



# Moorepark Dairy Levy Research Update

*Management and establishment of grass-white clover swards*

Moorepark Animal & Grassland Research and Innovation Centre  
Teagasc, Moorepark, Fermoy, Co. Cork.

March, 2024

Series 42





# Management and establishment of grass-white clover swards

Authors: Michael Egan, Michael O'Donovan, Áine Murray, Philip Creighton, Peter Doyle and Brian McCarthy



March 2024

## Contents

<b>Introduction</b>	<b>5</b>
<i>Benefits of white clover</i>	5
<b>Establishing grass/white clover swards</b>	<b>6</b>
<i>White clover establishment blueprint</i>	6
<i>Reseeding</i>	6
<i>Over-sowing</i>	7
<i>Post-sowing management – (full reseed or over-sowing)</i>	8
<i>Weed control</i>	8
<i>How does white clover grow?</i>	10
<i>Rosette phase (months 1-3)</i>	10
<i>Expansion phase (months 3-12)</i>	10
<i>Clonal phase (months 12+)</i>	11
<b>Grazing management for white clover swards</b>	<b>12</b>
<i>Nutrient management</i>	14
<b>Grazing management to prevent bloat</b>	<b>18</b>
<i>High risk times for bloat</i>	18
<i>BLOAT</i>	19
<b>White clover varieties</b>	<b>20</b>
<i>Red clover</i>	21
<i>Managing a red clover sward</i>	22
<i>Red clover varieties</i>	23
<i>Useful links</i>	24
<b>White Clover content score card</b>	<b>25</b>

## Introduction

The recognition of the nitrogen (N) fixation, benefits in forage quality and animal performance of grass-white clover pastures has led to a resurgence of interest. There are management challenges to ensure that grass-white clover swards are established and persist on commercial grassland farms. This publication discusses and sets out the principles for the management and establishment of grass-white clover swards so that its benefits can be achieved at farm level.

## Benefits of white clover

The benefits of white clover tend to occur from late April/early May onwards as sward clover content increases. The main benefits of white clover inclusion in grass swards are:

- **Nitrogen fixation.** White clover fixes N from the atmosphere making it available for plant growth. Depending on N fertiliser application rate and sward clover content, white clover can fix up to 60 - 120 kg N/ha per year
- **Lower requirement for N** especially in the mid-season. Research has shown that with 100 kg less N fertiliser (i.e. 150 vs 250 kg N/ha) grass white clover swards can produce similar annual herbage DM (approximately 14 t DM/ha)
- **Increased herbage quality** compared to grass-only swards in the summer months. Grass-white clover swards have higher crude protein (+ 9%) and organic matter digestibility (+ 1.2%) contents and lower fibre (- 6%) contents than grass-only swards
- **Increased dry matter (DM) intake** in summer and autumn. Cows grazing grass-white clover swards can consume 0.5 to 1.5 kg more DM per day than cows grazing grass-only swards
- **Higher milk production and live weight gain.** Cows, beef animals and lambs grazing grass-white clover swards had increased milk solids yield of 20 - 40 kg/cow and increased average daily gain of 100 g/day for beef and 15-20 g/day for lambs resulting in 10-20 day reduction in days to slaughter, respectively.

## Establishing grass/white clover swards

Establishing white clover on farm will take some time, using a combination of both reseeding and over-sowing. Incorporating white clover in a full reseed is the most reliable method of clover establishment. Over-sowing is a simple and low cost method of introducing white clover into swards. Success is very much dependent on soil fertility, weather conditions at the time of oversowing and post-sowing grazing management.

### White clover establishment blueprint

A targeted multi-year approach should be used in establishing a white clover system i.e. a combination of reseeding and over-sowing.

- Reseed approx. 10% per year
- Over sow approx. 15% per year
  - » Year 1- reseed 10% & over sow 15% = 25%
  - » Year 2- reseed 10% & over sow 15% = 25% (50%)
  - » Year 3 – reseed 10% & over sow 15% = 25% (75%)
  - » Year 4 - reseed 10% & over sow 15% = 25% (100%)
  - » Year 5 + - on-going process

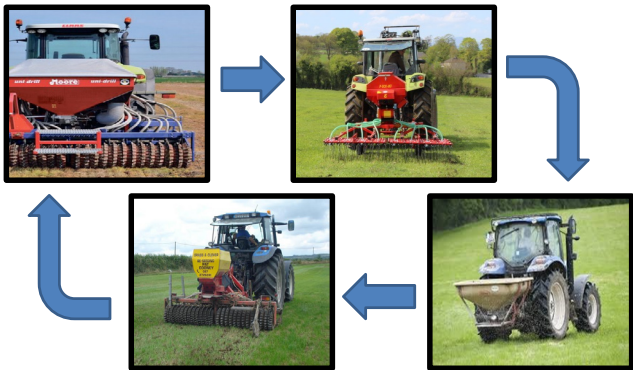
### Reseeding

- Spring reseed provides best results - April, May
- Spray off the old pasture with glyphosate
- Prepare a fine, firm seedbed (with the most appropriate cultivation method for that paddock)
- Soil sample and apply required lime, Phosphorous (P) and Potassium (K)
- Use the Irish Recommended List for grass and clover cultivar selection
- Ensure good seed: soil contact by rolling after sowing

Sowing rates		
	Grass	White clover
Cattle	28-30 kg/ha	4-5 kg/ha
Sheep	25-28 kg/ha	5-6 kg/ha

## Over-sowing

- Control weeds the previous year prior to over-sowing white clover (if possible)
- April/early May is the best time for over-sowing
- Over-sow directly after a tight grazing
- White clover can be over-sown using a number of methods (see Figure 1)
- Ensuring soil contact post over-sowing is one of the most crucial factors
- Over-sowing methods - (Figure 1) are equally successful on the correct timing and and post sowing management are optimal
- Broadcasting – gives more varied results:
  - » Mix clover seed with a compound fertiliser in the field – max of 1 ha at a time
- Stitching – can ensure a better soil: seed contact:
  - » In sheep swards stitching **should be** used
- Sow at a rate of 5 to 6 kg/ha



**Figure 1.** Methods of over-sowing white clover into existing swards

## Post-sowing management – (full reseed or over-sowing)

- Allowing light to reach the base of the sward is crucial in post-sowing management, this encourages stolon development
- The first grazing should be at a pre-grazing herbage mass of 600 to 1000 kg DM/ha
- Subsequent three grazings should be at a pre-grazing herbage mass <1,100 kg DM and swards should be grazed to  $\leq 4$  cm (graze tight) – this will mean that paddock grazing times will be reduced in these paddocks
- No silage in the first 12 months after sowing
- Swards should be grazed later in the autumn to avoid carrying heavy covers over the winter

## Weed control

Weed control in reseeded and over-sown grass-white clover swards is vital to improve sward persistence. Clover safe herbicides should be used in establishing and established swards. All pesticide users should comply with the regulations as outlined in the Sustainable Use Directive (SUD).

- Reseeds
  - » Weeds are best controlled when the grass plant is at the three leaf stage and the clover when the trifoliolate leaf has appeared (see picture of correct timing for herbicide application). White clover safe herbicide should be used
  - » Pro-Clova will be the only licensed clover safe herbicide available for new reseeds
  - » Eagle and Pro-Clova are both licensed for established swards
- Over-sown
  - » Established weeds should be controlled the previous year before over-sowing
  - » Consider the residue time of non-clover safe sprays (this may effect clover establishment – read product label)





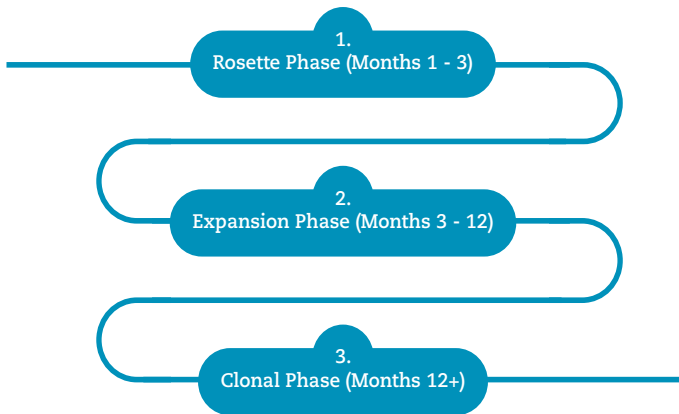
*Dock weeds at the perfect stage for herbicide*



*Grass plant at the 3 leaf stage and white clover plant with the trifoliate leaf emerged*

## How does white clover grow?

There are three stages of white clover growth from germination to full establishment.



### Rosette phase (months 1-3)

- Reliant on central taproot
- Few branches (5 - 10 cm)
- Rosette plant form
  - » Small vertical primary stem surrounded by ring of short secondary branches
- Important to graze during this phase to promote growth (without damaging plant)

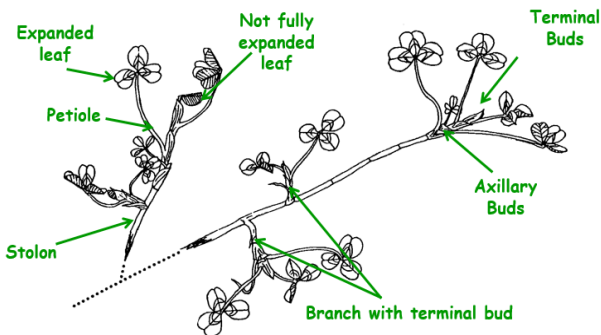
### Expansion phase (months 3-12)

- Reliant on central taproot
- Rapid expansion – up to 15 branches (25-30 cm)
- Poor rooting structure, careful grazing required (six months)

- 12 months post-sowing taproot begins to die – can take up to 2.5 years for all taproots in the sward to die
- On-set of N fixation, no release into soil for up to 12 months
- Achieving low grazing residuals is crucial for stolon development

### Clonal phase (months 12+)

- Reliant on adventitious roots which form from the nodes of the stolons
- Normal status of clover in established swards (Figure 2)
- Clover actively fixing and releasing N to the sward
- Stolons last for 12-18 months. New stolons produced at the terminal bud
- New stolons become independent plants and this cycle continues each year
- Achieving low grazing residuals is crucial for stolon development



**Figure 2.** White clover plant in the clonal phase – Phase 3

## Grazing management for white clover swards

Grazing management is similar for grass-clover swards and grass-only swards. Flexibility and willingness to adapt to the conditions are important when managing grass-clover swards. Good grazing management is also important for increased persistency and production of white clover in grazed swards. Grass-clover swards benefit from low grazing residuals.

### Spring (First rotation)

- Target early spring grazing – this benefits white clover growth
- Avoid poaching/damaging swards – poaching reduces white clover content
- Be flexible – use on/off grazing, graze wetter paddocks in drier weather, etc.
- Target 3.5- 4 cm post-grazing sward height

### Mid-season (April to July)

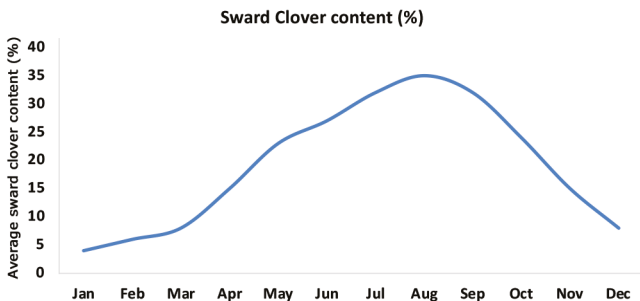
- Maintain pre-grazing herbage mass between 1,300 and 1,600 kg DM/ha (8 to 10 cm)
- Target 4 cm post-grazing sward height
- Chemical N fertiliser may be reduced in the mid-season on swards with good white clover content (see Table 1 and 2)

### Autumn

- Build grass on the farm from early to mid-August - extend rotation length
- Close the farm in rotation from early October
- Target post-grazing sward height of 4 cm in the final rotation
- Avoid poaching swards
- Be flexible – use on/off grazing, graze wetter paddocks in drier weather, etc.

- Close paddocks with a high sward white clover content (i.e. > 30%) towards the end of the final rotation (end October/early November)

An average annual sward white clover content of approx. 20 – 25% is desirable for animal and sward production benefits. In general, sward white clover content increases through the spring, into summer and generally peaks in August/September (Figure 3). Good grazing residual management is key to increasing sward clover content over the year.



**Figure 3.** Average annual profile sward clover content across the year with an annual content of 25%



*Ideal grazing residual*

## Nutrient management

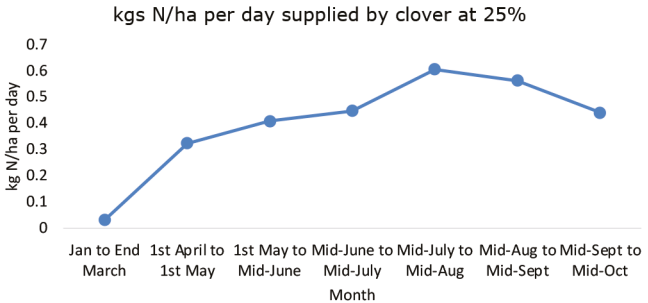
### *Nitrogen fertilisation strategies*

A soil pH > 6.3 (ideally 6.5) is critical for white clover development and persistency. Low soil pH reduces soil nutrient availability for plant growth. White clover is more sensitive to low soil pH than PRG with formation of nodules for N fixation compromised at a soil pH below 5.8.

White clover requires a minimum of soil index 3 for P (5.1 – 8 mg/l) and K (101 – 150 mg/l). Soil P and K availability are also important for biological N fixation (BNF) which is reduced when there is a P and/or K deficiency. Sulphur (S) applications are also important for clover growth and BNF and S should be applied from April on all grazing swards.

Early Nitrogen fertiliser application is important to encourage growth and development. To ensure enough pasture is available to feed animals in early spring, N fertiliser must be applied at similar rates to those used in grass-only swards as BNF is limited at this time. Figure 4 below outlines the BNF timeline for a grass/clover sward across the year. As such, the rate of chemical fertiliser applied should complement the BNF rate to ensure that herbage production is not compromised due to N deficiency.

In the summer, when sward clover content is sufficient ( $\geq 20\%$ ), N fertiliser application can be reduced. Some N fertiliser is required in autumn to build AFC so N should be applied in late-August/early September to ensure pasture availability for the autumn. Suggested N application strategies for grass-clover swards with a range in sward white clover contents are shown in Table 1 and 2.



**Figure 4.** *Biological nitrogen fixation from a grass-clover sward with an average sward white clover content of 25% equates to 100 kg N/ha fixed annually*



**Table 1. Nitrogen fertiliser application strategy for a dairy farm on a range of sward clover contents assessed in April**

<sup>1</sup> April average sward clover content	Feb	Mar	April	May (2 rotations)	June (2 rotations)	July (2 rotations)	Aug	Sept	Total
<b>Kg N/ha</b>									
Grass sward	24	36	20	32	28	28	21	23	<b>212</b>
<sup>2</sup> 5%	20	35	20	20	20	20	20	20	<b>175</b>
<sup>3</sup> 10%	20	35	20	15	15	10	15	20	<b>150</b>
<sup>4</sup> 15%	20	35	20	15	10	<sup>6</sup> SW	10	20	<b>130</b>
<sup>5</sup> 20%	20	35	20	15	SW	SW	SW	15	<b>105</b>

<sup>1</sup>April average sward clover content (%) – Clover content determined in April: <sup>2</sup>5% clover content in April = 10% average annual sward clover content; <sup>3</sup>10% clover content in April = 20% average annual sward clover content; <sup>4</sup>15% clover content in April = 25% average annual sward clover content; <sup>5</sup>20% clover content in April = 30% average annual sward clover content. <sup>6</sup>SW – soiled water – soiled water should be applied when chemical N fertiliser is not spread



**Table 2. Nitrogen fertiliser application strategy for a drystock farm on a range of sward clover contents assessed in April**

April average sward clover content kg N/ha	Feb/ March	April	May	June	July	Aug/ Sept	Total
Grass sward (low/none)	28	28	28	18	28	20	<b>150</b>
25% (medium)	28	20	20	11	15	18	<b>112</b>
310% (high)	20	20	10	0	10	15	<b>75</b>

<sup>1</sup>April average sward clover content (%) – Clover content determined in April; <sup>2</sup>5% clover content in April = 10% average annual sward clover content; <sup>3</sup>10% clover content in April = 15% average annual sward clover content

## Grazing management to prevent bloat

Bloat maybe an issue in swards with high white clover content. Bloat can occur at any time of the year but it is more likely to occur in the second half of the year when sward white clover content is highest. Applying a mitigation strategies can minimise and prevent bloat as well as good grazing management.

### High risk times for bloat

- Having animals hungry animals prior to allocating grass-clover swards – this induces gorging the swards when entering such swards
- Animals grazing grass-clover swards without previous access to grass-clover swards
- Swards with a high sward clover content - >40% in the mid-season period
- Wet morning or heavy dew on the pasture
- Very lush grass - low pre-grazing herbage mass, after grass etc.
- Reseeded swards with high clover seeding rates i.e. swards with high levels of white and red clover sown



Water trough bloat oil dispenser

# BLOAT

## Understanding Bloat

**B**

Be consistent (problems going from grass to grass clover swards)

**L**

Little and often – use a strip wire to control grass allocations

**O**

Oil – use bloat oil during periods of high risk

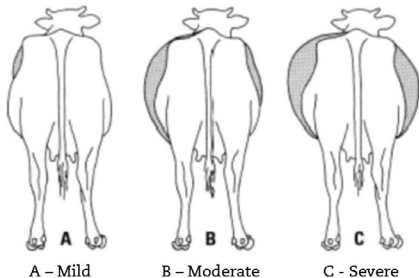
**A**

All cows out after milking together; makes sure the first cows milked don't gorge on clover before the others get out

**T**

Target fibre in the diet

There are three degrees of bloat:



**Figure 5.** Identifying degrees of bloat in cattle

## White clover varieties

White clover cultivars are categorised by leaf size.

- *Small leaf white clover*
  - » Lower yielding
  - » More persistent
  - » Tolerant of tight grazing, e.g. sheep grazing
- *Medium leaf white clover*
  - » Intermediate for yield and persistency
  - » Suitable for cattle grazing
- *Large leaf white clover*
  - » Higher yielding
  - » Aggressive and can dominate a sward
  - » Suitable for cattle grazing and silage

**Table 3. Irish white clover variety recommended list 2024**

Variety name	Leaf size*	Total yield <sup>1</sup>	Clover %
Brianna	V Large	108	46
Kakarike	V Large	92	53
Barblanca	Large (0.76)	105	50
Violin	Large (0.75)	101	46
Alice	Large (0.73)	100	49
Dublin	Large (0.73)	102	49
Chieftain	Medium (0.68)	98	45
Aberswan	Medium (0.65)	94	49
Buddy	Medium (0.58)	98	46
Iona	Medium (0.56)	95	43
Crusader	Medium (0.56)	96	44
Aberherald	Medium (0.55)	98	45
Coolfin	Small (0.51)	104	46
Aberpearl	Small (0.51)	100	45
Galway	Small (0.36)	95	37
Aberace	Small (0.26)	95	33

<sup>1</sup>Control Mean - 9.4 t DM/ha; controls in 2016 Trial were Barblanca, Alice, Chieftain and Crusader

\*Values in brackets indicate leaf size compared to the variety 'Aran' (i.e. Aran = 1.00), based on data from UK D.U.S. tests.

## Red clover

Red clover (*Trifolium pratense* L.) is a deep tap rooting, N fixing legume that is primarily used for silage production. It offers high yields of 12-20 t DM/ha and can fix in excess of 150 kg N/ha per year. Red clover has a different growth habit to white clover and requires different management to optimise its performance, and can be more complicated to manage than conventional grass silage. The crown of the red clover plant acts as the growing point and is located above ground level. The stem grows upwards from the crown. The crown of the plant should be protected from compaction, poaching, overgrazing or cutting too low in order to maintain the proportion of red clover in the sward.



Red clover plant

### Establishing a red clover sward

- Red clover performs best on well-drained, fertile soils
- Spring reseed provides best results - April, May, June
- Spray off the old pasture with glyphosate
- Prepare a fine, firm seedbed
- Target soil pH 6.3 – 7.0 and Index 3 for P and K

Sowing rates		
	Grass	Red clover
Kg/ha	22	10

- Use the UK Recommended List for cultivar selection
- Use a clover-safe post-emergence herbicide during suitable weather conditions.

## Managing a red clover sward

- Multi cut silage system – 3 to 4 cuts per year
- Six to eight week cutting intervals – improves persistence
- First cut should be targeted in early-mid May – increases clover contents in subsequent defoliations
- Avoid excess chemical N fertiliser applications - Approx 50 kg N/ha for first cut and zero thereafter
- High P and K requirement

Four cut silage programme		
	Phosphorus	Potassium
kg/ha	4 kg P per 1 ton DM/ha	25 kg K per 1 ton DM/ha
<b>1<sup>st</sup> cut (target 5500 kg DM/ha)</b>	22 kg P/ha	140 kg K/ha
<b>2<sup>nd</sup> cut (target 4500 kg DM/ha)</b>	18 kg P/ha	110 kg K/ha
<b>3<sup>rd</sup> cut (target 3000 kg DM/ha)</b>	12 kg P/ha	75 kg K/ha
<b>4<sup>th</sup> cut (target 2000 kg DM/ha)</b>	8 kg P/ha	50 kg K/ha
<b>Total</b>	60 kg P/ha	375 kg K/ha

*\*All Phosphorus and Potassium requirements can be met by a combination of chemical and organic fertiliser.*

- Ensure adequate wilting time (24 - 36 hrs wilt - target  $\approx$  30% DM)
- Avoid compaction, avoid repeatedly driving over the same area - will cause crown damage and plant loss
- Target a cutting height of 5 cm and if grazing in spring and autumn, graze to 6 cm
- Grazing red clover can increase the risk of bloat rather than white clover due to higher clover content in the grazing horizon of the sward, adhere to bloat prevention as per section

- Red clover can contain up to 1% oestrogenic compounds – resulting in reduced ewe fertility
  - » Avoid grazing red clover sward with ewes 6 weeks before and after mating
- Red clover is susceptible to a number of pests and diseases although incidences in Ireland are rare
  - » Stem eelworm is the major pest of red clover
  - » Clover rot (*Sclerotinia*) is the most serious disease affecting red clover
  - » A 5-year break between red clover crops is recommended to combat pests and diseases



*Red clover compaction damage*

## Red clover varieties

Red clover varieties are not included in the Irish Recommended list of grass and clover varieties published by the Department of Agriculture, Food and the Marine each year. Therefore, the United Kingdom (UK) Recommended List of Red Clover Varieties should be used when selecting red clover varieties. Teagasc research is currently evaluating different red clover varieties across a number of sites in Ireland.

**Table 4. United Kingdom red clover variety recommended list 2024**

Variety	Ploidy	<sup>1</sup> Yield of 1 <sup>st</sup> cut	<sup>2</sup> Total annual yield	Average Crude protein %	<sup>3</sup> Ground cover %
Merviot	Diploid	105	95	18.6	50
Lemmon	Diploid	99	98	18.9	60
AberClaret	Diploid	96	103	18.2	59
Harmonie	Diploid	101	98	19.4	66
Sinope	Diploid	102	100	18.8	61
Fearga	Diploid	91	101	18.0	58
Ganymed	Diploid	104	105	18.0	63
Amos	Tetraploid	100	98	19.6	61
Maro	Tetraploid	98	95	19.2	50
Atlantis	Tetraploid	103	101	19.5	61
Magellan	Tetraploid	101	102	19.5	62

<sup>1</sup>Yield of 1<sup>st</sup> cut Average = 100 at 5.53 t DM/ha

<sup>2</sup>Total annual yield Average = 100 at 11.7 t DM/ha

<sup>3</sup>Ground cover % end of the 2<sup>nd</sup> harvest year



Red clover sward

## Useful links

Irish Recommended Grass and Clover lists

<https://www.gov.ie/en/publication/43ec9-grass-and-white-clover-varieties-irish-recommended-list-2020/>

UK Recommended Grass and Clover lists

<https://ahdb.org.uk/knowledge-library/recommended-grass-and-clover-lists-2020-21>



## White Clover content score card



**Clover content 10%**



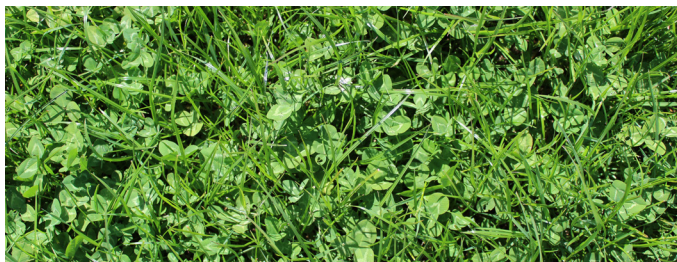
**Clover content 15%**



**Clover content 20%**



**Clover content 25%**



**Clover content 30%**



**Clover content 35%**



Animal & Grassland Research and Innovation Centre,  
Teagasc,  
Moorepark,  
Fermoy,  
Co. Cork.

Tel: 353 (0)25 42222

[www.teagasc.ie](http://www.teagasc.ie)

