fertiliser price of £300/t for 34.5%N, splash plate and injection cost benefits are £28/ha and £36/ha respectively. Hence a cost benefit of slurry injection of £8/acre.

Slurry spreading guidelines

- Avoid high risk times. Applying in late autumn and early winter with high rainfall results in nutrient leaching, run-off and lower soil temperatures which reduce plant uptake
- Use low emission methods in the summer, eg splash plate as high losses of ammonia are common
- Avoid high risk areas. Steep slopes, waterlogged ground and frozen ground should be avoided
- Avoid heavy applications (> 50m^3/ha/application should be avoided)
- Apply only what the crop needs, check soil indexes and account for nutrients in slurry
- Check that spreaders are calibrated correctly and spread accurately
- Produce a clear manure management plan.

	White Clover	Slurry
Spring	• Seed – select suitable variety(ies) and re-seed • Clover % – check and look at stolon health • If dominant*, allow grass to compete by applying N as fert or slurry and cut for silage or rotationally graze • If weak*, graze hard and apply P&K to allow clover to compete for light and nutrients with grass.	• Check slurry nutrient content and apply accordingly • Check soil indexes, correct pH and base applications of fertiliser/slurry on P&K indexes • Care with staggers • Don't inject slurry where clover stolons vulnerable • Applying N at this time to grass-dominant swards will discourage clover.
Summer	• Seed – select suitable varieties – good time to over-sow after silage cut • Check ryegrass content and consider a mix rather than clover alone • Rest by rotational grazing or silage cut • Replace P&K off-take and account for slurry nutrients (RB209).	• Test slurry nutrient content. Allow for P&K in compound applications • Use low emission techniques to optimise N use and allow rapid return to grazing • Do not use fertiliser N where clover content is good or clover will not fix nitrogen.
Autumn	• Plan spring grazing now • Graze to avoid winter kill but avoid exposed stolons through winter.	• Do not apply fertiliser or slurry N after August (RB209) • Plan slurry storage/cover for winter/spring.
Winter	• Avoid hard or light grazing of clover swards. • Avoid poaching and stolon damage during winter or spring regrowth will suffer.	• Do not apply to frozen ground. • Make the most of nutrients by applying when soil conditions allow active uptake by plants.

*Use clover ring to guide to clover % at different times of the year.

This document is based on research carried out by The Institute of Biological, Environmental and Rural Studies, University of Aberystwyth, Muck and Slurry Use on Clover Swards (2010). Additional information has been sourced from Managing Clover for Better Returns, part of the Better Returns Programme, produced by EBLEX.

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