Growing and feeding lucerne

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Lucerne

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Introduction

Lucerne is a useful source of protein for feeding to cattle and sheep. A high-yielding legume, its roots naturally fix nitrogen making it a cost effective crop to grow either on its own or with carefully selected companion grasses or cereals.

However, it is not suitable for all farms – and will not perform or persist on heavy land or waterlogged soils, these conditions are likely to rot its deep tap root. This means farms with high rainfall are unlikely to grow lucerne successfully.

For those farming on free-draining or even drought-prone sites, lucerne can be a good accompaniment to grow and feed alongside other forages such as grass or maize.

Lucerne can be slow to establish and may need nurturing in the early stages, requiring adequate supplies of a range of macro- and micro-nutrients. The crown must be protected at all times when cutting or grazing, but with care a stand can last four to five years.

Research in the UK and overseas suggests lucerne can support exceptional animal performance and is worth considering when drawing up winter forage plans.

Key points:

- Lucerne is valued for its yield, protein and drought tolerance
- Lucerne is renowned for its slow establishment
- Lucerne can be grown on fertile, free-draining sites. It does not perform well in waterlogged soils
- Varieties should be selected with a winter dormancy score of 4–5
- Approximately 100 - 200 kg N/ha is fixed every year
- Target dry matter (DM) production is 12t DM/ha/yr (4.8t DM/acre/yr)
- It is important to maintain a minimum sward height of 6–7cm to avoid damaging the crown
- Under UK conditions, lucerne can be difficult to ensile. Using an additive is advisable
- Most growers choose to harvest the crop at the point of early flower bud – for quality, yield and adequate root development
- Never set-stock lucerne. It must be rotationally grazed to allow recovery time, or back fenced if strip grazing a field
- Lucerne is high in protein and certain minerals and is a good complement for maize silage.

Lucerne is valued for its yield, protein content, digestible fibre and drought tolerance.

Growing and feeding lucerne

Lucerne or *Medicago sativa*, commonly known as alfalfa, is a legume and widely grown throughout the world.

Like other legumes it does not grow when the soil temperature is below 8°C, so is likely to perform well between April/May and September in the UK. Yields can struggle in cold spring and – even with its drought tolerance – in dry summers.

Lucerne grows off a tap root which stores nutrients to help the plant re-grow after cutting or grazing. Like other legumes there are nodules on its roots which contain nitrogen-fixing bacteria so the crop does not require additional applied nitrogen (N) to grow.
There have been some reports of lucerne roots going down as far as 15 metres in search of water. This could result in damage to drains when growing this crop.

Lucerne is renowned for its slow establishment. This is due in part to it channelling energy into root development first, prior to leaf and stem production.

The plant generally grows well for four to five years, but can last longer. Its persistency will be affected by damage to its tap root, soil compaction from machinery or any pest and disease challenges.

Lucerne exhibits auto-toxicity, which means its seeds will not grow in a field of established lucerne, making it impossible to 'top-up' thinning crops. This also means there is a requirement to leave a gap of five to six years between crops.

The target fresh weight (FW) production per year is 40t/ha (16t/acre), with the target annual DM yield (at 30% DM for silage) of 12t DM/ha (4.8t DM/acre).

The nutritive value of lucerne is around 18-22% crude protein (CP) and around 10MJ/kg DM of metabolisable energy (ME). It can be grown with certain grasses to improve the feed's energy content, or fed with maize silage to make a balanced ration for energy and protein. However, even when grown with fescue or timothy as partner in a sward, competition from the grass can severely reduce the output and survival of lucerne.

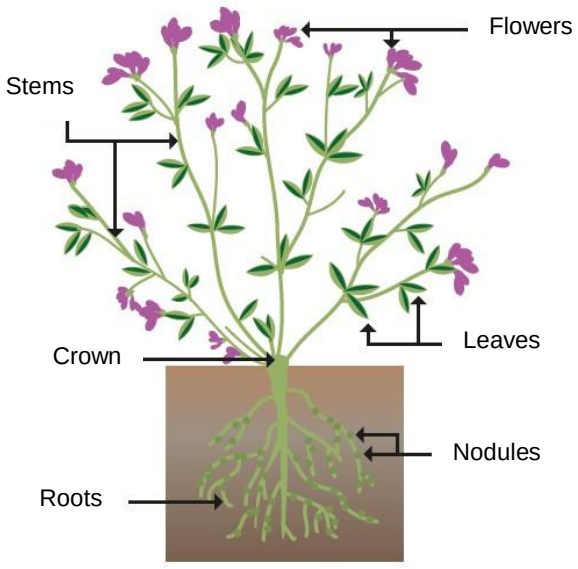


Figure 1. A diagram of a lucerne plant

Table 1. The potential advantages and disadvantages of growing lucerne

Potential advantages	Potential disadvantages
High yielding (12t DM/ha/yr)	Needs multiple cuts (3–4 per year)
High protein (18–22% CP)	Low energy levels (10MJ of ME)
No requirement for applied N	Moderate requirement for phosphate (P), sulphur (S), magnesium (Mg) and high requirement for potash (K) and calcium (Ca)
Once the crop is established, it can suppress weeds	Slow establishment which means weeds can dominate
Forage rich in digestible fibre	If not managed correctly there may be increased risk of bloat in grazing animals
High levels of minerals and vitamins	Has a requirement for boron (B), molybdenum (Mo) and manganese (Mn)
Contains high quality amino acids (similar to those in milk)	

Table 2. Example costings for growing lucerne for two example years

Establishment	**2010 (£/ha)**	**2012 (£/ha)**
Seed / 20kg (and inoculation)	115	124
Fertiliser [60P:60K kg/ha] (possibly N in low N soils, eg after cereals)	82	104
Crop protection	60	65
Establishment variable costs	**257**	**293**
Contractor (to establish crop)		
Ploughing	50	57.5
Discing	24	30
Power harrowing	38.5	52.5
Flat rolling	21.5	21.5
Drilling (seed and fertiliser)	35	42.5
Establishment contractor costs	**169**	**204**
Total establishment cost per crop per year (over 5 years)	**85.2**	**99.4**
Annual costs	**£/ha**	**£/ha**
Complete harvest (at 3.5 cuts/yr at £120/ha/cut)	420	420
Fertiliser spreading	8	12.5
Annual fertiliser (0N:120P:220K)	193	230
Establishment costs (from above)	85.2	99.4
Land rental	186	237
Total annual cost	**892.2**	**998.9**
Example costs	**£/ha**	**£/ha**
Cost/kg DM (at 12t DM/ha production)	0.07	0.08
Cost/kg DM (at 12t DM/ha production) without land rental charge	0.06	0.06
Cost/kg protein (at 12t DM/ha production at 21% protein)	0.35	0.40
Cost/kg protein as above without land rental charge	0.28	0.30

Growing and feeding lucerne

Options for growing lucerne

Depending on the required purpose of the crop, lucerne can be grown either as a monoculture or in a mixture.

To maximise protein production per hectare, particularly for crops that will be ensiled, pure stands of lucerne are most effective and the resulting forage complements maize silage well.

Pure stand
As it is slow to establish, growing lucerne on its own can be the best way to achieve successful establishment, as it will not be in competition with other, potentially more aggressive species. However, its auto-toxic nature will prevent over-sowing of grasses or other species in the fourth and fifth years of the crop, when production begins to diminish.

Mixtures
Growing lucerne in a mixture can offer a number of advantages including:

- Easier harvesting and preservation
- Reduced weed burden
- Reduced bloat risk in grazed lucerne pastures

Depending on the companion species, mixtures will also help to spread production throughout the year, which may be beneficial where growing seasons are short.

Cocksfoot, timothy and tall fescue can all be grown successfully in mixtures with lucerne. Their drought tolerant characteristics will enhance production during times of water stress.

Avoid sowing lucerne with quick growing species, such as Italian or hybrid ryegrasses, as these are likely to out compete the lucerne seedlings.

Species that are highly active during the winter and dormant during summer are considered a good complement to lucerne. This is because they allow the lucerne crop to flourish in summer and provide good winter cover to prevent soil erosion.
They also help increase the yield of the last cut in the season. However consideration should be given to the risk of lucerne being out competed.

Legumes such as subterranean clover or medic which are predominantly winter active complement the spring, summer and autumn growth of lucerne and are particularly successful in grazing situations. However these are not frequently grown in the UK.

Cover crop
Lucerne can be sown under spring cereals, with priority given to lucerne and the whole crop silage harvested when the cereal crop is at the milky stage.

Early results from AHDB Dairy-funded research suggest that sowing with a cover crop such as spring barley; can reduce weed infestation in the establishment phase.

However the competitive nature of the barley may result in fewer lucerne plants surviving. In other countries, lucerne has also been sown successfully with lupins or brassicas.

It is important to recognise that the cover crop will compete with lucerne seedlings for light and nutrients and can hinder establishment. If using a cereal as a cover crop, using 50–75% of normal seed rate is usually advisable to help lucerne establish by reducing competition – a maximum of 10kg/ha.

If a cereal is being used as a cover crop it may be worth considering:

- Type of straw – where possible choose a short-strawed, erect variety to avoid smothering the lucerne plant
- Harvesting difficulties – if the straw is not being baled/picked up as wholecrop, there is a risk that heavy straw may smother the lucerne. It is advisable to scatter the straw evenly
- Tillering – crops that tiller well, eg oats, are poor companion crops for lucerne due to their shadowing effect on the under-sown lucerne.

Site selection and preparation

Lucerne can be grown on a wide range of fertile free-draining sites and soil types. It will not perform well in waterlogged soils as the tap root can rot. This means it may not be suitable for areas with high rainfall and heavy clay soils.

Lucerne has a high requirement for calcium (Ca), so soils that are naturally pH 6 or higher are ideal. It can cope with alkaline soils up to pH 8.5.
Lucerne can grow well in both conventional and organic systems, however due to its auto-toxic nature there will need to be five to six years between crops.

Preparation
Due to its impressive, deep root structure, it is important that any soil structure problems have been remedied before establishment.

Where possible, it is important to ensure the seedbed is clean through the use of herbicides, as slow lucerne establishment can give weeds a chance to dominate.

Cutting lucerne removes a significant amount of nutrients – for every tonne of dry matter removed from the field 8kg of P, 30kg of K and 30kg of Ca is also removed. This means that growing it on soils with good P and K indexes (2 or more) and high pH will reduce the fertiliser or lime requirements in the short term.

Muck and slurries can be used to boost P and K levels, but care needs to be taken, that no more than 30kg N/ha should be applied. Well-rotted and old farm-yard manure (FYM) may be more suitable as the N levels will be lower.

Magnesium, Sulphur, Molybdenum and Boron are required during crop establishment. It is useful to carry out a full trace element soil test before sowing so requirements are known.

Variety selection

There are two dominant types of lucerne grown in Europe: Provence and Flemish.

‘Provence’ or Southern types of lucerne have a long growing season, are able to withstand frequent cutting regimes and are very drought tolerant. However they lack winter hardiness and are on the whole less suited to UK conditions.

In contrast 'Flemish' or Northern varieties are less drought hardy, with poor adaptation to frequent cutting. However they are more cold-tolerant due to their dormancy rating and are therefore usually better suited to UK conditions.

The most important characteristic to consider when selecting varieties is dormancy.

Dormancy is a measure of the winter hardiness of a variety and exists on a scale of 1-12, with 1 being very dormant in winter and 12 having virtually no winter dormancy at all. Varieties with a high dormancy score tend to be more productive, with more vigorous seedlings and faster recovery after cutting. Be aware that the quality of these varieties reduces significantly as they become more mature.

In contrast, winter dormant varieties tend to have less vigorous seedlings but display excellent persistency.

For UK conditions and to achieve three to four cuts a year, a dormancy rating of 4-5 is considered optimal.

Provence types will have a dormancy rating of 6-8, while Flemish types are likely to have a rating between 2 and 6.

In addition to dormancy, information is also available (see below) on other characteristics including: protein content, herbage yield, pest and disease resistance.

These are often only generated for conservation management. Information on lucerne managed for grazing pastures, or where grown in mixtures is limited.

Descriptive list
At present there is no recommended list available for lucerne in the UK. However, a descriptive list of lucerne varieties is contained in the Recommended Grass and Clover Lists booklet for England and Wales which is produced annually.

This list has a limited number of varieties on it and does not include all those available in the UK. One possible source of information is the French Recommended List which has approximately 30 varieties of lucerne on it. The French list is available here: www.herbe-book.org/presentation.php?espece=13

There is a descriptive list of lucerne varieties for growers in England and Wales

Establishment

Sowing date
In the UK, it tends to be most common to drill lucerne in the spring (normally from late April) as the soil starts to warm up. It can be drilled throughout the summer, as long as soil moisture is not limiting. In southern England it may be possible to sow it in late summer, but no later than mid-August to ensure crop establishment before winter.

Sowing
Lucerne seed should always be inoculated with *Rhizobia meliloti* bacteria to ensure successful root nodulation and efficient nitrogen fixation. Generally the seed will be treated, but if not, the seed can be mixed with inoculant just before drilling.

The seed should be sown into a fine, firm seedbed to a depth of 0.5 to 1cm. The seed is small, so going any deeper than 1cm will lead to poor germination. The rows should be 10-12cm apart and the seed needs to be rolled in.

Broadcasting the seed onto a fine and firm seedbed, followed by rolling reduces the risk of the seed going in too deep. It may be useful to establish tramlines for ease of fertiliser application and spraying for pests or diseases.

Seed rate

Lucerne can be sown as a pure stand or with grass, or under-sown into a cereal nurse crop. The advantage of mixtures is they provide a crop yield in the establishment year and help to suppress weeds.

The grasses need to be selected carefully so they do not out compete the lucerne seedlings. Generally perennial, hybrid and Italian ryegrass are not appropriate.

Table 3. Seed rates for different systems of growing lucerne

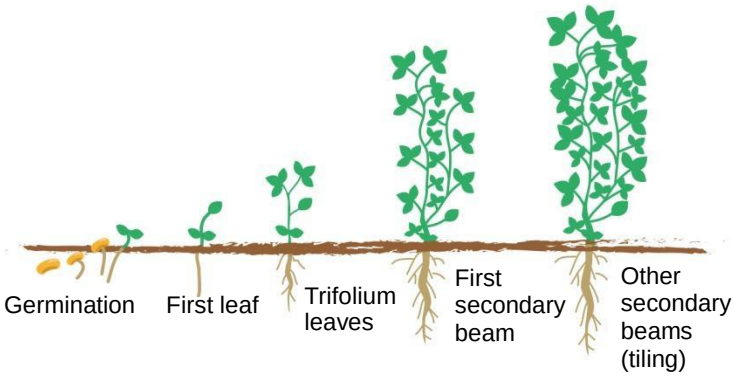
Cropping system	Seed rates
Pure lucerne	20-25kg/ha
Lucerne with grasses such as timothy/cocksfoot/fescues	Lucerne – 15-20kg/ha Grass – 8kg/ha
Lucerne under-sown with cereal cover crop	Lucerne – 20-25kg/ha Cereal seed at half rate

Source: Germinal Seeds GB

For pure lucerne stands the aim is to achieve 500-800 plants per m^2 at establishment.

It is likely that plant numbers will drop to 120-150 per m^2 after two years.

Figure 2. The growing cycle of lucerne



Lucerne re-growth

The first leaf is different, usually described as the ‘spade’ shaped leaf; subsequent leaves are trifoliate and the first to third trifoliate leaf stages are important for herbicide timing.

Case study
Ben Dixon, Dairy and Beef Producer, Shropshire
"We have 70 organic Jersey cows that are milked through a robot. We aim to have lucerne in their diets all year round either through silage or grazing, either by strip or zero grazing. If grazing, they tend to do better if the crop is younger.

Our oldest stand is five years old and still doing well. We tend to establish it in the spring with spring barley, which will take off as a wholecrop silage and then have a light grazing in the first autumn.

We apply some slurry in the spring, but limited other inputs.

When we make silage we cut it in the afternoon and then move it into 6m (20ft) swaths. It is then picked up 24-48 hours later and clamped. There is around five to six weeks between cuts.

We have found that it can struggle in dry times, but does better than red clover. We have a dry farm and in the dry summer a few years ago we lost fields of red clover but the lucerne came back."

Fertiliser

Lucerne is a legume and has no requirement for N fertiliser apart from that needed for establishment in low N soils (following cereal crops).

Lucerne can fix up to approximately 250kg N/ha/yr when taking both above and below ground production into account. This fixation will increase soil N content which can be used by following crops.

Phosphorus and potassium

Lucerne, similar to other legumes, has a high phosphorus (P) and potassium (K) requirement. While there are currently no official recommended P and K rates for lucerne, the crop's requirements are similar to those of red clover (see table 4 below).

Table 4. Annual (RB209) recommended P and K applications for red clover

Soil index	0	1	2	3	4
P	130	105	80	20	0
K	340	290	250	90	0

Phosphorus deficient lucerne can be identified by its fine spindly stems and narrow leaves which become bluish green or, in severe cases, purple. This is particularly common in acidic soils.

Typical signs of potassium deficiency are white or yellow spots around the margins of older leaves, or as a yellowing of the leaf margins and tips. Deficiencies of potassium in lucerne can result in significant yield reductions coupled with increased incidence of leaf diseases.

Other nutrients

In addition to P and K, significant quantities of calcium (Ca) and sulphur (S) can be removed when growing and harvesting lucerne. To optimise yield, it is essential that soil pH is maintained above 6. Regular soil testing should be carried out to monitor this.

Sulphur deficient plants are usually identified by the yellowing and stunting of young shoots. Low sulphur soils may require up to 25kg/ha/yr to optimise growth.

Trace elements

Lucerne can be sensitive to deficiencies of boron (B), molybdenum (Mo) and zinc (Zn).

Boron deficiency is identified as yellow leaves with a red-purple tinge and malformed heads. High levels of B can also be toxic to the plant, so care must be taken when applying it. Herbage analysis is a good way to test for B deficiency.

Molybdenum is essential for plant nodulation and production. Pale leaves, thinning crops, and wilting petals are all signs of Mo deficiency, which often occur at low pH levels (pH<5.0). Small applications of Mo may be required every four to five years. It is best to seek advice before applying.

Zinc deficiencies can result in an increased incidence of root rot, leaf disease and reduced yield. This is more common on high pH soils. Zinc sulphate can be applied to correct deficiencies.

Placement of fertiliser

In most cases top-dressing of fertiliser is sufficient, although responses can be poor if conditions are very dry. In these incidences fertilisers could be placed at 7-15cm deep using specialist equipment.

To ensure optimum establishment, banded fertiliser application 2-3cm below the seed is advisable at sowing with a specialist drill.

Management

Minimum sward height

It is important when grazing or conserving lucerne that a minimum sward height of 6-7cm is maintained to avoid damaging the crown – (see Figure 1).

Pest and disease control

The choice of agrochemicals to control pests and diseases in lucerne is limited and unless tramlines are used, there are few opportunities to enter the actively growing crop.

It is therefore important to ensure good establishment and to monitor growing crops closely. Seek specialist agronomy advice if crops appear to be challenged in some way.

Table 5. Common pests and diseases of lucerne
Source: Germinal Seeds GB

Pest/disease	Effect	Action
Sitona weevil larvae and leatherjackets	May attack at an early stage in establishment, biting off young shoots	Consult an agronomist – no insecticides are currently approved for use. Weevils can cause damage to small lucerne plants
Aphids	May infest established crops	No chemical approval exists at present
Slugs	A potential problem at initial establishment	Use slug pellets as required
Eelworm	Can cause persistency problems. Where infestations in the soil are known to occur, varietal resistance is the only practical solution. Eelworms are often more prevalent of heavier soils	Always use fumigated seed to avoid importing eelworm to the soil and crop. Consult an agronomist
Verticillium wilt	Leaves wilt on warm days and become blotchy with yellow or brown markings. The plants eventually die	Choose resistant varieties as there are no chemical treatments available
Dodder *(Cuscata)*	This parasitic plant has seed similar to lucerne and is difficult to remove from seed samples. It is rarely a serious problem in the UK as it multiplies rapidly at high temperatures (>30^{o}C) after rainfall	There are no control methods. Destroy any patches that develop with total herbicides and burning

Source: Limagrain, Germinal Seeds GB and Dengie Crops Ltd

Always consult a BASIS qualified adviser on the use of agrochemicals to control weeds, pests or diseases.

Aphids on a wheat sheaf

Slug

Verticillium wilt on oil seed rape

Weed control
Several herbicides are approved for use on lucerne, including propyzamide and carbetamide (see Table 6). They should be applied to an established crop during the winter dormancy

period. They are effective on grass and some broadleaved weeds, and will have some residual control into the spring. There are also some 'extension of authorisation of use' permissions, for example Fusilade Max, a contact herbicide for grass weeds.

Table 6. Pesticides cleared for use on lucerne

Chemical (example products	Reason/use	Maximum rate/ha	Usual rate/ha	Harvest interval or latest date	Notes
Propyzamide (eg Kerb Flo)	Grass weeds and small chickweed	1.75L	1.5L	1 October-end January[a]	Established crops
Carbetamide (eg Crawler)	Grasses, speedwell and chickweed	3.5kg	3.0kg	November-end February	After crop establishment
2,4-DB 400g/l (eg DB Straight, Headland Spruce, Butoxone DB)	Oilseed rape, charlock[b] and shepherd's purse	4.5L	2.0-3.0L		1st-4th trifoliate leaf stage
Tri-allate (eg Avadex Excel 15G)	Wild oats	15Kg	15Kg		
Diquat* (eg Reglone)	Total weed control[c]	2.0L	2.0L	End March[d]	During dormant phase of crop
Fluazifop-p-butyl* (eg Fusilade Max)	Grass weed control[e] (not meadow grass)	3.0L	0.5-1.0L	52 days before cutting or grazing	Should be used before end of October of before mid-June

Source: Compiled by Dengie Crops Ltd

(a) November to December best
(b) Use higher rate for charlock; poor on white mustard.
(c) Keep livestock out of treated area for 24 hours
(d) Mid-December to mid-January best
(e) Unprotected persons to be kept out of treated area for 24 hours after treatment
* = off label use. Check with an agronomist before buying.
Note: Read label and obey conditions and restrictions. Check current position at:
https://secure.pesticides.gov.uk/offlabels/OffLabelList.as

Sustainable Use Directive (SUD). Are you ready?
There are three key dates for producers using herbicides or pesticides on grassland:
During 2014
Demonstrate that Integrated Pest Management (IPM) is being followed on your farm.
25 November 2015
The sprayer operative on your farm must hold a recognised Certificate of Competence.
26 November 2016
Working crop sprayers must have an NSTS Certificate.
Why does this matter?
These measures are/will be legal requirements for UK farmers. Non-compliance could lead to prosecution and threaten your Single Farm Payment.
Links to a range of useful plans can be found at www.voluntaryinitiative.org.uk.

Conserving lucerne

Lucerne can be clamped or baled.

Under UK conditions, high humidity and the low sugar content of lucerne can make it difficult to ensile.

In addition, lucerne is high in protein and calcium which will buffer any changes in pH in the clamp/bale. Good conservation management is key to achieving high quality forage.

Cutting time

In the first year of the crop, one or two cuts may be harvested. After this however, the crop will be suitable for cutting four to five times a year, usually at approximately five week intervals. Typically in the UK, lucerne can be harvested from mid-May onwards (depending on location). The greatest yields are achieved in the first two cuts (see Table 7).

Table 7. The proportion of total yield from lucerne cuts

Cut	Proportion of total yield (%)
Late May	35
Early July	35
Mid-August	20
Late October/early November	10

Source: Sheldrick et al. 1995

Deciding on the best time to cut can be a compromise between yield, quality and crop persistence.

While the protein content of lucerne is greatest at the pre-bud stage, it is currently believed that routine cutting at this time may shorten the lifespan of the crop.

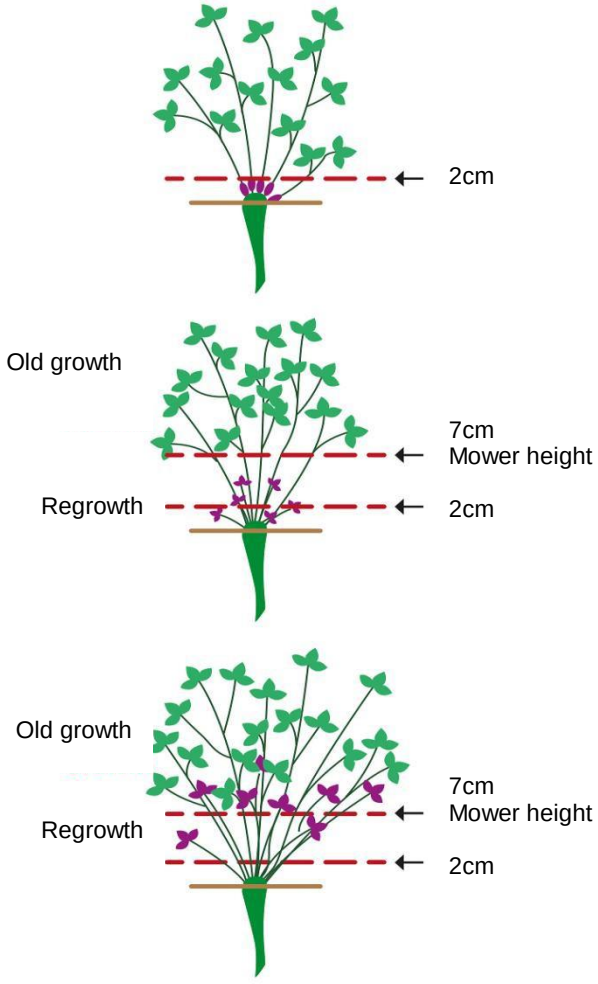
Case study
Angela Robertson, Beef Producer, Worcestershire
"Our lucerne stands generally last around five years and we use it to maximise production of a relatively small area.
We tend to cut our lucerne in the morning, unlike grass, so it is damper and there is less risk of leaf shatter.
We have learnt that it is important to try to prevent the lucerne stubble piercing the wrap on the silage bales. If possible we wrap the bales once they have been taken from the field and we check them for damage.
We tend to feed lucerne to our lactating cows, but aim not to have more than 60% lucerne in the diet as it can make their dung loose. It is clear to see why when our first cut analysed at 24% protein and second cut at 19%."

Herbage harvested at full bloom will have a higher proportion of stem. As the crop flowers the stems become more fibrous and the feeding quality of the forage decreases.

Most growers choose to harvest the crop at the point of flower (10-30% flowers open), to ensure a good compromise between quality and yield and to ensure there is adequate root development.

To ensure persistency, some growers opt to harvest one flowered crop per year. Work from New Zealand supports this approach. However, French growers do not do this, as it means the subsequent cut is of lower quality. It is likely that the NZ guidance is more important for systems based around grazing the crop rather than cutting.
The re-growth of new shoots can also help ascertain optimum time for cutting. Harvesting when new shoots are visible will ensure good re-growth. However shoots should be short enough to avoid damaging these with the mower (See Figure 3).

Over the next few years the AHDB Dairy Grassland, Forage and Soils Research Partnership will be investigating the effect of stage of maturity at cutting (bud vs. flower) on the quantity and quality of lucerne silage. More information is available at: dairy.ahdb.org.uk/lucerne



Too early
Half the plants have buds just beginning to show at the base.
No new leaves apparent.

Optimum time
Regrowth averages 2cm, mainly buds.
Leaves are not fully unfolded.

Too late
Regrowth higher than cutting height.
Leaves are unfolded.

Figure 3. The consequence of different cutting times on lucerne plants

Growing and feeding lucerne

Mowing and wilting

A minimum cutting height of 7cm is advisable to avoid damage to the crown of the plant. This will also allow good airflow under each swath, which will help dry the crop.

Direct cut lucerne is high in moisture and often too low in sugar to allow effective fermentation to occur, so it is important to wilt the crop to a minimum DM content of at least 30% (40-50% if baling) to concentrate the sugar content. As a result, lucerne/grass mixtures are thought to be easier to ensile due to the higher sugar content of grasses.

A minimum cutting height of 7cm is advisable to avoid damaging the crown

Up to 70% of the protein and 90% of the minerals and vitamins in the plant are in the leaf so it is important to minimise leaf losses. As the leaf dries out quicker than the stem of the plant, over-wilting or extensive handling can result in large amounts of leaf shatter.
The use of roller-type mower conditioners, which cut and condition the lucerne by crimping or crushing the stem is advisable when harvesting lucerne. These will speed up the rate of moisture loss from the stem without extensive damage to the leaf. However by encouraging more rapid leaf drying it can increase leaf shatter, so care is needed.

Raking the crop before the dew has evaporated and reducing tractor speed will help reduce leaf losses.

Case study
Chris Ruffley, Harper Adams University, Shropshire
"We feed lucerne silage to our dairy cows and youngstock alongside maize. We take the silage process very seriously and achieve consistent analyses. We aim to produce 30-35% DM silage, and we only cut if there are three guaranteed rain-free days. We aim to cut it before it flowers and want four cuts a year. We use a rubber roller mower conditioner and leave a 10cm (4 inch) stubble. We have found that our choice of mower is more gentle and reduces the risk of leaf shatter but still encourages water loss.

On day one of silaging we cut in the afternoon and leave it in 3 metre (10ft) swaths behind the mower and we do not touch it on day two. Then very early in the morning of day three (2-3am) we will row it up when the dew is on it. It is then picked up by the forager in the afternoon of day three. We use an additive to help fermentation and our choice will alter based on dry matter predictions.

We generally sow pure stands, but tried undersowing it with spring barley in 2013, as we were re-seeding 24ha (60 acres) so wanted to guarantee a good yield off the first cut. However a pure stand is still our preference as it works well and lasts four to six years.

We perhaps need to think more about nutrient management in the future, as it tends to receive only slurry or separated slurry."

Additives
Using an additive is advisable when ensiling lucerne. Seek advice from the local merchant or supplier.

Clamp or bale?
Lucerne silage can be preserved either in a clamp or in big bales (see Table 8). Aim for a target DM of 30-40% for clamp silage and 50% for big bale silage. For bales, ensure there are at least four layers of plastic to minimise the risk of stems piercing the wrap.

Table 8. Feeding value comparison between lucerne ensiled in a clamp or in a bale

	Clamp	Bale
Dry matter (%)	39.1	39.8
pH	4.3	4.4
Ammonia-N g/kg Total N	60.8	56.9
Lactic acid g/kg DM	50.0	36.1
Acetic acid g/kg DM	16.7	10.5
ME MJ/kg DM	N/A	N/A
WSC g/kg DM	3.5	8.1
Crude protein g/kg DM	23.4	23.4

Source: IBERS, Aberystwyth University

Grazing and feeding lucerne

Best practice
- Grazing can reduce persistency, so great care must be taken not to damage the crown. Aim for a minimum sward height of 6-7cm
  - Work from the USA suggests plant survival is reduced by 15-22% over two years by continuous stocking compared to rotational grazing
- Bloat is a risk
  - Make sure animals are introduced to the crop gradually and allow for an adjustment period of up to three weeks
  - Never introduce hungry animals on to the crop
  - Always ensure a fibre source (hay, straw) is available
- Sodium is stored in lucerne roots, so animals may become deficient – ensure salt blocks are available

Never set-stock lucerne. It must be rotationally grazed to allow recovery time, or ensure a back fence is used if strip grazing a field

Guidelines for grazing lucerne
Developed by Professor Derrick Moot at Lincoln University, New Zealand
- Autumn recovery
  - Allow at least 50% of the lucerne stems to have an open flower sometime from mid-summer to autumn, to encourage root recharge
  - Graze if dry weather has stopped growth, but then allow recovery after rainfall until growth stops reduces yield
- Spring production
  - Establish a five to six paddock rotation which allows for 35-42 days between grazing

- During the summer the leaf is high quality (ME >12MJ/kg DM and CP >24%) and the stem is low quality (ME~8MJ/kg DM and CP <14%)
- Ensure a minimum of six to eight weeks on lucerne to maximise liveweight gain, as the rumen takes time to adjust
- Do not allow the crop to flower – graze before flowering
- If the harvest is delayed, the proportion of stem will increase

- Summer management
  - During the summer, shorten the rotation so the animals move faster around the paddocks, so they return after 30-35 days
  - Water stress accelerates flowering but leaf is still high quality
  - Conserve a true surplus

Feeding lucerne
High DM yield, protein and calcium content make lucerne a suitable forage for ruminants and it is more digestible than other similar feedstuffs. The actual digestibility of the forage will depend on factors such as growth stage, cutting frequency, harvesting conditions and fermentation processes.

For ruminants, the lower readily available starch content and higher buffering capacity of lucerne compared to maize silage also has a beneficial effect on rumen pH.

The high protein content (18 - 25%) of lucerne silages make it a good replacement for soybean meal in diets. It is also a good compliment to maize silage because it is high in nutrients that maize is low in.

AHDB Beef & Lamb have a guide on growing and feeding lucerne within their BRP plus+ range, this gives additional information for lambs and grazing bulls.

Analysis
Unlike grass silage there currently is no near-infrared spectroscopy (NIRS) analysis available for lucerne silage. Feed value testing must therefore be undertaken via wet chemistry analysis which is available at most commercial laboratories. This is more expensive than typical grass silage analysis but costs vary depending on the values requested.

Minerals
Lucerne silage is higher in calcium than most other forages and caution should be taken when feeding it to dry cows. In addition, the crop is also low in phosphorus and supplementation may be required.

Research work – feeding lucerne silage to dairy cows
A review of a number of research trials which have compared the performance of dairy cows fed either lucerne or grass silage, has shown that lucerne silage can increase DM intake (+2.2kg/d) and milk yield (+1.7kg/d) compared to grass silage (see Table 9). In these trials, forage type had no significant effect on milk fat or milk protein content.

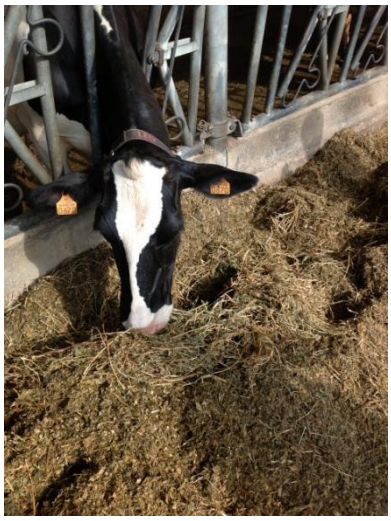


Table 9. Results from experiments comparing grass silage and lucerne silage

	Grass	Lucerne
Dry matter (kg/day)	20.2	22.4
Milk yield (kg/day)	29.5	31.2
Milk fat (g/kg)	38.1	37.9
Milk protein (g/kg)	31.6	31.8

Source: Steinshamn, 2010

In contrast, when compared to red clover (see Table 14), despite there being higher DM intakes with lucerne (+0.8kg/d), there was no significant increase in milk yield (average yield = 30.4 vs.30.6kg/d). In comparison with red clover however, lucerne was found to increase milk protein content by an average of 0.8g/kg.

Table 10. Results from experiments comparing red clover silage and lucerne silage

	Red clover	Lucerne
Dry matter (kg/day)	21.8	22.6
Milk yield (kg/day)	30.4	30.6
Milk fat (g/kg)	38.5	39.4
Milk protein (g/kg)	31.6	32.4

Source: Steinshamn, 2010

Currently researchers at HAU, SRUC and University of Reading are investigating the effect of rate of inclusion, cutting date and chop length of lucerne silage in dairy cow diets.

Summary

- Lucerne can be a very useful source of protein but the site needs to be selected carefully
- Lucerne has higher persistency than red clover but similar protein levels and yields
- Select a variety that is winter dormant (dormancy rating of 4-5)
- Lucerne can be slow to establish and care is needed when choosing a companion species so the lucerne is not smothered during its first year
- It has different nutrient requirements to grass, especially in relation to potash, calcium and boron, so it needs to be looked after
- Good levels of animal performance have been achieved on lucerne crops, especially when compared to grass alone.