

Nitrogen Fixation

Practical Guide

Nitrogen fixation in agriculture is largely about the use of legumes and their symbiotic relationship with the *Rhizobium* species of bacteria in producing usable nitrogen from the 78% of the atmosphere that is nitrogen gas.

Legume nitrogen fixation takes place when common soil bacterium *Rhizobium* invades the root of a leguminous plant forming a nodule. Within this nodule, the plant supplies the nutrients the bacteria require and the bacteria convert the inert N₂ gas into biologically useful ammonia, for use by the plant.

The use of forage legumes such as white clover, red clover and lucerne as well as grain legumes such as field beans and peas can significantly reduce the need for the application of inorganic nitrogen fertiliser.

Growing legumes on the farm for animal feed can also significantly improve the quantity of home-grown protein, making the unit more self sufficient in feedstuffs and reducing the need for transporting bulky feeds.

Better use of N fixing crops could mean less greenhouse gas emissions in production, transport and application of inorganic nitrogen fertiliser.

This Practical Guide looks at how to optimise nitrogen fixation for more efficient plant growth and reduced greenhouse gas emissions.



Top tips:

- **Regularly sample soils** and take the necessary corrective action to ensure optimum growing conditions for legumes. **Phosphate** and **pH** levels are particularly important.
- Make sure that the **clover varieties** you sow are suitable for your management requirements and are the best available.
- If you have an arable farm that produces **silage**, try growing a field of red clover. It will reduce your inorganic nitrogen requirements for the following crop and produce a large quantity of silage.
- If your swards are low in clover try **oversowing** some of them with first choice grass and white clover varieties. It will be **cheaper than ploughing** and could increase productivity without increasing nitrogen applications.
- Ensure all swards are **well grazed down in the autumn**. This will ensure that the white clover gets away to a good start in the spring.



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Websites

www.farmingforabetterclimate.org

www.sac.ac.uk/climatechange

www.farmingfutures.org.uk

www.ipcc.ch

www.agrecalc.com

www.soilassociation.org.uk

www.planet4farmers.co.uk



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Oversowing Clover Tips

- Make sure that soil nutrient levels are satisfactory.
- Sow early in the spring into moist soils.
- Ensure the sward is well grazed down before sowing.
- Sow 5kg/ha of a white clover mix designed for your management purposes alongside 5kg/ha perennial ryegrass.
- Keep the pasture bare after sowing to ensure light reaches the clover seedlings.

Key Fact:

A sward with a high white clover content can produce as much forage as a sward receiving 180kg/ha of inorganic nitrogen.

On a 100 hectare grassland farm this is the equivalent of 52 tonnes of ammonium nitrate fertiliser.



Maximising Nitrogen Fixation from Red Clover

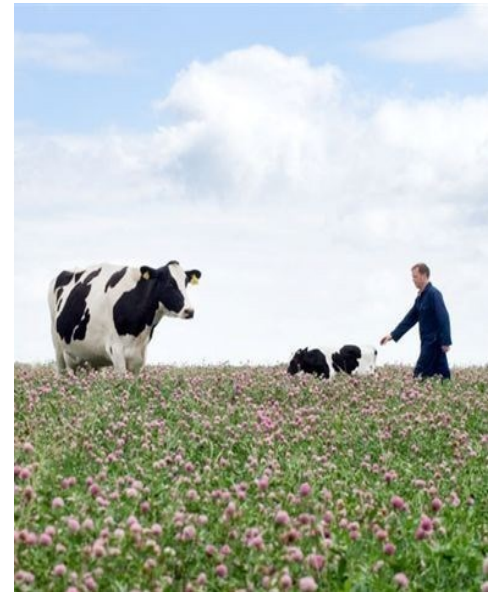
Red clover is a forage crop that was overlooked for a number of years but is now enjoying a resurgence. As it grows from a crown, rather than being stoloniferous like white clover, the individual plants are easily damaged making a red clover sward less persistent usually lasting 2-3 years.

The advantage of red clover is that it is a very vigorous crop capable of fixing up to 250kg/ha of nitrogen in its first full year.

- It is best grown in association with an Italian or hybrid ryegrass. A typical mix could be 10kg/ha red clover with 15kg of ryegrass.
- Red clover is best suited to cutting management with typically 2 silage cuts being taken with the second aftermath utilised by grazing with fattening lambs.
- Avoid tugging ewes on red clover leys as there have been reports of fertility problems due to the

presence of oestrogen type compounds in the plants.

- Due to potential problems with stem eelworm it is best to have a 4 to 5 year break in the rotation before resowing red clover.



Maximising Nitrogen Fixation from White Clover

White clover is the most commonly grown forage legume in the UK.

It is generally classified by leaf size, with small leaf sized varieties most suitable for intensive grazing and large leafed varieties adapted for cutting management. Medium leafed varieties

are flexible and can be used in most situations. White clover spreads through stolons and is very persistent in the sward. Nitrogen fixation in a grass/white clover sward can be as much as 180kg/ha. In order to achieve this the sward must contain a high percentage of clover and needs to be managed carefully.

- Ensure soil nutrient levels, in particular pH and phosphate levels are satisfactory.
- Sow 3-5kg/ha in a mix containing predominantly tetraploid perennial ryegrass into a fine, well consolidated, seedbed, ideally by direct sowing in the spring.
- Graze the sward down through the autumn to ensure adequate light reaches the stolons in the spring.

Response of grass-only and grass-clover swards to fertiliser N (Source: GM23 trial results)

