Animal &
Grassland Research
and Innovation
Centre

Teagasc Sheep Open Day

Athenry, Animal & Grassland Research and Innovation Centre

Wednesday 21st June, 2017

teagasc

Agriculture and Food Development Authority

AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

SHEEP OPEN DAY 2017

21st June, 2017

Compiled and edited by:
Michael G. Diskin

Teagasc, Animal & Grassland Research and Innovation Centre,
Mellows Campus, Athenry, Co. Galway.

Table of Contents

Paper	Title	Page
	Foreword *Gerry Boyle*	**6**
	Sheep Open Day 2017 - Fáilte go Baile Átha an Rí *Michael G. Diskin and Michael Gottstein*	**7**
GRASSLAND & SYSTEMS		
1	**Improving the efficiency and profitability of your sheep flock** *Michael G. Diskin and Michael Gottstein*	**11**
2	**Effect of ewe prolificacy & stocking rate on lamb growth & carcass output** *Philip Creighton and Elizabeth Earle*	**17**
3	**Effect of ewe prolificacy potential & stocking rate on grass production, utilisation & quality** *Philip Creighton and Elizabeth Earle*	**21**
4	**Effect of stocking rate and weaning rate on profit** *Alan Bohan, Philip Creighton, Laurence Shalloo and Nóirín McHugh*	**25**
5	**Effects of age at first lambing and ewe genotype on performance up to years of age** *Tim Keady*	**28**
6	**PastureBase Ireland – capturing grassland data on drystock farms** *Micheál O'Leary, Anne Geoghegan and Michael O'Donovan*	**33**
7	**Prediction of grass dry matter intake in grazing ewes** *Michelle McManus, Robert Prendiville, Tommy M. Boland and Philip Creighton*	**38**
FLOCK HEALTH		
8	**Wormer resistance in sheep** *Barbara Good and Orla Keane*	**42**
9	**Procedure for carrying out a Faecal Egg Count (FEC) in lambs** *Frank Hynes*	**44**

10 **Interpreting a Faecal Egg Counts (FEC) in lambs 46**
Frank Hynes

11 **Improving coccidiosis diagnosis 50**
Charles Weir, Maresa Sheehan and Barbara Good

12 **Ewe and lamb behaviour, and lamb mortality during the peri-parturient period 52**
Dwayne Shiels, Cathy Dwyer, John Mee, Seamus Fagan, Kevin Hanrahan and Tim Keady

13 **Mineral deficiency -prevalence, risk factors, supplementation strategies and impact of supplementation on performance . . . 55**
Daniel Hession, Nigel Kendall, Kevin Hanrahan and Tim Keady

14 **SheepNet – sharing expertise and experience towards sheep productivity through NETworking 58**
Tim Keady

15 **The DAFM regional veterinary laboratories sheep mortality survey 2016 . . . . . 60**
John Fagan, Margaret Wilson, Colm Brady, Maresa Sheehan, Gerard Murray, Colm Ó Muireagáin, Damien Barrett, Denise Murphy, Seamus Fagan, Fiona McKeever, John Moriarty, Miceál Casey and Frank Hynes

GENETICS & BREEDING

16 **An Irish New Zealand Animal Comparison – The INZAC Flock. . 66**
Fiona McGovern and Nóirín McHugh

17 **Sheep genetics in Ireland 71**
Nóirín McHugh, Thierry Pabiou and Eamon Wall

18 **Accelerating genetic gain using genomics 74**
Áine O'Brien, Nóirín McHugh, Eamon Wall, Thierry Pabiou and Donagh Berry

19 **Designing a new health sub-index for the national breeding indexes 77**
Áine O'Brien, Alan Bohan, Thierry Pabiou, Nóirín McHugh and Donagh Berry

20 **European research area network research project on sustainable sheep production (SusSheP) 80**
L. Abril-Parreño, Eamon Wall, Thierry Pabiou, Philip Creighton, Michael G. Diskin, Kieran Meade, Nóirín McHugh and Sean Fair

BETTER FARM

21 **BETTER farms sheep programme 84**
Frank Campion, Ciaran Lynch and Michael G. Diskin

HILL SHEEP

22 **Potential of the national hill flock 90**
Ciaran Lynch, John Cannon, Seamus Campbell, John Noonan and Michael G. Diskin

23 **Finishing hill store lambs on Autumn pastures 95**
Michael G. Diskin, Noel Claffey, Michael Gottstein, Frank Hynes, Ciaran Lynch, Ivan Kelly, Damien Costello, Brian Garry and Frank Campion.

24 **Finishing store lambs on an all-concentrate diet 100**
Michael G. Diskin, Noel Claffey, Michael Gottstein, Frank Hynes, Ciaran Lynch, Ivan Kelly, Damian Costello , Brain Garry and Frank Campion

25 **Flock health issues with store lambs 107**
Barbara Good, Michael G. Diskin, Michael Gottstein, Frank Hynes, Ciaran Lynch and Ivan Kelly

MEAT QUALITY AND RUMEN FUNCTION

26 **Effects of breed and gender on carcass traits and meat quality attributes of male lambs 111**
Noel Claffey and Michael G. Diskin

27 **Is there a difference in the eating quality of lamb from rams compared to castrates? 114**
Vasiliki Gkarane, Noel Claffey, Michael G. Diskin, Paul Allen, Alan Fahey, Rufielyn Gravador, Aidan Moloney, Nigel Brunton and Frank Monahan

28 **Understanding the rumen microflora to enhance nutrient utilisation and reduce methane emissions in sheep 117**
Emily McGovern, Noirín McHugh, Philip Creighton and Sinéad Waters

ENVIRONMENT

29 **Sustainable grazing of uplands** **121**
Catherine Keena and Declan Byrne

30 **Rush control and water quality** **126**
Tim Hyde

31 **How farmers can help Bees** **129**
Catherine Keena and Una Fitzpatrick

32 **Campaign for Responsible Rodenticide Use (CRRU)** **133**
Catherine Keena, Mark Lynch and John Lusby

FORESTRY

33 **Forestry and farming – 0pportunities for sustainable diversification** **138**
Noel Kennedy

BREXIT

34 **Brexit and the Irish sheep industry** **143**
Kevin Hanrahan, Trevor Donnellan and Fiona Thorne

HEALTH & SAFETY

35 **Best practice for health and safety on sheep farms** **149**
John McNamara, Serena Gibbons and Francis Bligh

Notes **154**

Foreword

You are all very welcome to this Teagasc Sheep Open Day. Here in the Teagasc Animal and Grassland Research and Innovation Centre in Athenry, we have brought together our advisers, specialists and researchers in addition to staff from the Department of Agriculture Food and the Marine along with other stakeholders to present new information and address key challenges facing sheep farmers in the years ahead.

Sheep production is a significant contributor to the agricultural and national economy with an output value of €240 million in 2016. This is an increase of 4% on 2015 with volume of meat output having increased 3%. The 36,313 flocks produce a high quality product, with about 75-80% of this exported. Significant employment is provided in both the primary production and processing sectors. The improvement in lamb prices in recent years combined with reduced feed costs would all suggest that 2017 could be a good year for the sheep industry. I welcome the recently introduced Sheep Welfare Scheme. This scheme will not only give a boost to improving productivity at farm level but will also boost returns from sheep production. However, there is no room for complacency. Brexit is creating currency uncertainty. About 22% of Irish lamb is sold into the UK market. Weaker sterling is also putting pressure on Irish high lamb prices in continental Europe. Technical performance in terms of ewe productivity, grassland management, stocking rate and flock health are all important drivers of profitability and must be the sustained focus of all sheep producers and particularly in times of uncertainty. This is the clear message from today's Open Day.

Preliminary data from the Teagasc 2016 National Farm Survey an average gross margin of €595/ha for lowland mid-season lambing flocks. However, the top one third of flocks generated a gross margin of €1329/ha compared to €268/ha for the bottom one third of flocks. Due to higher weaning and stocking rates, output on the top third of farms (€1881/ha) was more than double the output (€780/ha) of the bottom third of farms and total direct costs were only marginally higher (€552/ha vs €512/ha) despite the significantly larger output. Gross margin per hectare was almost five times higher on the top farms compared to the bottom farms. This indicates that there is significant scope to increase income by improving technical efficiency on many farms. Modest improvements in a number of key technologies have very significant impacts on productivity and profitability.

This booklet collates and summarises a significant body of knowledge on technical issues in sheep production and should prove an invaluable reference to sheep producers. I would like to thank all the Teagasc Staff who assisted with the organisation of this Open Day

Professor Gerry Boyle,
Teagasc Director

Sheep Open Day 2017 - Fáilte go Baile Átha an Rí

Michael G. Diskin[1] and Michael Gottstein[2]

[1] *Sheep Enterprise Leader, Teagasc, Mellows Campus, Athenry Co. Galway.*

[2] *Head of Sheep Knowledge Transfer Programme, Teagasc, Macroom, Co. Cork.*

Thar cheann foireann Teagasc agus baill foirne eile atá paiteach le imeachtaí an lae inniu, cuirimid fáilte roimh go dtí Baile Átha an Rí.. Tá reimshe leathan eolas ar fail inniu agus tá súil againn go mbainnfidh sibh leas agus tairbhe as on lá agus go gcuirfidh sibh cuid den eolas agus de na teicneolaíochtaí i bhfeidhm sa mbaile. Tá Teagasc, ag a bhfuil clár chomhtháilte taighde, oiliúna agus oideachas á reachtáil aige, suite go lárnach chun cuidiú le feirmeoirí caorach le forbairtí teicniúla atá dírithe are feabhas inbhuanaithe a chur chun críoch.

On behalf of all staff involved delivering this Sheep Open Day, it's our pleasure to welcome you all to Athenry today. This Open Day is focussed on relevant technologies that will help sheep farmers achieve sustainable production and improve farm profitability. This event is organised in a series of out-door stands combined with indoor "villages" and workshops.

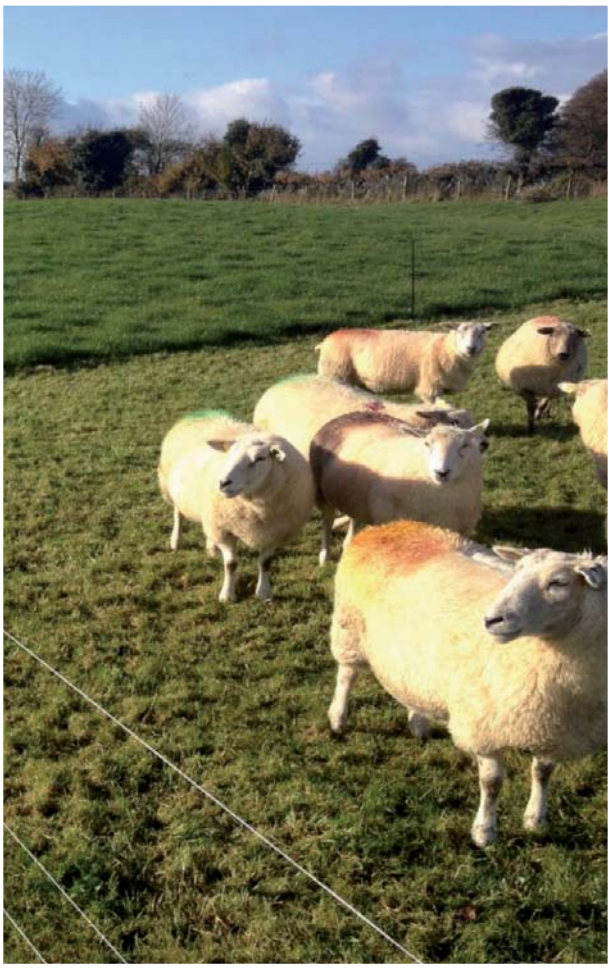
- **Grass:** Our ability to grow and utilise grass is Ireland's greatest natural resource. Results from the Research Demonstration farm highlights the importance of ewe prolificacy and stocking rate, particularly the former in terms of increasing gross margins. There is massive potential on all lowland sheep farms to increase ewe prolificacy. Improving soil fertility, growing more grass. Utilising this extra grass through rotational grazing systems will facilitate stocking rates to be increased. Breeding ewe lambs increase ewe lifetime productivity without impacting on ewe longevity.
- **Flock health.** There are numerous flock health challenges on sheep farms with resistance to anthelmintics a key challenge. Faecal egg counts (FEC) now afford producers the ability to better target the drugs they use and indeed to reduce overall drug usage. Where sheep are brought into a flock it is vital that they undergo a strenuous biosecurity protocol before being introduced to the main flock to avoid the introduction of such diseases as contagious ovine digital dermatitis (CODD), orf, as well as parasites that are resistant to anthelmintics and sheep scab, which can all be inadvertently introduced.
- **Genetics:** Some interesting and valuable data is now emerging from the on-going studies comparing elite New Zealand Suffolk and Texel sheep with their Irish counterparts. This study combined with the continuous refinement of indices by Sheep Ireland will deliver permanent genetic gains to the Irish Sheep industry.

- **BETTER farms:** This programme was established to demonstrate and quantify the benefits of technology adoption at farm level. Modest improvements in ewe prolificacy, stocking rates and in particular growing and utilising more grass substantially improves profitability. We strongly encourage sheep producers and Discussion Groups to visit the Teagasc BETTER farms. Active participation in such Discussion Groups has been shown to be a most effective way of getting new technology adopted on farms which subsequently translates into increased productivity and increased farm income.
- **Hill sheep:** The Irish Hill Sheep sector plays an important role in the economic health of rural economies and in the maintenance of the natural landscape in many of Ireland's most scenic areas. The Scottish Blackface hill ewe is very hardy and resilient breed and is hugely responsive to improved nutrition. The hill ewe has a significant untapped potential both in the hill environment and as the dam of prolific cross bred ewes for the lowlands. The results emerging from on-going studies with finishing of hill lambs in Athenry also provides a clear roadmap for increasing the value of the hill lamb.
- **Meat quality:** Issues of taint in lamb meat has frequently been linked to rams lambs. Teagasc and UCD are just completing a comprehensive study of this. Relatively small differences exist in the sensory attributes of lamb from rams and castrates. A small percentage of meat from both rams and castrates exceed threshold scores for sensory attributes. However, consumers found both ram and castrate lamb to be very acceptable.
- **Environment:** Sheep producers are faced with numerous environmental and regulatory challenges. This is particularly true for the hill sector where issues of under-grazing are now emerging as important issues. Similarly, a broader environmental consideration must be given before pesticides are used and must only be used in strict accordance with regulations including the careful disposal of containers
- **Forestry**: This is a rapidly expanding competitive sector, from planting to harvesting and to timber processing. There is increasing recognition of the economic, social and environmental contribution from forestry including its crucial role in greenhouse gas mitigation.
- **BREXIT:** This is creating currency and market access uncertainty. About 22% of Irish sheep meat is sold into the UK market. Weaker sterling is also putting pressure on Irish high lamb prices in continental Europe. Specifically, sheep producers should focus on factors that are under their control and that significantly impact on output and profitability - Control the Controllables.
- **Health and safety:** Farming is one of the most dangerous workplaces in Ireland.

Typically about one third of all workplace deaths occur in the agriculture sector. On average about 19 fatal farm accidents occur on Irish farms each year. This year, to the 31st May, 12 farm deaths have occurred, with eight of these involving tractors and machinery.

- **Walsh Fellows:** The Sheep Programme are fortunate to have a cohort of committed post-graduate students (Walsh Fellows) working on programmes vary from measuring grass intake, lamb mortality, mineral nutrition, lamb taint, economic analysis of different sheep systems, flock health, rumen function and genetic improvement. All of our students have stands at this Open Day and are well worth visiting to see some of their on-going studies and see some of the areas currently understudy that may well impact on sheep production in the near future.
- **Take Home Messages:** This booklet is laid out with an increased focus on relevant take home messages. Farmers should focus on implementing on their farms a number of the messages from today's event.

GRASSLAND & SYSTEMS



Improving the efficiency and profitability of your sheep flock

Michael G. Diskin[1] and Michael Gottstein[2]

[1] *Sheep Enterprise Leader, Teagasc, Mellows Campus, Athenry Co. Galway.*
[2] *Head of Sheep, Teagasc, Macroom, Co. Cork.*

Take Home Messages

- Implement a breeding policy to produce prolific replacement ewes to increase the number of lambs reared per ewe joined
- Implement grass management plan to improve soil fertility, increase grazing divisions and maximise stocking rate,
- Reduce reliance on concentrate feed (particularly at low stocking rates).
- Use high genetic merit rams
- Implementing a flock health plan
- There is scope for more crossbreeding of hill ewes with maternal or terminal breeds to produce prolific replacements or better quality lambs for slaughter

Sheep production is still an important farm enterprise on many farms in this country. There are currently 36,313 sheep farmers with a breeding ewe flock of 2.6 million ewes. The total number of sheep declared in December 2016 represents an increase of approximately 160,000 (4%) on the total number declared in December 2015 and reflects the highest levels recorded since 2005. Sheep meat output having increased by 3% from 2015 to 2016. Ireland is 340% self-sufficient in sheep meat resulting in over 71% of the total production been exported. The lowland sheep flock is the major source of lamb output, accounting for 85% of carcass output. The hill flock and mountain flocks account for the remainder.

Preliminary data from the Teagasc 2016 National Farm Survey an average gross margin of €595/ha for lowland mid-season lambing flocks. However, the top one third of flocks generated a gross margin of €1329/ha compared to €268/ha for the bottom one third of flocks. Due to higher weaning and stocking rates, output on the top third of farms (€1881/ha) was more than double the output (€780/ha) of the bottom third of farms and total direct costs were only marginally higher (€552/ha vs €512/ha) despite the significantly larger output. Gross margin per hectare was almost five times higher on the top farms compared to the bottom farms. This indicates that there is significant scope to increase income by improving technical efficiency on many farms. This is also evident from the significant productivity and gross margin gains achieved on the Teagasc Research and Demonstration Flock in Athenry and on the Teagasc BETTER Sheep Farms. Modest improvements in a number of key technologies have very significant impacts on productivity and profitability.

Brexit is creating currency and market access uncertainty. About 22% of Irish sheep meat is sold into the UK market. Weaker sterling is also putting pressure on Irish high lamb prices in continental Europe. Technical performance in terms of ewe productivity, grassland management, stocking rate and flock health are all important drivers of profitability and must be the sustained focus of all sheep producers and particularly in times of uncertainty. This is the clear message from today's open day.
Data from Teagasc eProfit Monitors, National Farm Survey (NFS), BETTER Farm and Research Demonstration Farm all clearly shows that well managed sheep production enterprises can return gross margins that compare very favourably with other drystock enterprises. The key drivers of profitability are:

1. Number of lambs reared per ewe joined,
2. Stocking rate,
3. Maximising the use of grazed grass and reducing the reliance on concentrate feed.

There are a number of key components that individual sheep producers can adopt that will enhance the profitability and ultimately the sustainability of their enterprise

Focus on factors that are under your control – Control the Controllables

Specifically, sheep producers should focus on factors that are under their control and that significantly impact on output and profitability including:

Adopt a 3-5 year business plan for your sheep enterprise.

Here the focus should be on drivers of profitability namely increasing:

- Implement a breeding policy that maximises the number of lambs reared per ewe joined
- Implement grass management plan which looks at improving soil fertility, increase grazing divisions and maximise stocking rate,
- Reduce reliance on concentrate feed (particularly at low stocking rates).
- Use High genetic merit rams
- Implementing a flock health plan

Prolificacy and stocking rate

The average stocking rate on lowland farms in Ireland is 7.3 ewes/ hectare. Quantifying the relationship between prolificacy, stocking rate and profitability has been focus of at the Teagasc Research Demonstration farm at

Prolificacy is a major driver of output in lowland flocks.

Athenry, since 2012. Increasing prolificacy has the greatest impact on profitability per ha and should be the first priority to change at farm level. There is also significant room to simultaneously increase stocking rate but this must be done in conjunction with increasing grass production. An interesting figure to emerge from the on-going studies is that it takes almost 1 tonne of grass dry matter to sustain a ewe and her progeny for a year. Some of the best lowland sheep farms and many of BETTER Sheep farms are consistently growing 12 tonnes of grass/ hectare per annum and, therefore, have the potential to carry 12.5 ewes per hectare.

Develop a plan to provide prolific flock replacements

Committed lowland sheep producers must develop a strategy of producing, either from within their own flock or from an outside source, prolific flock replacements. Numerous studies that show that the female progeny from Belclare rams have the capacity to increase litter size by 0.2 or 20 extra lambs weaned per 100 ewes joined to the ram. Results from the Research Demonstration farm show that lambs from Belclare cross ewes have identical growth rates to lambs from Suffolk and Texel cross ewes. The use of other maternal breeds such as the Blue Leicester and the Lleyn will also improve the number of lambs reared per ewe for self-contained flocks about 1/3 of the flock should be bred to maternal rams .

Concentrate on production from grazed grass

Grass is the cheapest form of feed and must be central to efficient profitable lamb production. The first objective must be to grow sufficient grass and secondly to maintain quality leafy grass in front of the ewes and lambs at all stages.

Carefully examine the amount of concentrate feeding to lambs

Concentrate feed is the single biggest variable cost on sheep farms. There is significant evidence that on some farms, that an excessive amount of purchased concentrates are fed to both ewes and lambs. Much of this is unnecessary and is doing nothing for profitability except replacing cheaper grazed grass in the diet of the ewes and or lambs. Investing in technologies to better manage and utilise grass (temporary fencing, creep gates etc.) has to potential to make significant savings on concentrate feed.

Improve soil fertility and increase grazing divisions to maximise stocking rate

It's also clear that a good grassland infrastructure, in terms of paddocks and fencing are an integral part of an efficient grass-based sheep production system and that a minimum of 5 paddocks or divisions are required for each group of ewes to control grass and operate a rotational grazing system. To grow grass soil fertility status in

term of liming, phosphorus (P) and potassium (K) status must first be corrected. Correcting the above, combined with a planned reseeding programme and the implementation of a rotational paddock system, will greatly increase grass production and utilization at farm level and reduced the over reliance of many sheep farms on purchased concentrates to feed to both ewes and lambs. .

Resistance to anthelmintics

Anthelmintic resistance to the three commonly available anthelmintics has been identified on Irish sheep farms. Producers are advised to use these drugs only when necessary and to ensure the correct dosage is delivered. Faecal egg sampling of lambs should be used to determine when treatments are required. Where there are suspicions regarding the efficacy of a particular drug this should be investigated through pre and post dosing faecal egg counts and an alternative drug should be used. Faecal egg sampling has also been shown to reduce anthelmintic use on farms as well as applying better targeting of the drugs at the worm burden.

Implement a flock biosecurity plan

Provided a flock has already achieved a high health status the best way of maintaining such a status is to operate a closed flock with only rams being bought in. There are a number of important diseases such as enzootic abortion (EAE), contagious ovine digital dermatitis (CODD) which causes severe lameness, orf, as well as parasites that are resistant to anthelmintics, sheep scab which can all be inadvertently introduced to a flock though the purchase of sheep. Therefore, where sheep are brought into a flock it is vital that they undergo a strenuous biosecurity protocol before being introduced to the main flock. This includes, purchasing from known sources, dosing for gastrointestinal worms and liver fluke on arrival, foot bathing, and a minimum of 2 weeks of isolation before introduction to the main flock.

Use of high genetic merit rams

Sheep Ireland is charged with developing a new breeding programme focussed on:

- Increasing the profitability and sustainability of the national sheep flock, by improving productivity and reducing the costs to the sector, with a clear focus on the requirements of the market place.
- Progressing significant infrastructural changes and enhancements to the national breeding system to ensure a viable and sustainable sheep breeding structure into the future.

In future, Sheep Ireland will provide genetic indices for both maternal and terminal traits of rams. Producers should aim to use high genetic merit sires in their flocks. Consistent use of high genetic merit sires will result in permanent cumulative increases in productivity in your flock. The use of high merit genetically evaluated

rams has been shown to increase growth rate, litter size, and to reduce mortality. Flock owners should consider using this valuable information in addition to their own experience in picking future rams for their flocks.

Winter shearing of ewes

Research at Atherny has shown that shearing ewes at the start of housing in December will increase lamb birth weight by about 0.5 kg, and increasing weaning weight by about 2 kg resulting in advancing age at slaughter by 2 weeks. This is a significant and easily attainable productivity gain that could be financially very worthwhile particularly in an environment of declining lambs prices from June onwards.

Learn from Teagasc BETTER Sheep Farms

Teagasc have established a number of Lowland and Hill BETTER sheep farms to accelerate technology transfer from research to farm practice. Well-established breeding, grassland, nutrition and flock health technologies are being applied and evaluated on these farms. Discussion Groups, are encouraged to visit these farms and see for themselves the benefits of implementing key technologies. If not already a member of a Discussion Group, sheep producers are encouraged to join one, and learn and adopt technologies from these BETTER farms.

Further integration of hill and lowland sectors

The Irish Hill Sheep sector plays an important role in the economic health of rural economies and the maintenance of the natural landscape in many of Ireland's most scenic areas. The Scottish Blackface ewe dominates in the hill areas and is very hardy and resilient breed and is hugely responsive to improved nutrition. The hill ewe has a significant untapped potential both in the hill environment and as the dam of prolific cross bred ewes for the lowlands. In many of the better hills and marginal land areas there is scope to increase the level of cross breeding to maternal breeds such as the Belclare of Blue Leicester to produce prolific replacement females for lowland flocks or to terminal breeds to produce lambs for slaughter. Cross bred lambs are typically 3-4 kg heavier at weaning than pure Scottish Blackface lambs and also produce faster growing lambs when finished on an all-concentrate diet. In some of the mountain and hill areas Producer Groups have been established to produce prolific crossbred replacements for fat lamb production on the lowlands. There is scope for further expansion of such initiatives and the certification of the health status of both male and ewe lambs from such groups would further enhance their value and attractiveness to lowland buyers. For male hill and crossbred lambs, recent Teagasc data would strongly suggest that it is important to move these lambs to good lowland pasture as early as possible after weaning. This will maximise the live weight gain from pasture and minimise the amount of concentrate feed required to finish such lambs.

There is scope to produce more health-certified prolific replacements lambs or store lambs for further finishing from hill flocks.

Marketing and lamb quality

Lamb should be managed and marketed so as to maintain a high quality standard that merits a premium price in the market place. Carcase weight and fat cover are the most important factors in determining carcase quality. Producers need to be familiar with the carcase specifications for the market they supply and select lambs to fit those specifications. The Bord Bia Lamb Quality Assurance Scheme standard is now a widely recognised standard and membership of this scheme will enable lamb to be sold on the higher priced premium markets.

Effect of ewe prolificacy & stocking rate on lamb growth & carcass output

Philip Creighton and Elizabeth Earle

Teagasc, Animal and Grassland Research and Innovation Centre, Athenry, Co Galway

Take Home Messages

- Increased ewe prolificacy levels significantly increased lamb carcass output/ha while having no negative effect on lifetime lamb performance
- Increasing stocking rate increased lamb live weight weaned/ha
- May be limitation to increases in SR
- The appropriate stocking rate for a farm will be dictated by its grass growing potential to support a given stocking rate.
- Increasing ewe prolificacy should always be the first priority while increasing stocking rate must always be in conjunction with increased grass production.

Introduction

The production of lamb in grass-based production systems is principally based upon the utilisation and conversion of herbage into lamb carcass. Successful grazing systems require animals that can efficiently convert feed into a high value product. At present, lamb production systems are limited by the efficiencies at which they operate, such as number of lambs weaned per ewe and the level of herbage utilised per ha. In order to remain competitive, improvements in the efficiency of such systems are of paramount importance. Ewe prolificacy potential (PP) and stocking rate (SR) are two of the most influential factors affecting lamb output and the efficiency at which feed resources are utilised in grass-based lamb production systems.

Grass, either grazed or conserved, has the potential to supply up to 95% of the annual energy requirements of sheep, although many producers cite increasing annual herbage production and utilization in lamb production systems to be a challenge at farm level. Grass utilisation is one of the most important factors influencing productivity and profitability of grass-based livestock systems. The lower associated cost of production of grazed grass relative to alternative feed sources provides an opportunity to produce lamb from a primarily grass-based diet in a cost-effective manner.

With this in mind, a long term study investigating the effect of stocking rate and ewe prolificacy potential within Irish grass based systems of sheep production was established on the Teagasc Athenry Sheep Research Demonstration farm in late 2011. In this study there were three different stocking rates of 10, 12 and 14 ewes/ha. There were two levels of prolificacy, a medium prolificacy system aiming to wean 1.5 lambs/ewe and a high prolificacy system aiming to wean 1.8 lambs/ewe. A total of 6

(3 stocking rates x 2 prolificacy potentials) farmlets were established with all input and outputs quantified. Specifically, data was gathered across these contrasting systems on:

- Animal performance
- Carcass output from grass per unit area - the main output from lowland sheep systems.

The overall objective of this study was to assess the biological and economic efficiency of six grass-based systems of sheep production differing in overall stocking rate and lamb output.

Results

Results presented in the following tables highlight some of the key performance indicators with regard to individual lamb performance, overall system efficiency and output. It is worth noting that this is a research study aimed at pushing the boundaries with regard to what is achievable when it comes to finishing lamb from a grass based diet in the most efficient and economic manner.

Table 1. The effect of ewe prolificacy potential (PP)[1] and stocking rate (SR)[2] on average daily gain (ADG), weaning weight, and carcass traits

	PP[1]		SR[2]			P-value	
Parameter	**MP**	**HP**	**LSR**	**MSR**	**HSR**	**PP**	**SR**
Birth to six weeks ADG	287	278	287^{a}	287^{a}	275^{b}	*	*
Six to 14 weeks ADG	245	240	256^{a}	248^{b}	223^{c}	NS	***
Birth to weaning ADG	261	255	268^{a}	263^{a}	243^{b}	*	***
Weaning weight (kg)	31.5	30.5	32.0^{a}	31.5^{a}	29.6^{b}	***	***
Post-weaning ADG	158	167	176^{a}	161^{b}	150^{c}	**	***
Lifetime ADG	218	216	231^{a}	219^{b}	200^{c}	NS	***
Drafting weight (kg)	45.1	45.1	45.2	45.1	45.1	NS	NS
Days to slaughter	215	215	203^{a}	213^{a}	230^{b}	NS	***
Table 1 Continued							
Carcass weight (kg)	19.6	20.0	19.9^{a}	19.8a^{b}	19.7^{b}	***	*
Carcass conformation	3.0	3.0	3.1^{a}	3.0^{ab}	3.0^{b}	NS	*
Carcass fat	2.8	2.9	2.8	2.8	2.8	***	NS
Kill out proportion	0.43	0.44	0.44	0.44	0.44	***	NS

[1]Prolificacy potential: MP = medium prolificacy potential, HP = high prolificacy potential, [2]Stocking rate: LSR = 10 ewes/ha, MSR = 12 ewes/ha, HSR = 14 ewes/ha, [3]SEM = standard error of the mean,[4]ADG = average daily gain (g/day),^{a,b,c} Within rows, means with differing superscripts significantly differ, *P<0.05, **P<0.01, ***P<0.001, NS = Not significant (P>0.05),

Animal performance:

Table 1 shows the effect of ewe prolificacy level and stocking rate on lamb performance in terms of growth rate in grams/day pre and post weaning. Also presented is lamb weaning weight at 14 weeks of age, lifetime average daily gain, drafting weight and slaughter data. As can be seen increasing stocking rate does decrease individual animal performance and increase days to slaughter. There was no difference in the days to slaughter data for the 10 and 12 ewe/ha groups but days to slaughter was significantly higher for the 14 ewe/ha group. Interestingly, prolificacy level had no effect on lifetime average daily gain or days to slaughter.

Table 2 shows the effect of ewe prolificacy level and stocking rate on key output measures including liveweight weaned per ewe and per hectare, total carcase output and the proportion of lamb carcass output achieved from grazed grass. As can be seen again there was no effect of prolificacy level on the proportion of total lambs finished from a grazed grass based diet. Stocking rate did have a significant effect on the proportion of lamb finished from grazed grass with the lowest level achieved at the 14 ewe/ha treatment.

Table 2 The effect of ewe prolificacy potential (PP)[1] and stocking rate (SR)[2] on output

	PP[1]		SR[2]			P-value	
Parameter	**MP**	**HP**	**LSR**	**MSR**	**HSR**	**PP**	**SR**
No. of lambs born/ewe	1.9	2.1	2.0	1.9	2.0	***	NS
No. of lambs weaned/ewe	1.5	1.7	1.6	1.6	1.6	**	NS
Litter birth weight/ewe (kg)	8.4	8.3	8.5	8.3	8.3	NS	NS
Live weight weaned/ewe (kg)	50.5	52.2	52.5	51.6	49.8	NS	NS
Live weight weaned/ha (kg)	505	544	438[a]	539[b]	596[c]	***	*
Lamb carcass output (kg ·per ha^{-1})							
Grazed herbage only[3]	293	334	291	314	335	*	NS
Grazed herbage plus supplementation[4]	52.7	62.4	30.4[a]	53.7[ab]	89.0[b]	NS	*
Total lamb carcass produced	346	396	321[a]	368[b]	424[c]	*	***
Proportion of lamb carcass produced off grazed herbage[5]	0.85	0.85	0.91[a]	0.85[ab]	0.79[b]	NS	*

The aim of this study was not to determine the ideal stocking rate and prolificacy level that every sheep farmer should follow, rather to maximise the utilisation of grass to maximise an efficient, profitable output of lamb. The optimal stocking rate for individual farms is dictated by the grass growing potential of that farm i.e stock the farm to maximise utilisation of what grass can be grown.

Economics

Detailed economic results for this study, including risk analysis, are being modelled by Bohan et al 2017 using the newly developed Teagasc Lamb Production model. They concluded that in general, increasing the number of lambs weaned per hectare increased profit per hectare but the major increase in profitability per hectare was seen at the high prolificacy levels. At all stocking rates the high prolificacy groups were more profitable and had a greater capability to cope with fluctuations in key variables which resulted in greater profit levels. Another aspect they examined was the impact of grass production and utilisation levels in combination with increasing stocking rate and prolificacy levels. They concluded that increasing stocking rate and prolificacy levels without concurrently increasing the amount of grass grown and utilised to match the increasing demand was counterproductive as it required high levels of concentrate supplementation to match ewe and lamb requirements which reduced the overall profit of the systems. They, also, concluded that increasing prolificacy levels and then stocking rate in combination with increasing grass production and utilisation was the key to increasing profit.

Conclusions

In conclusion, ewe PP had no significant effect on lifetime lamb performance and many other key productivity indicators and illustrates potential to increase ewe PP in grass-based lamb production systems. The use of higher SR in this study demonstrates the potential to increase the live weight of lamb weaned per ha in a grass-based lamb production, with the 10 and 12 ewes per ha systems achieving similar levels of performance for pre-weaning ADG and days to slaughter. The current findings suggest some potential limitations to increasing SR above 12 ewes per ha in a grass-based lamb production system due to lower individual lifetime lamb performance. Producers should, therefore, be careful not to increase to SR levels that cannot be supported by their farm which will be influenced by its grass growing potential when making decisions to increase SR levels. Increasing ewe prolificacy should always be the first priority while increasing stocking rate must always be in conjunction with increased grass production.

Acknowledgements

The authors would like to thank the technical and farm staff at Teagasc Athenry for their work throughout this study and also acknowledge the help and support of the staff of the Grassland Research Department Teagasc. Funding from the Teagasc Walsh fellowship programme is also gratefully acknowledged.

Effect of ewe prolificacy potential & stocking rate on grass production, utilisation & quality

Philip Creighton and Elizabeth Earle

Teagasc, Animal and Grassland Research and Innovation Centre, Athenry, Co Galway

Take Home Messages

- Increasing SR increased grass production and utilisation
- It takes approximately 860kg of grass DM to support and ewe and her lambs for the year
- No difference in grass utilised between medium and high prolificacy ewes
- Every farm is different- Need to know grass production potential of your farm

Introduction

Grass-based livestock production systems in Ireland have the potential to grow between 11 to 15 tonnes of grass dry matter per hectare annually. However, total annual grass DM production varies considerably across farms, depending on location, farm type, season, and grazing management decisions applied. Herbage utilisation at farm level can be increased through the measuring and budgeting of pastures and the use of rotational grazing systems. The main objective of grassland management for sheep systems is to supply high quality digestible pastures to the grazing ewe and her lambs.

Set stocking/continuous grazing systems are commonly operated on Irish sheep farms, with sheep grazing the same grassland area throughout the grazing season. Rotational grazing systems offer greater flexibility in grassland management by providing increased control over sward structure, grazing severity, regrowth periods and overall pasture supply. This involves dividing the grassland area into a number of paddocks, which are then grazed, fertilised and rested in turn and can allow greater levels of herbage utilisation be achieved. Growing as much grass as the farm is capable of growing should be the first step in any farm plan. The next step will be how to best utilise the grass and produce as much lamb output from it as possible in a profitable manner. Grazing management and infrastructure, as mentioned above, will play a big part in this but stocking rate and the type of animal on the farm will also have significant effects. The optimal stocking rate for individual farms is dictated by the grass growing potential of that farm i.e stock the farm to maximise utilisation of grass grown.

Presented today, are the results of a long term study investigating the effect of stocking rate and ewe prolificacy potential within Irish grass based systems of sheep production carried out at Teagasc Athenry Sheep Research Demonstration farm over the last five years. In this study there were three different stocking rates of 10, 12 and

14 ewes/ha. There were two levels of prolificacy, a medium prolificacy system aiming to wean 1.5 lambs/ewe and a high prolificacy system aiming to wean 1.8 lambs/ewe. Data was gathered across these contrasting systems on:

- grass supply and demand
- grass utilised per ewe and per kg of lamb carcass produced
- grass quality

Results

Results presented in the following tables highlight some of the key performance indicators with regard to grass production, utilisation and quality. It is worth noting that this research study aimed at pushing the boundaries with regard to what was achievable when it comes to finishing lamb from a grass-based diet in the most efficient and economic manner.

Table 1 outlines the pre and post grazing sward characteristics for the different treatments. As stocking rate increased, grass utilised per hectare in the form of grazed grass and grass silage increased. The silage requirement of the groups increased due to a longer winter housing period as stocking rate increased. The average duration of the winter housing period ranged from 89 days for the 14 ewe/ha groups down to 53 days for the 10 ewe/ha groups.

Table 1. Effect of ewe prolificacy potential (PP)[1] and stocking rate (SR)[2] on sward characteristics and herbage utilisation

	PP		SR			P-value	
	MP	HP	LSR	MSR	HSR	PP	SR
Pre-grazing herbage mass (> target PGSH3; kg DM ha-1)	1236	1296	1199^{a}	1282^{ab}	1316^{b}	NS	*
Pre-grazing herbage height (cm)	8.0	8.2	8.2^{a}	8.1^{a}	7.8^{b}	NS	*
Post-grazing herbage height (cm)	4.0	4.0	4.3^{a}	4.1^{b}	3.6^{c}	NS	***
Density (kg DM cm-1)	310	311	312^{a}	310^{ab}	309^{b}	NS	*
Herbage Utilised (kg DM ha-1 year-1)							
Grazed	8954	8828	7381^{a}	8482^{b}	10809^{c}	NS	***
Proportion of herbage utilised (to 3.5 cm)	0.89	0.86	0.82^{a}	0.85^{b}	0.95^{c}	*	***
Silage	1496	1519	926^{a}	1555^{b}	2040^{c}	NS	***
Proportion of surplus silage	0.82	1.01	2.07^{a}	0.48^{b}	0.19^{b}	NS	***
Total (kg)	10449	10347	8306a	10038b	12849	NS	***

[1]Prolificacy potential: MP = medium prolificacy potential, HP = high prolificacy potential, [2]Stocking rate: LSR = 10 ewes/ha, MSR = 12 ewes/ha, HSR = 14 ewes/ha, [3]SEM = standard error of the mean, [a,b,c] Within rows, means with differing superscripts significantly differ, *P<0.05, **P<0.01, ***P<0.001, NS = Not significant (P>0.05),

There was no difference in the quantities of grass utilised by medium or high prolificacy groups. The higher demands from the extra lambs within the high prolific systems (+0.2 lambs per ewe) would appear to be cancelled out by the lower maintenance requirements of the high prolific ewes due to their lower mature bodyweight compared to the medium prolific ewes. On an efficiency basis taking into account the total kilograms of lamb live weight weaned per kilogram of ewe live weight mating, the high prolificacy potential ewes were 5% more biologically efficient which is additional to the direct benefit of prolificacy.

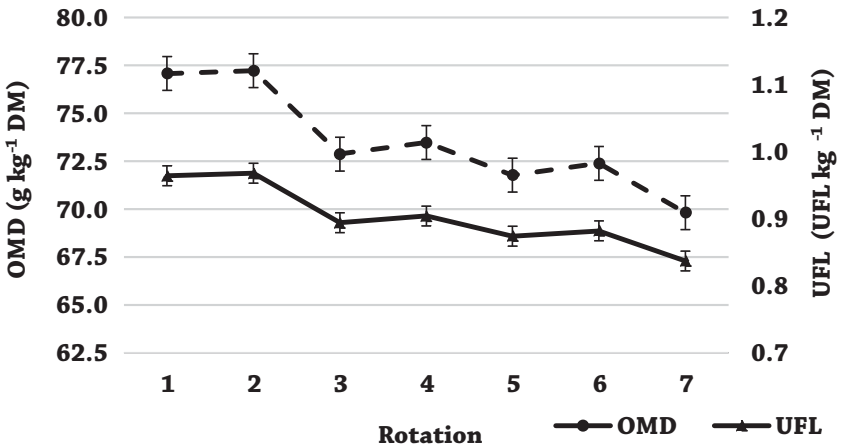


Figure 1. Effect of grazing rotation on sward organic matter digestibility (OMD) and Unite fourrage laite (UFL) levels. Error bars represent mean standard error.

Figure 1 shows the effect of grazing rotation on sward organic matter digestibility and energy level (UFL) across the grazing season as measured across all groups. As can be seen sward quality and energy level were highest in the spring period as we might expect. While levels decreased as they moved into mid-season they remained stable right up until rotation 7 which would correspond to the September/October period. It is for this reason that concentrate feeding was introduced to lambs in October in most years of the study to maintain energy intake and to reduce demand for grass.

The aim of this study was not to come up with an ideal stocking rate and prolificacy level that every sheep farmer should follow, rather to maximise the utilisation of grass and to maximise an efficient, profitable output of lamb. The optimal stocking rate for individual farms is dictated by the grass growing potential of that farm i.e stock the farm to maximise utilisation of what grass can be grown. Table 2 shows the average grass utilisation levels for the systems and what it means in terms of grass utilised/ewe, per kg of lamb carcase produced and the level of additional supplement (either concentrates or additional forage) required to support the systems. The important point to note here is that a significantly higher quantity of total DM was required to support the 14 ewe/ha groups compared to the 10 and 12 ewe/ha groups. This is

something that needs to be taken into consideration when deciding on the optimum stocking rate for your farm. This was largely due to the higher days to slaughter for lambs at this stocking rate level which required feeding for longer compared to the lower stocking rate groups.

Table 2. The effect of ewe prolificacy potential and stocking rate on the quantity of dry matter consumed as grazed herbage, conserved herbage, concentrates and total DM on a per ewe and lamb unit basis and per kilogram of carcass produced

	Prolificacy potential			Stocking rate			
Parameter	**MP**	**HP**	**sign.**	**LSR**	**MSR**	**HSR**	**sign.**
DM (kg) consumed per ewe and lamb unit							
Grazed herbage	743	735	NS	738^{a}	707^{b}	772^{c}	***
Conserved herbage	122^{x}	124^{y}	*	93^{a}	130^{b}	146^{c}	***
Total herbage	864	859	NS	831^{a}	837^{a}	918^{b}	***
Concentrates	27.3^{x}	29.5^{y}	***	26.2^{a}	27.3^{b}	31.7^{c}	***
Total DM	892	889	NS	857^{a}	864^{a}	950^{b}	***
DM (kg) consumed per kg of carcass							
Grazed herbage	25.7^{x}	22.2^{y}	***	23.0^{a}	23.1^{a}	25.7^{b}	***
Conserved herbage	4.2^{x}	3.8^{y}	***	2.9^{a}	4.2^{b}	4.8^{c}	***
Total herbage	30.0^{x}	26.0^{y}	***	25.9^{a}	27.4^{b}	30.6^{c}	***
Concentrates	0.95^{x}	0.89^{y}	***	0.82^{a}	0.89^{b}	1.05^{c}	***
Total DM	31.0^{x}	26.9^{y}	***	26.7^{a}	28.3^{b}	31.6^{c}	***

Conclusions

Achieving a balance between the supply of high quality pasture and high herbage utilization is paramount in optimising grass-based lamb production systems. Increasing SR and grazing severity increased herbage DM production and utilisation, demonstrating the positive effects of SR on sward productivity. There is potential for sheep producers to increase the ewe PP of their flock in conjunction with higher SR without negatively affecting sward productivity. The similar levels of herbage utilisation achieved by the two ewe PP investigated demonstrates the potential to increase output through increasing the ewe PP of a flock without needing to increase herbage DM production or utilisation.

Acknowledgements

The authors would like to thank the technical and farm staff at Teagasc Athenry for their work throughout this study and also acknowledge the help and support of the staff of the Grassland Research Department Teagasc. Funding from the Teagasc Walsh fellowship programme is also gratefully acknowledged.

Effect of stocking rate and weaning rate on profit

Alan Bohan[1], Philip Creighton[2], Laurence Shalloo[1] and Nóirín McHugh[1]

[1] *Teagasc, Moorepark Animal & Grassland Research and Innovation Centre, Fermoy, Co. Cork*

[1] *Teagasc, Animal & Grassland Research and Innovation Centre, Athenry, Co. Galway,*

Take Home Messages

- Stocking and weaning rate along with grass growth are the key drivers of profit
- Increasing the number of lambs weaned per hectare reduces the cost of production per lamb and in turn increases profit
- Increasing stocking rate and weaning rate without increasing grass growth and utilisation was counter productive
- Increasing weaning rate was more profitable than increasing stocking rate but the most profitable system was an increase in both

Introduction

Stocking rate and ewe prolificacy have been described as the key drivers of sheep farm profitability. The average sheep farm in the 2015 e-profit monitor was stocked at 8.2 ewes/ha and weaning 1.43 lambs per ewe joined, which resulted in a net profit of €135/ha. The top third of farmers, however, had higher stocking rates (10.5 ewes/ha) and weaned more lambs (1.52 lambs per ewe joined) which resulted in a greater net profit (€376/ha). The e-profit monitor data clearly demonstrates that stocking rate and weaning rate effect profit, therefore, the objective of this study is to quantify the effect of stocking rate and weaning rate on farm productivity and profitability using Teagasc lamb production model. This study focussed on the scenarios under investigation in the research demonstration flock in Athenry sourcing all input data directly from that study. The six scenarios under investigation are outlined in Table 1.

Table 1. The stocking and weaning rate for each of the six scenarios investigated in the current study

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Stocking rate	10	12	14	10	12	14
Weaning rate	1.5	1.5	1.5	1.8	1.8	1.8

Teagasc Lamb Production Model

The Teagasc lamb production model (TLPM) is a computer representation of a sheep farm that calculates the physical and financial outputs of a sheep system and allows the user to vary certain inputs such as stocking rate and prolificacy to assess their effect

on farm productivity and profitability. The TLPM uses inputs such as animal numbers and valuations, farm size, scanning rate and lambing date to calculate the physical outputs such as: flock feed demand, mortality and culling rates, lamb growth rates and drafting patterns, fertiliser and concentrate feed use, as well as, financial outputs. Data from the Research Demonstration flock in Athenry was used to populate the main inputs to simulate the six scenarios presented in Table 1. The TLPM simulated 6, 20ha self-replacing, March lambing flocks in the scenarios outlined above. Real farm data such as lamb growth rates, drafting rates, mortality rates, culling rates along with grass growth and utilisation were used to allow the TLPM to accurately simulate each scenario.

Physical performance

The number of lambs weaned per hectare increased as stocking rate and ewe prolificacy increased, and ranged from 16 lambs/ha in scenario 1 to 27 lambs/ha in scenario 6. The greater number of lambs weaned per hectare, resulted in a higher carcass weight produced per hectare which rose from 272 kg/ha in scenario 1 to 474 kg/ha in scenario 6. The lower individual lamb growth rates in the higher stocking rate scenarios resulted in more lambs remaining on the farm from October 1st resulting in greater number of lambs receiving concentrate feeding as grass quality and supply decreased. This increase in the number of lambs supplemented with concentrates coupled with the increased concentrate requirement pre lambing of ewes with greater litter sizes resulted in a concentrate consumption ranging from 456 kg/ha (scenario 1) to 888 kg/ha (scenario 6).

Financial performance

Lamb sales increased from €1,299/ha to €2,219/ha, with concentrate costs rising from €136/ha to €266/ha in scenario 1 to 6, respectively. The greater receipts from lamb carcass at 14 ewes/ha (scenario 5 and 6) were greater than the additional costs and reduced lamb performance associated with both scenarios. The average cost of producing a lamb in scenarios 1, to 3 was €75 but decreased to €65 per lamb in scenarios 4, to 6. This translated into an average net profit of €22/lamb and €31/lamb at the low and high prolificacy potentials, respectively. The greatest net profit was achieved in scenario 6, with €2,219/ha in lamb sales, which equated to a gross margin of €1,210/ha and a net profit of €802/ha. In general, increasing the number of lambs weaned per hectare increased net profit per hectare but the major increase in profitability per hectare was achieved at the higher weaning rate.

Increasing lambs weaned per hectare without increasing grass growth

In all scenarios the increased number of lambs weaned per hectare is supported by increasing grass growth and utilisation. Sensitivity analysis was conducted to assess

the effect of increasing the number of lambs weaned per hectare without increasing grass growth. Grass utilisation varied by stocking rate at 80%, 85% and 90% for the 10, 12 and 14 ewes/ha scenarios, respectively. The additional energy requirement of the flock was met through purchased concentrate. As stocking rate increased net profit decreased with the higher weaning rate scenarios coping slightly better. Scenarios 3 and 6 recorded a minus net profit figure when grass growth was maintained. This analysis highlights the negative effect on profit when the number of lambs weaned per hectare is increased without increasing grass growth to match this increase in feed demand.

Improve stocking rate or weaning rate

Improving the weaning rate from 1.5 to 1.8 results in a flock rearing an additional 0.3 lambs per ewe, with only a slight increase in the input requirements as the maintenance, veterinary and fixed costs of each ewe are constant. Increasing weaning rate from 1.5 to 1.8 increased net profits by €336/ha on average across all stocking rates. Increasing stocking rate will result in a greater output from a constant area of land along with increased grass utilisation results in increased efficiency of land. Increasing stocking rate at 1.5 lambs/ewe increased net profit by €16/ha on average while increasing stocking rate at 1.8 lambs/ewe increased net profit by €87/ha on average.

Conclusion

Increased number of lambs weaned per hectare resulted in the greatest financial returns, when combined with increased grass production and utilisation. Results from this study provide an economic component to previous stocking rate and prolificacy potential studies and provide a starting point to better understand the key drivers of profitability on Irish sheep farms.

Effects of age at first lambing and ewe genotype on performance up to 4 years of age

Tim Keady

Teagasc, Animal and Grassland Research and Innovation Centre, Mellows Campus, Athenry, Co. Galway

Take Home Messages

- Breeding ewe lambs provides an opportunity to reduce replacement costs
- Replacements which produce their first litter at 1 year, rear an additional 1 lamb per ewe joined relative to ewes which produce their first litter at 2 years of age
- By 4 years of age, Belclare ewes joined to produce their first litter at 1 year have reared an additional 2.1 lambs per ewe joined (approximately €200) relative to >75% Suffolk ewes producing their first litter at 2 years of age
- From 2 to 4 years of age Belclare and Suffolk×Belclare ewes reared an additional 0.95 and 1.06 lambs per ewe joined relative to >75% Suffolk ewes

Introduction

Over 65% of the ewes in the national flock are sired by terminal sire breeds. Suffolk X ewes are the predominant genotype accounting for over 50% of lowland ewes. It is estimated that the ewe replacement rate for the national lowland flock is approximately 22% (National Farm Survey). Replacement ewes normally join breeding flocks at 18 months of age with the intention of producing their first litter at 24 months. Replacements are a major cost in mid-season prime lamb production systems. The cost of replacement ewes at joining at approximately 18 months of age is equivalent to 25% of the value of lamb carcass output that they will produce during their lifetime. Two ways of reducing replacement cost are, firstly, to increase longevity and thus the number of litters produced, and, secondly, to increase litter size and thus the number of lambs weaned per ewe joined to the ram.

Athenry study

An on-going study at Athenry was designed to evaluate the effects of age at first lambing (1 or 2 years) and ewe genotype [≥75% Suffolk, Suffolk×Belclare, purebred Belclare] on the lifetime performance of ewes. Suffolk was chosen as over half of the national flock comprise Suffolk types while the Belclare was chosen because of its proven high productivity. Half of the ewe lambs, within each genotype, were joined with rams to produce their first litter at 1 year of age while the remainder were joined to produce their first litter at 2 years of age. All ewe lambs in this study were managed as one flock from 4 months of age until time of joining. Following joining all ewes

were managed as one flock until one month post housing (early January). To avoid maternal and terminal breed confounding and to maximise hybrid vigor in the lambs Charollais sires were used.

From early January to 6 weeks prior to lambing, ewe lambs which were joined were offered concentrate supplementation (250 g/day) to meet pregnancy requirements and enable the ewes to continue to grow. During the last 6 weeks of pregnancy ewes carrying singles, twins and triplets received 18, 26 and 33 kg concentrate, respectively.

The ewe lambs that were to be joined for the first time to lamb at 2 years of age received grass silage as the sole diet during their first winter housing period. When the ewe lambs that lambed at 1 year of age were weaned (at 15 months) they were managed as one flock with those that had not been joined the previous autumn. At this stage of the study results from lambing up to 4 years of age are available for all animals.

Ewe lamb mating management

The "ram effect" can be used to induce ewes and ewe lambs to start cycling provided they are sufficiently close to the time of onset of normal cyclicity . For the "ram effect" to work the ewes should have not been in contact (sight or smell) with rams for the previous month. The "ram effect" was used on ewe lambs and results are summarised in Table 1. Fertile rams were introduced to the flock 14 days after the rams used to induce the 'ram effect' were first introduced to cover ewes with short cycles and ewes that were already cyclic at the time of ram introduction. Expected peak mating times are 4 and 9 days after fertile ram introduction.

Table 1. Timetable for use of the "ram effect"

Day	
1	Introduce aproned rams
3	Remove aproned rams
14	Introduce fertile rams
18	1st peak in matings
23	2nd peak in matings

All ewe lambs were raddled during the joining period and the lambing season was compact with 62 and 84% lambing within 2 and 3 weeks, respectively. Raddle colour was changed weekly to enable ewes be penned according to expected lambing date and scanned litter size.

When using the "ram effect" to synchronise the mating season it is essential to have an adequate number of rams for mating (1 experienced ram per about 40 ewes) and to have adequate facilities (lambing pens – 1 per 5 to 6 ewes) and labour during the lambing season.

Effect of age at lambing on ewe growth

Ewe lambs that were joined and those that were not joined lost 3.2 and 6.7 kg (includes loss of fleece post shearing) respectively post joining to mid pregnancy. Ewe lambs

that were joined lost less weight as they received concentrate supplementation. The ewe lambs that were not joined gained more body weight post turnout to pasture, such that by weaning at 15 months of age they were similar in body weight to those which had reared lambs. Therefore, provided ewe lambs which produced their first litter at 1 year of age receive an adequate plane of nutrition, there is no evidence of any negative consequences for their progress to achieving mature body weight.

Effect of weight at joining

An important part of the current study was to provide information on the effect of weight at joining on the performance of ewes lambing at 1 year of age. The effect of weight at joining on the probability of a ewe rearing at least one lamb when lambing at 1 year of age is presented in Figure 1. The data presented in Figure 1 reflect differences due to ewe and lamb mortality, litter size and ewe barrenness. Regardless of ewe genotype, as weight at joining increased the probability of rearing at least one lamb improved. To have a 0.9 probability (90% chance) of rearing at least one lamb Belclare, Suffolk×Belclare and ≥75% Suffolk ewe lambs would need to be 48.5, 51.2 and 60.0 kg at joining respectively. Thus Belclare, Suffolk×Belclare and ≥75% Suffolk ewe lambs would need to be 63%, 64% and 72% of mature body when joining at 7.5 months of age to have a 90% probability of rearing at least one lamb when lambing at 1 year of age.

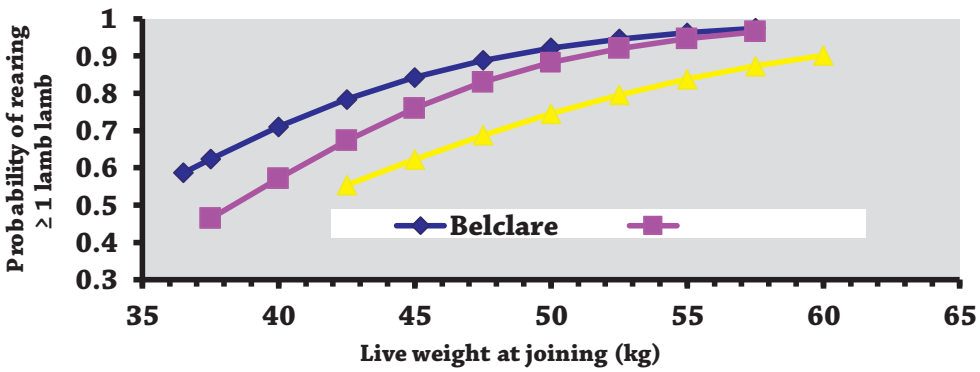


Figure 1. Effect of body weight at joining on the probability of rearing at least one lamb.

Effect of age at first joining on performance of 2 tooth ewes

A question often asked is 'does producing a litter at 1 year of age affect ewe performance when lambing at 2 years of age?' Lambing ewes at 1 year of age had no negative effect on litter size or the number of lambs reared per ewe joined when lambing at 2 years of age (Table 2). Lambs born to ewes which had previously produced a litter were 0.3 kg heavier at birth. Age at first lambing had no effect on the number of ewes that were available for joining at 31 months of age.

Table 2. Effect of age at first joining on ewe performance when lambing at 2 years of age

	Age at first joining (months)	
	7	19
Litter size	1.78	1.79
Lambs reared per ewe joined	1.41	1.38
Lamb birth weight (kg)	4.82	4.52
Lamb weaning weight (kg)	30.4	30.1
Ewes joined at 31 month (%)	83	80

Effect of ewe genotype

The effect of ewe genotype on performance, when lambing as 1 and 2 year olds, is presented in Table 3. Regardless of age at lambing, Belclare ewes had the highest litter size and reared 0.37 and 0.29 more lambs per ewe joined than the ≥75% Suffolk ewes at 1 and 2 years of age. Belclare ewes lambing at 1 year of age had similar productivity (lambs reared per ewe joined) as the ≥75% Suffolk ewes when they lambed at 2 years of age. Belclare×Suffolk ewes, at 2 years of age, reared a similar number of lambs per ewe joined as Belclare ewes.

Table 3. Effect of ewe genotype on performance when lambed at 1 and 2 years of age

		Genotype		
		Belclare (Bel)	Suffolk×Bel	Suffolk
Lambing at 1 year	Litter size	1.65	1.41	1.26
	No reared/ewe joined	1.19	1.05	0.82
Lambing at 2 years	Litter size	1.9	1.84	1.60
	No reared/ewe joined	1.50	1.49	1.21
Ewes joined at 31 months (%)		84	81	80

Effects on performance to 4 years

Number of lambs reared during a ewe's lifetime is a key factor influencing profitability. Ewe genotype and age at first lambing had a big impact on ewe productivity (Table 4). Relative to the >75% Suffolk ewes lambing for the first time at 2 years, Belclare and Suffolk×Belclare which lambed at one year reared of age had reared an extra 2.12 and 1.96 lambs per ewe joined by 4 years of age. On average during years 2 to 4 Belclare and Suffolk×Belclare reared an extra 0.26 and 0.32 lambs per ewe joined relative to the >75% Suffolk ewes. Belclare and Suffolk×Belclare ewes have reared an additional 0.8 and 1.0 lambs per ewe joined, respectively, relative to the >75% Suffolk between 2

and 4 years of age. Up to 4 years of age ewes joined to produce their first litter at one year of age reared an extra 1 lamb per ewe joined.

Table 4. Effect of ewe genotype and age at first lambing on litter size and number of lambs reared up to 4 years of age.

	Ewe genotype					
	Belclare		Bel x Suff		> 75% Suff	
Joined as ewe lambs	Yes	No	Yes	No	Yes	No
Litter size - 1year	1.65	-	1.41	-	1.26	-
- mean 2 to 4 years	1.99	2.06	1.98	2.03	1.75	1.73
- total	7.61	6.16	7.36	6.08	6.53	5.20
Lambs reared per ewe joined						
- 1year	1.17	-	1.02	-	0.82	-
- mean 2 to 4 years	1.67	1.66	1.67	1.78	1.46	1.36
- total	6.19	4.97	6.03	5.35	5.19	4.07

PastureBase Ireland – Capturing grassland data on drystock farms

Micheál O'Leary, Anne Geoghegan, & Michael O'Donovan

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

Take Home Messages

- Drystock farms recording farm covers regularly on PastureBase Ireland (PBI) have grown between 10.5 – 12.3 t DM/ha/year over the past four years (2013-16).
- The variation between farms in grass DM production was from 9.1 t DM/ha to 15.4 t DM/ha
- There are approximately 200 drystock farms on PBI, there is over 100,000 drystock farms in Ireland with >4000 fulltime farming. The number of farms measuring needs to increase dramatically, to improve grazing management performance.

Introduction

The strong reputation of Irish grass fed sheep production in traditional markets is an asset which can be further exploited. The potential to achieve high levels of lifetime gain from grazed grass allows Irish farmers a major competitive advantage over many of their European counterparts. On average the cost of producing a kilo of liveweight gain from grazed grass is 80-85% less when compared to an intensive concentrate based system. Every extra tonne of grass utilised on a drystock farm is worth an addition €100/ha.

PastureBase Ireland has been in operation since January 2013. At this stage significant trends in grass dry matter (DM) production and grazing management are becoming evident from commercial farm data. PastureBase Ireland is a web-based grassland management tool incorporating a dual function of grassland decision support while collecting and storing a vast quantity of grassland data from dairy, beef and sheep farmers in Ireland in a central national database. At present the vast majority of farms recording measurements on PBI are dairy farms, with drystock farms only accounting for 10 - 15% of the population.

PastureBase Ireland is informing us that farmers need to have a good handle on current grass supply in order to manage grass well. No knowledge of farm cover, grass demand or grass growth leaves a gap in how grass can be managed correctly in any grazing system. The crucial point on any farm is utilising the feed resource inside the farm gate. Any farm that is dependent on imported feed is exposed in the current volatile environment.

The PastureBase Ireland database stores all grassland measurements within a common structure. This allows the quantification of grass growth and DM production

(total and seasonal) across different enterprises, grassland management systems, regions, and soil types using a common measurement protocol and methodology. The background data such as paddock soil fertility, grass/clover cultivar, aspect, altitude, reseeding history, soil type, drainage characteristics and fertiliser applications are also recorded.

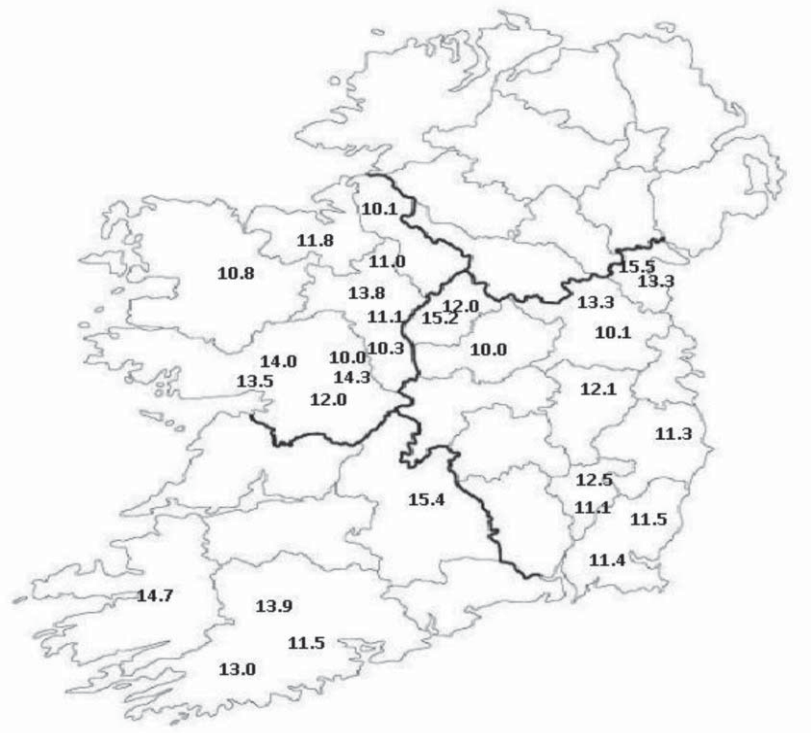


Figure 1. Grass dry matter production (t DM/ha) from PastureBase Ireland drystock farms across the country in 2016

Grassland performance on farms

Figure 1 shows the annual DM production data from drystock farms across the country in 2016. These farms have >25 weekly farm walks completed on PBI. In 2014, the average grass DM production on drystock farm was 11.8 t/ha which was a 1.3 t DM/ha increase from the previous year from 10.5 t/ha (2013) which was anticipated as 2014 was a superior year for grass growth. Mean DM production of drystock farms who completed >25 walks in 2015 shows that there was an increase of 0.5 t DM/ha (12.3 t DM/ha) when compared with DM production in 2014. Dry matter production was similar in 2016, on average 12.2 t DM/ha was produced.

Investigating the annual DM production further, it shows that the range in DM production that existed between drystock farms in 2016 was large. Some drystock farms only produced 8 - 9 t/ha while, the top drystock farms on PBI exceeded >14 t/ha, with some farms achieving >7 grazing on the grazing platform (comparable

performance of a dairy farm). It is clear that on drystock farms, grass production levels can be similar to that of dairy farms. However the farm system must be focussed on using grass efficiently and needs to be set up to do so.

Table 1 shows the total dry matter production (t DM/ha) from drystock farms from PastureBase Ireland grass recordings for the period 2014 – 2016. Why and how does this amount of variation in grass production occur on farms? From the data in which we have been collating in PBI over the last three years trends are beginning to be seen in growth rates which are directly related to grazing management. While soil type has an impact, PBI data can show farms in the midlands and northwest producing higher quantities of grass DM than those in the south. Obviously, good grazing management can overcome many issues when we are discussing grass production on farms, this is a trend also evident from dairy farms.

Table 1. Total dry matter production (t DM/ha) from drystock farms from PastureBase Ireland grass recordings in 2014 – 2016.

2014	**Mean**	**Max**	**Min**	**Range**
Total DM production (t DM/ha)	11.8	14.7	8.7	6.0
Grazing DM production (t DM/ha)	10.3	15.1	8.1	7.0
Silage DM production (t DM/ha)	1.5	3.0	0.2	2.8
No. of grazings per paddock	5.0	6.9	4.0	2.9
2015				
Total DM production (t DM/ha)	12.3	14.6	9.1	5.5
Grazing DM production (t DM/ha)	9.8	12.7	7.2	5.5
Silage DM production (t DM/ha)	2.4	4.6	0	4.6
No. of grazings per paddock	5.4	8.1	3.9	4.2
2016				
Total DM production (t DM/ha)	12.2	15.5	9.4	6.1
Grazing DM production (t DM/ha)	10.2	14.0	8.0	6.0
Silage DM production (t DM/ha)	2.0	3.9	0.4	3.5
No. of grazings per paddock	5.1	7.0	3.9	3.1

Taking a more in-depth look of why some farms are able to produce high quantities of grass it was clear from the analysis that, delivering more grazings from each paddock during the season is key driver of success. On a high proportion on drystock farms the number of paddocks is inadequate, leading to large paddocks. As a consequence, livestock are grazing these paddocks for too long (residency time is up to two weeks). The productivity of these paddocks is then significantly reduced. Where regrowths are not protected, they are being continually regrazed, nitrogen application is not up to date and rotation length is non-existent.

Figure 2 shows the relationship between the number of grazings achieved per paddock and the associated DM production (dairy data). This highlights that every extra grazing achieved per paddock will increase DM production by 1,385kg DM/ha. It is critical that all drystock farms sub-divide existing paddocks into more realistic areas. Paddock residency should be no longer than 3 - 4 days on drystock farms during the mid-season. Any period longer than this will result in underperforming swards and poor live weight gains.

Why are some drystock farms producing high quantities of grass?

1. Rotational grazing system – paddock system
2. Good farm infrastructure i.e. adequate size paddocks
3. Maximising spring grazing – early turnout and finishing the first rotation on time
4. Addressing soil fertility annually
5. Records a farm cover weekly (>25 walks/year)
6. Making decisions weekly on the information generated after each farm cover
7. Achieving a high number of grazings per paddock per year – top farms achieving >8 grazings per paddock per year.

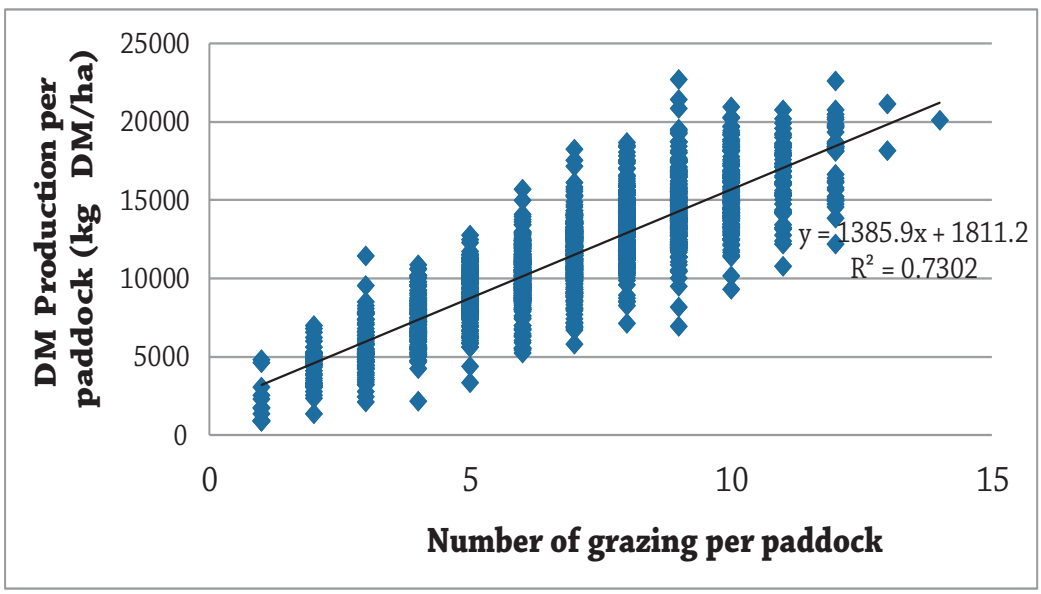


Figure 2. The number of grazing achieved per paddock and annual grazing dry matter production

Future plans

Since early 2016 PBI and AgriNet Grass have merged to form one grassland management decision support tool for farmers. This venture is a great asset for Irish farmers as it will offer world leading grassland software to aid decision making on their farm. Large quantities of data will now be stored in one database for dissemination and for the benefit of Irish farmers. Over the past 12 months PBI has undergone considerable redeveloped with the addition of new management tools and a more user friendly interface.

Conclusions

It is clear that Ireland has massive potential to increase annual DM production with a better focus on grazing management. PastureBase Ireland, the national database, will allow the industry to move forward with better understanding of the performance of grassland farms. PastureBase Ireland has highlighted that all drystock farms can increase DM production with clear focus on grassland management and as a consequence increase liveweight gain and overall farm profitability.

Sign up

If you wish to join PBI and start managing your grass better, contact your local Teagasc adviser or **support@pbi.ie**.

Prediction of grass dry matter intake in grazing ewes

Michelle McManus[1,2 3], Robert Prendiville[1], Tommy M. Boland[2] and Philip Creighton.[3]

[1] *Animal and Grassland Research and Innovation Centre, Teagasc, Grange, Dunsany, Co. Meath.*
[2] *School of Agriculture & Food Science, University College Dublin, Belfield, Dublin 4, Ireland.*
[3] *Animal and Grassland Research Innovation Centre, Teagasc, Athenry, Co. Galway, Ireland.*

Take Home Messages

- Feed costs account for 70%–75% of variable costs on Irish sheep farms.
- The primary focus of this research is to develop and validate novel low-cost methods of measuring feed intake in sheep.
- A simple, easy to measure non-invasive measurement that is predictive of grass intake would present significant progress towards incorporating intake and feed conversion efficiencies in genetic indices and breeding programmes.

Introduction

Feed conversion efficiency (FCE) within livestock production systems is extremely important, with feed costs accounting for 70%–75% of all variable costs incurred on Irish sheep farms.

To derive genetic evaluations for FCE, we must be able to estimate grass dry matter intake (GMDI) known as feed intake, of ewes. Next we must be able to measure where the ewes energy is being partitioned to, known as her energy sinks; maintenance, live weight gain and milk yield. Data on some energy sinks are available or easily attainable such as live weight and live weight gain, whereas others such as milk yield and feed intake, particularly in pastoral systems, have historically been costly and labour intensive.

The primary focus of this research was to develop and validate novel low-cost methods of estimating feed intake of ewes. This project estimated the intake of a subset of ewes from the research flock in Teagasc Athenry. Ewes had a number of different measurements taken to develop the methodology to predict feed intake in ewes at pasture.

Grass dry matter intake (GDMI) was estimated using a marker called the n-alkane. It was a bolus administered to the ewes with a known alkane concentration. Faecal and grass samples were collected and analysed to estimate GDMI of ewes.

The following measurements were then carried out to see if any could be used to predict GDMI:

- **Weight and body condition score (BCS).** Ewes were weighed and body conditioned scored throughout the study to determine if there was a relationship between body weight and BCS and their change over time and GDMI.
- **Linear measurements and body scoring.** Linear measurements involved measuring different parts of the ewes body e.g. the length of back or the circumference of her rib cage. Body scoring involved visually assessing the ewes for conformation traits such as straightness of legs or roundness of the hindquarters.
- **Milk yield.** Estimation of milk yield was determined using the weigh-suckle-weigh technique. Lambs were separated from their dams for a 4-hr period. Following the 4-hr separation, lambs were returned to the ewe and allowed to suckle. When lambs stopped suckling, they were separated from their dams. Any remaining milk was milked out by hand. The lambs were separated for a further 4-hr period. Following this second separation, lambs were weighed prior to suckling the ewe, and weighed again immediately after they were finished suckling. The difference between pre- and post- suckling weights is defined as milk yield and indirectly as 4-hr milk production which can then be used to estimate daily milk yield.
- **Heart rate.** Heart rate was measured using paddles that were fastened around the ewes girth. See Fig.1. These were attached to the ewe for a 24 hour period to record heart rate under grazing conditions.
- **Blood pressure.** Blood pressure (BP) is measured by securing the ewe in a crate and placing a BP cuff below the ewes hock. See Fig.2. Multiple measures are taken and stress is minimised by allowing ewes to see their lambs and handling the ewes with care.
- **Infrared Thermal imaging.** Thermal imaging is a non-invasive and non-contact heat detecting technology. Images of the eye, cheek (Fig.3.) and rib area, as well as the front and back legs are taken.

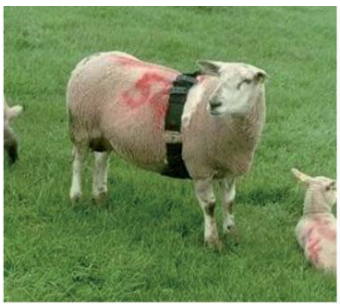


Fig. 1.

Fig. 2.

Fig.3.

Analysis of the results is on-going. To date, average and max eye temperature in ewes using Infrared Thermal imaging has been identified as a possible predictor of GDMI in grazing ewes. The validation of these measurements as predictors of feed intake is currently being carried out on a subset of the UCD Lyons research flock in Kildare. It is important the validation is carried out on a different flock to prove the predictors will work across different flocks, farms and different management systems.

Acknowledgements

The authors would like to thank the technical and farm staff at Teagasc Athenry and UCD Lyons Estate and Thomas Byrne and Norann Galvin Teagasc Moorepark for their assistance throughout this study. The authors gratefully acknowledge funding from the Department of Agriculture Research Stimulus Fund (RSF13/S/496).

FLOCK HEALTH

Wormer resistance in sheep

Barbara Good[1] and Orla Keane[2]

[1] *Teagasc, Animal & Grassland Research and Innovation Centre, Athenry, Co. Galway*
[2] *Teagasc, Animal & Grassland Research and Innovation Centre, Grange Dunsany, Co. Meath.*

Take Home Messages

- Infections with gastrointestinal nematodes (gut worms) affect the productivity of grazing lambs
- Good gut worm control is highly dependent on effective wormer products.
- Drench tests completed as a task in the STAP programme revealed a significant amount of drug failure
- 49% of flocks reported drench failure, which could be due to the development of anthelmintic resistant worm populations.
- Anthelmintic resistance is defined as the ability of worms to survive a dose of a wormer that would normally kill them.
- Multiple drug resistance has now been confirmed in Irish flocks
- Producers are encouraged to test the efficacy of wormers in their flocks and use FEC to inform decisions on parasite treatment.

Introduction

Ambitious targets have been set for growth in the sheep production sector. Improvement in technical efficiencies and how flock health is managed so as to reduce losses due to animal diseases is pivotal to meeting these targets. Grazing sheep are naturally exposed to parasitic roundworms that live in the gut and infection can result in chronic disease, ill-thrift and occasionally death. Good worm control is highly dependent on effective worming products. However, a direct and unavoidable result of continuous use of wormers is the development of drug resistant worms. These are worms that can survive a dose of the wormer that would normally kill them.

Development of drug resistant worms

Between 2013 and 2015 the Department of Agriculture, Food and the Marine (DAFM) administered a sheep technology adoption programme (STAP), with the aim of increasing profitability on Irish sheep farms by encouraging the adoption of best management practices. One of the options available to STAP participants was to test the efficacy of the anthelmintic treatment (benzimadazole (white group), levamisole (yellow group) or macrocyclic lactone (clear group)) used in their flock by means of a drench test, which is a modification of the faecal egg count reduction test; individual faecal samples were collected from the same group of lambs before and at a defined time after anthelmintic treatment, the number of eggs present pre and post treatment

was subsequently determined in the laboratory from a pooled faecal sample.
A large number drench tests (4,211) were undertaken by farmers during the 3 years of the programme. Information on the anthelmintic product used was available for 3,771 of these tests; anthelmintics from the classes benzimidazole (BZ), levamisole (LV) and macrocyclic lactone (ML) (avermectins (AVM) plus moxidectin (MOX)) were used in 42.0%, 23.4% and 32.5% of tests, respectively. The efficacy of treatment against 'other trichostrongyles' (excluding Nematodirus spp) could be established for 1,446 tests; 49% of these tests were considered ineffective (i.e. a reduction of faecal egg count (FEC) ≤ 95%). There was a significant difference among the drug groups in efficacy; 31.5%, 51.9%, 62.5% and 84% of treatments were considered effective for BZ, LV, AVM and MOX, respectively. The efficacy of treatment against Nematodirus spp. could be established for 338 tests and the overall efficacy was 96%. Due to the significant difference among the anthelmintic classes for efficacy against 'other trichostrongyles' along with the high level of efficacy against Nematodirus spp., a genus for which anthelmintic resistance is rarely reported, it was concluded that anthelmintic resistance was responsible for the majority of the anthelmintic treatment failures observed.
The finding that almost half of all anthelmintic treatments administered to lambs were ineffective highlights the importance of testing the efficacy of anthelmintic treatments. Drench tests should be regarded as the first step to gaining a quick indicator of anthelmintic efficacy on a farm. While the issue of the inefficacy of BZ against 'other trichostrongyle' populations in Ireland is not new, it is important that producers remain aware of the high level of efficacy of BZ as a targeted treatment against Nematodirus spp. Moreover, the low FEC observed on a significant number of farms in this study provides clear evidence of the usefulness of FEC to inform decisions as to the timing of treatment and who to treat.
In a separate study, ivermectin resistance was confirmed in 2 out of 4 farms examined that had been declared as having suspected resistance. The species of roundworm found to be resistant was the brown stomach worm (Teladorsagia) and it was also resistant to BZ and LV also making it multi-drug resistant. The development of parasites resistant to a number of drugs is a concerning development.

Conclusions and implications

For many years the administration of broad-spectrum anthelmintics was viewed to be effective in controlling roundworms in sheep. In the absence of clinical signs, suboptimal efficacy may have been overlooked or blamed on factors other than parasites. Drench tests offer an impartial and simple method to test the efficacy of the wormer. Wormer resistance to at least one family/class of wormers is a reality on many farms. Multiple drug resistance is a serious threat. Producers are encouraged to test the efficacy of the wormer on their flock and in line with best treatment practices to use worm egg counts to inform decisions on treatment for worms.

Procedure for carrying out a Faecal Egg Count (FEC) in lambs

Frank Hynes

Teagasc Sheep Specialist, Animal & Grassland Research and Innovation Centre, Mellows Campus, Athenry, Co. Galway

Take Home Messages

- Faecal Egg Counts (FECs) have many uses including helping decide whether animals need to be treated for worm infestation or not.
- FEC sampling kits can be obtained from appropriate laboratories
- Separate fresh samples should be collected from at least ten representative lambs from the flock
- These samples should be packaged and posted with supporting documentation on the day of sampling
- Decisions on whether to dose lambs or not should be based on the results of these tests

Introduction

A Faecal Egg Count (FEC) counts the number of worm eggs in faeces (dung) which gives an indication of the number of adult worms in the gut of sheep. An FEC has many uses including helping you decide whether animals need to be treated for worms or not. This test is particularly targeted at lambs. To ensure you make most use of this test it is important to follow the correct procedure when taking a FEC.

Collection of faecal samples

1. Farmer must contact an appropriate laboratory to request a sampling pack (empty sample containers, submission form, ziplock bags) and also to arrange a payment procedure. A list of laboratories and veterinary practices that are approved for this test under the Deparetment of Agriculture Food and the Marine (DAFM) Sheep Welfare Scheme can be found on the Departments website: *Department website - Farming Sectors - Sheep and Goats – AWSS.*
   http://www.agriculture.gov.ie/farmerschemespayments/basicpaymentschemegreeningareasofnaturalconstraint/sheepwelfarescheme2017/
2. Place approximately 15 lambs in a clean pen. Allow them enough time so that a number of faecal deposits have been observed. If lambs have been feeding a short time before taking them into the pen they will defecate fairly quickly. By moving gently through the pen, the farmer will encourage the lambs to defecate allowing fresh samples to be collected immediately before being trampled on by the lambs in the pen. All faecal samples collected must be fresh.

3. Using gloves, collect faecal samples from at least 10 different fresh faecal deposits and place them in 10 separate containers. (Aim to collect at least a 'heaped teaspoonful' of faeces per lamb being sampled).
4. Place all filled containers of faeces in the packaging provided. Complete the submission form and include this in the pack of samples.
5. Post samples with the submission form preferably on the day of sampling.
6. Results of the test will be received in the post within a few days. These results should be used to help decide if lambs should be dosed or not. If in doubt about how to interpret the results consult your veterinary surgeon.

Separate fresh samples must be collected from at least 10 lambs for an accurate result to the FEC test

Timing for FEC test

This test should coincide with peak infection period which usually occurs during the months from June to September. It is preferable to take these samples early in the week, so that samples can be posted on the same day as collection and should arrive at the laboratory the next day. This will avoid samples being held in the post over the weekend. If samples are collected at the weekend store them in a cool place preferably in a fridge not used for domestic purposes. Do not freeze or place in direct sunlight.

DAFM Sheep Welfare Scheme

If this task is being carried out as part of the DAFM Sheep Welfare Scheme the timing of tests and the number of tests carried out is important. Two such samples are required in the case of flocks categorised as lowland flocks and these must be carried out between 1st June 2017 and 30th September. In the case of flocks categorised as hill flocks one sample is required and it must be carried out in the first 4 weeks post weaning.

Interpreting a Faecal Egg Counts (FEC) in lambs

Frank Hynes

Teagasc Sheep Specialist, Animal & Grassland Research and Innovation Centre, Mellows Campus, Athenry, Co. Galway

Take Home Messages

- A Faecal Egg Count (FEC) counts the number of worm eggs in a sample of faeces (dung)
- FECs are very useful in helping decide if lambs need to be treated for worms
- They are also useful in monitoring how effective is the product being used to treat lambs
- The results of such tests must be interpreted correctly so that the benefits can be maximised
- The main worms of concern during the summer months are Strongyle species
- Other worm species present in the faeces sample are usually reported, however these are generally not of major concern during the summer months
- Taking FECs is one of the Target Actions in the DAFM Sheep Welfare Scheme

Introduction

A **F**aecal **E**gg **C**ount (FEC) counts the number of worm eggs in faeces (dung). The results are presented as 'eggs per gram' (epg) of faeces. The number of eggs found in the faeces gives an indication of the number of adult worms in the gut of sheep.

Uses for FEC

FECs can be used to:

- Help determine whether animals need to be dosed or not
- Help better timing of dosing
- Test the efficacy of the dose *(Drench test or Faecal Egg Count Reduction Test)*
- Reduce the number of doses where anthelmintic are used excessively
- Obtain information on the level of worm contamination going onto pasture

Taking of FECs is also a Target Action in the DAFM Sheep Welfare Scheme which commenced in 2017. If a farmer selected this action on joining the scheme, he/she is required to take one or two samples at specified times of the year for hill and lowland sheep flocks, respectively.

What appears in the FEC report?

Most of the approved laboratories report on the level of eggs present in faecal samples for the following:

1. Strongyle worms including *Trichostrongylus, Cooperia* and *Teladorsagia* spp.
2. *Nematodirus* spp.
3. Coccidial oocysts

While *Cooperia* is included at 1 above, is not particularly pathogenic and in general is of little concern, their eggs are similar to the other strongyle eggs and it will contribute to the FEC.

Some laboratories are also reporting on the number of:

- *Strongoloides* which are threadworms (far less pathogenic not be confused with Strongyles)
- *Moniezia*, which is a tapeworm and again not of major concern
- Lungworms, (including *Dictyocaulus* sp.) and is generally of low significance

Strongyle species

The main worms of concern for lambs from June onwards are the Strongyle worm species. This group includes *Trichostrongylus, Cooperia* and *Teladorsagia* spp. During the summer months when conditions are suitable for the spread of worm infection (warm damp weather and sheep grazing contaminated pasture), egg counts tend to increase rapidly. The messages to be taken concerning Strongyles from the test are summarised in Table 1.

Table 1. The message to be taken from Faecal Egg Count for strongyle species

Faecal Egg Count (EPG)	Interpretation
Count > 500	• Lambs should benefit from a worm dose immediately
Count < 500	• Dosing is not recommended at this stage. • A re-test may be recommended in the near future. • When the egg count is greater than 400, a decision to dose in the coming one to two weeks may be justified as the worm burden is likely to be on the increase • When the egg count is less than 400 a re-test should be considered in in 2 to 4 weeks' time with the longer delay acceptable when egg count is extremely

Nematodirus spp.

Assuming that by mid to late June, lambs will be greater than 10 weeks old; a high egg count for *Nematodirus* is probably of little significance because:

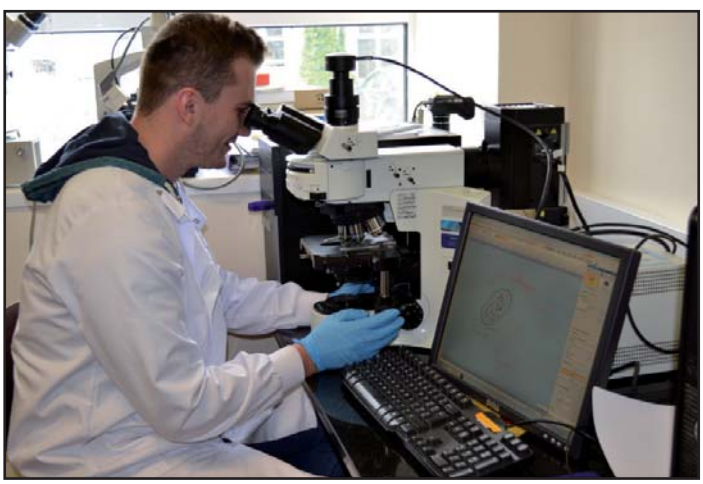
- Lambs tend to become resistant to *Nematodirus* from 10 to 12 weeks of age
- Egg production tends to be high when number of larvae in the gut are low
- There are several species of *Nematodirus* with *Nematodirus battus* being the only pathogenic species for lambs. The worm eggs identified in the egg count may also include non pathogenic species.

However, if lambs show signs of black scour, straining, dehydration, generally being unwell, *Nematodirus* could be causing the problem and a dose may be justified. Furthermore, a dose may be considered to reduce the worm egg burden being passed onto the pasture for next year.

Coccidia

Where the level of coccidian oocysts are high, there may or may not be a problem.

- Lambs tend to be infected with small numbers of coccidian parasites and develop immunity from about 8 weeks of age onwards. However, the immunity will not develop if the lambs do not have some exposure to coccidia. Furthermore, husbandry and management may lead to high challenge and even immune animals may develop clinical symptoms.
- There are several species of coccidia that are non-pathogenic and these may give rise to the high oocyst count in the test.
- However, the coccidia present may in fact be pathogenic. Therefore, if there is an unexplained scouring or lambs are not thriving, the results should be discussed with a veterinary surgeon as coccidia may well cause a problem.



Samples taken are analysed in the laboratory and the number of worm eggs in faeces are counted.

Other species identified on the test

Strongoloides, *Moniezia* & *Dictyocaulus* spp. are far less pathogenic in sheep than the groups of parasites discussed above. High egg counts should only be of concern if there is some unexplained problem, such as excessive coughing among lambs (not common) which may be associated with a high level of lung worms.

SCOPS, (Sustainable Control of Parasites in Sheep), is an industry led group in the UK that represents the interests of the sheep industry. This group have produced a technical manual with advice which is just as relevant for farmers in Ireland as in the UK. It contains a more detailed interpretation of FEC including what is described as low, medium and high egg counts. The full manual can be accessed on the following website:

http://www.scops.org.uk/content/SCOPS-Technical-manual-4th-Edition-June-2012.pdf

Conclusions

Faecal egg counts are very useful in helping decide if lambs need to be treated for worms. They are also useful in monitoring the efficacy of the product used to treat lambs. The results of such tests must be interpreted correctly so that the benefits can be maximised.

Improving coccidiosis diagnosis

Charles Weir[1], Maresa Sheehan[2], Barbara Good[1]

[1]Teagasc, Animal & Grassland Research and Innovation Centre, Athenry Co. Galway.
[2] DAFM., Kilkenny Regional Veterinary Laboratory, Co. Kilkenny

Take Home Messages

- Infections with coccidia can severely affect the health and productivity of lambs and can result in significant losses
- Clinical coccidiosis in flocks is typically associated with intensification and conditions that predispose to contamination of the environment with coccidial oocysts
- Coccidiosis is generally observed in lambs 4 to 8 weeks age
- The detection of coccidial oocysts in faeces is difficult to interpret as only a small number of species are associated with disease in lambs
- Currently detection of faecal coccidial oocysts must be interpreted together with other findings such as: clinical signs, gross and histopathological examination of sheep carcases and or improvement in lamb performance / clinical signs post-treatment
- Faecal examination allowing the identification of pathogenic species would greatly enhance the diagnosis of coccidiosis
- Neither coccidia counts nor speciation to identify which species is present is routinely done in laboratories in Ireland.

Introduction

Coccidiosis is a disease caused by protozoan parasites 'Eimeria' which live in the intestinal tract of sheep. Coccidiosis can be responsible for major economic and production losses in lambs due to clinical disease (diarrhoea) and lack of thrive and can cause death in affected lambs. In general, clinical disease is associated with intensification which results in a highly infected environment for susceptible lambs, disease can occur both indoors and on pasture.

The life cycle is simple requiring one host. The oocyst (eggs) passed in the faeces of the host are not yet mature and require a short period of time under optimal conditions (oxygen, moisture and temperature) to sporulate and become infective. The sporulated oocysts are highly resistant and can survive up to a year or more in the environment. Exposure to sunlight or desiccation is detrimental to their survival. After the ingestion of a sporulated oocyst, the parasite attaches to the cells lining the gut, invades and multiplies in the intestinal cells. It has been estimated that each oocyst potentially results in tens of millions of oocysts in the environment! Lambs will start to pass oocysts out in their faeces after as little as 12 days post infection but the timing depends on the Eimeria species.

While at least 15 Eimeria species have been described in sheep, only two *Eimeria crandalis* and *Eimeria ovinoidalis* are considered to be pathogenic species for sheep. As infection with more than one species is the norm and only a small number of species are pathogenic, quantifying the number of oocysts per gram of faeces using the McMaster methodology alone is difficult to interpret. Diagnosis of disease requires faecal examination to determine number of oocysts per gram and the identification of pathogenic species (Figure 1). Research is ongoing in the Parasitology laboratory in Athenry to examine the diversity of Eimeria (Figure 2) extracted from ovine and bovine coccidia positive submissions to the Kilkenny, Sligo and Athlone Regional Veterinary laboratories.

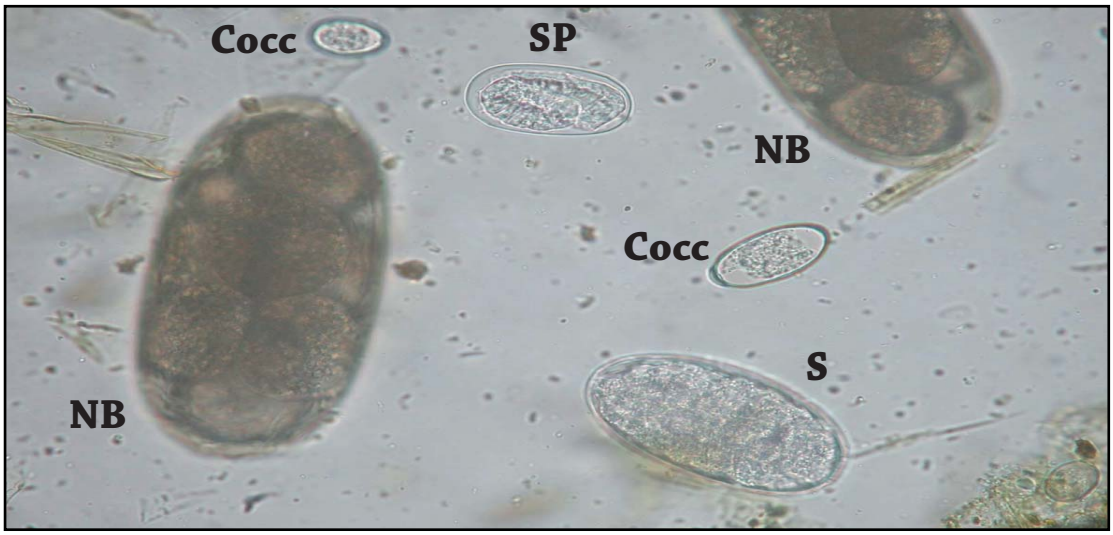


Figure 1 Diversity of worm eggs and much smaller coccidia oocysts found in a faecal sample from a young lamb NB = *Nematodirus battus*, S = Strongyle species, SP= *Strongyloides papillosus* and Cocc= coccidia.

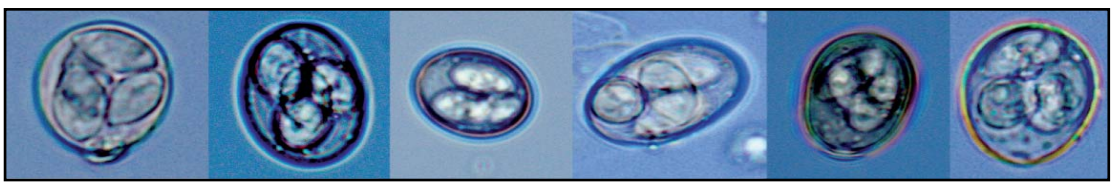


Figure 2. Diversity of Eimeria species in an ovine sample (400 x magnification)

Conclusions and implications

Diagnosis of coccidiosis would be greatly improved by the identification of pathogenic species in faecal samples. Samples known to be positive for coccidia are now being examined as part of a survey to describe the species composition in Irish flocks and herds.

Ewe and lamb behaviour, and lamb mortality during the peri-parturient period

Dwayne Shiels[1], Cathy Dwyer[2], John Mee[3], Seamus Fagan[4], Kevin Hanrahan[5] and Tim Keady[1]

[1] *Teagasc, Animal and Grassland Research and Innovation Centre, Mellows Campus, Athenry, Co. Galway*
[2] *Scotland's Rural College (SRUC), Roslin Institute Building, Easter Bush Campus, Edinburgh, United Kingdom*
[3] *Teagasc, Animal & Grassland Research Centre, Moorepark, Fermoy, Co. Cork*
[4] *Dept of Agriculture, Food and the Marine - Regional Veterinary Laboratory, Coosan, Athlone, Co. Westmeath*
[5] *Rural Economy Development Programme, Teagasc, Athenry, Co Galway*

Take Home Messages

- Each 1% change in lamb mortality is worth approximately €2.5 million to the Irish sheep sector annually
- Need to investigate -the risk factors and causes of lamb mortality on farms
  -the effects of ewe and lamb behaviour on lamb mortality

Introduction

The mean weaning rate in lowland flocks in Ireland is 1.3 lambs reared per ewe joined and has not changed in the last 40 years. While prolificacy and rearing ability are portrayed as the main causes of this low weaning rate, lamb mortality is also a major constraint. Reducing lamb mortality will increase productivity, namely number of lambs reared per ewe joined and, therefore, carcass output per hectare, and financial margins. Each 1% decline in lamb mortality is worth approximately €2.5 million to the Irish sheep sector annually. Lamb mortality is highest in the first days of life and is associated with many factors such as management, nutrition during pregnancy and ewe and lamb behavior etc.

Ewe behaviour and lamb bonding may be affected by various biological, genetic and management factors. In order to provide management strategies to reduce lamb mortality and to improve on-farm ewe and lamb performance, there is need for a better understanding of the effects of ewe management during pregnancy, litter size, ewe age and ewe parity on the behaviour of ewes and their offspring during the critical peri-parturient (post lambing) period.

Although adequate lamb birth weight significantly reduces mortality in larger litters, it has been shown that triplets have impaired behaviours compared to single and twin lambs. This suggests that there is some prenatal impairment that leads to reduced behaviour, or that some aspect of maternal care may be affected.

Objectives

The objectives of this project are to:

(a) Evaluate the effects of ewe previous lambing experience, age at first lambing and management during pregnancy, on:
   1. Ewe and lamb behaviour during the peri-parturient period.
   2. Lamb mortality.
   3. Subsequent ewe and lamb performance.

(b) To establish factors associated with, the prevalence and causes of lamb mortality in Irish sheep flocks

This project consists of a number of current studies, to address these objectives. A summary of these studies are as follows:

Study 1: Risk assessment of causes of lamb mortality on Irish sheep farms

A stratified questionnaire has been constructed and will be circulated to all sheep farmers participating in the National Farm Survey this autumn. The survey contains questions which will determine the prevalence of particular farm management practises that carry high and low risks for lamb mortality. Questions included on topics such as ewe and lamb management, facilities on the farm, hygiene and disease control, and the farmer's knowledge on lamb mortality.

Study 2: Lamb mortality study

A collaborative study involving the regional Veterinary Laboratories is currently on-going at Athenry to identify the causes of lamb mortality and the potential factors associated with different causes of lamb mortality. All dead lambs were tagged and linked to their dam before being sent for post mortem (PM). The PM's are undertaken at the Regional Veterinary Laboratories at Athlone and Sligo. The duration of the study is from birth to weaning and will be conducted over three years. Data on dam genotype, dam weight, dam condition score, dam breed, dam terminal index, litter size, lambing difficulty, ewe/lamb diet and flock management (vaccinations, nutrition, biosecurity etc.) etc will be collated. Potential relationships will be developed between cause of lamb mortality and on-farm factors/practices

Study 3: Effect of litter size and ewe age on ewe and lamb behaviour in the peri-parturient period

A study was initiated, using Belclare ewes, to evaluate the effects of litter size and ewe parity on ewe and lamb behaviour in the peri-parturient period. Camera recording ewe and lamb behaviours for every ewe from one hour prior to birth of the first lamb to two hours after the birth of the last lamb. Assistance was provided when required. Length of labour was recorded. Behaviour measurements including the length of time

for each lamb to get to their knees, attempt to stand, stand, reach udder, unsuccessfully suck and successfully suck was recorded. Ewe and lamb vocalisations and lamb rectal temps were also recorded. Colostrum samples were taken from ewes. Performance data of the ewes (body weight, body condition score) and lambs (body weight) is been recorded to weaning at 14 weeks of age.

Currently, field scan samples are being undertaken to determine the effects of litter size and ewe parity on the frequency of behaviour synchrony of ewes and their lambs, and distance between the ewe and her lambs as they age up to weaning.

Mineral deficiency -prevalence, risk factors, supplementation strategies and impact of supplementation on performance

Daniel Hession[1,2], Nigel Kendall[2], Kevin Hanrahan[3] and Tim Keady[1]

[1] *Teagasc, Animal and Grassland Research and Innovation Centre, Mellows Campus, Athenry, Co. Galway*
[2] *School of Veterinary Medicine and Science, University of Nottingham, Sutton Bonington, Leicestershire, LE12 5RD, UK*
[3] *Rural Economy Development Programme, Teagasc, Athenry, Co Galway*

Take Home Messages

- Mineral deficiency impacts on farm productivity and profitability
- Need for more
  - -targeted supplementation of sheep based on risk indicators for deficiency
  - -evaluation of mineral supplementation strategies

Introduction

In lowland sheep production systems operated in Ireland, grass (both grazed and conserved) can provide up to 95% of feed requirements. In mid-season prime lamb production the objective is to finish all lambs, prior to the end of the grazing season, from grazed grass offered as the sole diet. Many producers are unable to finish lambs from grazed grass due to many reasons, including poor grassland management, parasite control, trace element deficiency etc.

Mineral deficiency affects the performance, fertility and profitability of livestock. It is estimated that Irish sheep producers spend approximately €3 million annually on mineral drenches and boluses much of which maybe unwarranted, particularly in non-deficient areas. Mineral supplementation represents both a financial and labour cost on sheep farms, much of which maybe unwarranted, particularly in non-deficient areas.

Objectives

The objectives of this project are to:

(a) Establish the prevalence and seasonality of mineral deficiencies.
(b) Establish current practice, farmer knowledge and opinions in relation to mineral deficiencies and supplementation strategies.
(c) Develop strategies to identify requirements for supplementation based on risk assessment.

(d) Evaluate mineral supplementation strategies (type, combinations, frequency and method) on the reproductive performance of ewes and performance of their progeny.

This project consists of a number of studies, currently on-going to address these objectives. A summary of these studies are as follows:

Study 1: Survey of mineral supplementation and delivery strategies

A stratified questionnaire was circulated to all sheep farmers in the National Farm Survey which contained questions on mineral supplementation practices, product(s) used, timing/frequency of supplementation and the method of administration. The survey also asked questions to determine producer's knowledge on mineral deficiency symptoms and the expected response to mineral supplementation. The data are currently being collated for analysis.

Study 2: Prevalence of mineral deficiencies on sheep farms

In 2016, a total of 56 farms throughout Ireland were selected to participate in a study to establish the prevalence of, and seasonality of, mineral deficiencies on Irish sheep farms. Farms were selected for the study based on location (county, and location within the county), soil type and farm system (sheep the main enterprise). The number of farms selected per county was based on the percentage of the national breeding ewe flock in that county. This selection process resulted in a geographical spread of farms in each county (Figure 1).

Figure 1: Location of the 56 farms

On each farm, 3 paddocks which were grazed by ewes and/or lambs throughout the year, and randomly distributed and representative of the sward type and age were selected for monthly grass sampling.

Once a month, from March to November, each farmer collected a pre grazing grass sample from each paddock in line with a set procedure. The grass was cut to the expected post grazing sward heights of 4 cm in March and April, 5 cm in May and 6 cm subsequently. Soil samples were taken from each paddock and blood samples were taken from lambs which had received no concentrate or mineral supplementation.

A total of 1,768 soil, herbage and blood samples were collected from the 56 farms. These samples will be analysed for a suite of minerals including cobalt, copper, iodine, selenium, zinc, manganese and magnesium. Vitamin B12 will be determined in blood samples.

The results of the study will provide new information on the concentrations of important trace minerals in Irish pasture and also any seasonal changes. Potential relationships between the concentrations of trace minerals in the soil, grass and blood will allow for the development of risk indicators for the assessment of the mineral status of flocks.

Study 3: Effects of cobalt supplementation and method of supplementation on ewe reproductive performance

A study is currently on-going at Athenry to evaluate the effect of cobalt supplementation and the method of supplementation on ewe reproductive performance. The study commenced 6 weeks prior to joining and continues until weaning. Ewes were allocated to one of three treatments as follows:

1) Control (no supplementation)
2) Cobalt administered by drench fortnightly
3) Cobalt administered by bolus.

SheepNet – Sharing Expertise and Experience towards sheep Productivity through NETworking

Tim Keady

Teagasc, Animal and Grassland Research and Innovation Centre, Mellows Campus, Athenry, Co. Galway

Take Home Messages

- SheepNet -aims to increase sheep productivity and involves the 6 main EU sheep producing countries and Turkey
- Sheep productivity is one of the main factors influencing on-farm profitability and is influenced by a combination of efficient reproduction, efficient gestation and reduced lamb mortality
- In Ireland 1.3 lambs are reared per ewe joined

Introduction

Sheep meat and sheep milk production are very important farm enterprises in Europe and neighbouring countries. In Europe there are 85 million sheep on 830,000 farms while in Turkey there are 31 million sheep on 127,000 farms. According to EUROSTAT, the number of sheep producers in the EU has declined by 50% since 2000. During the past 10 years sheep productivity has decreased by up to 40% depending on the country and the farming system. Since sheep farming plays a key social, economic and environmental role in many "less favoured areas", these decreasing trends are a worrying constraint for the sustainable development of these less favoured areas.

In order to reinforce the attractiveness of the sheep sector, it is fundamental to increase, in a sustainable way, productivity of meat sheep (the number of lambs reared per ewe joined) and of milk sheep (the number of milking ewes per ewe joined).

SheepNet is a 3 year project which aims to increase sheep productivity. The six main sheep producing EU countries (France, Ireland, Italy, Romania, Spain, United Kingdom), and Turkey are involved in SheepNet. Tim Keady (tim.keady@teagasc.ie) is the national facilitator in Ireland. SheepNet is about practice-driven innovation to improve the 3 key factors involved in sheep productivity, namely, efficient **reproduction**, efficient **gestation** and reduced lamb **mortality**.

SheepNet will establish durable exchange of scientific and practical knowledge among researchers, farmers and advisors across Europe. SheepNet will also promote the implementation and dissemination of innovative and best technologies and practices for the improvement of sheep productivity and is organised around 5 steps as illustrated in Figure 1.

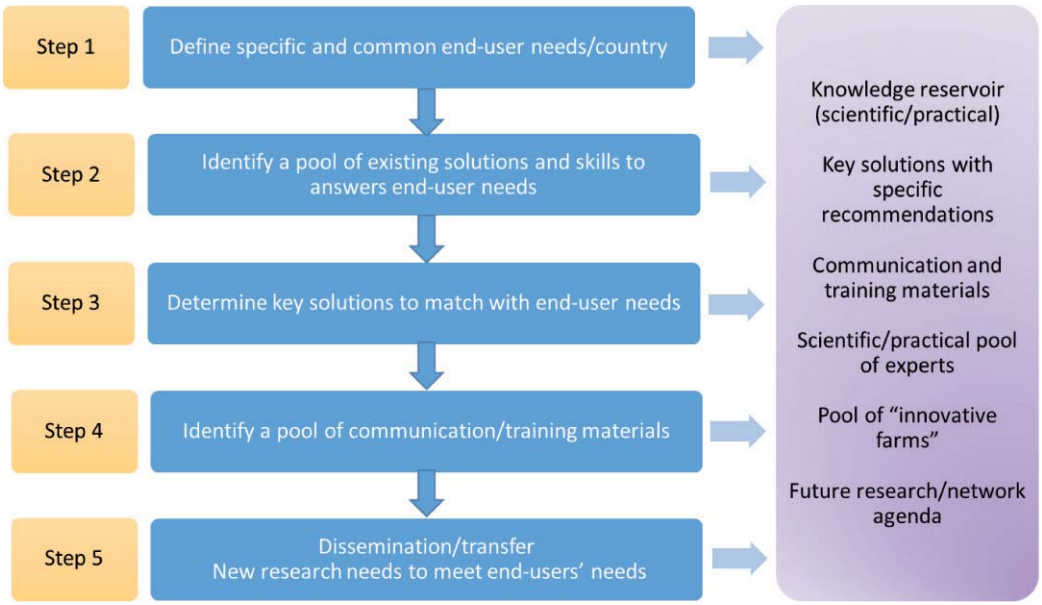


Figure 1: SheepNet is organised around 5 steps.

This network is open to all EU countries, stakeholders, sheep producers. Many national and transnational workshops, publications and events will be realised under SheepNet. Do not hesitate to contact us for further information:

www.sheepnet.network/ www.facebook.com/SheepNetEU

@SheepNetEU SheepNet

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 727895.

The DAFM Regional Veterinary Laboratories Sheep Mortality Survey 2016

John Fagan[1], Margaret Wilson[2], Colm Brady[2], Maresa Sheehan[2], Gerard Murray[3], Colm Ó Muireagáin[3], Damien Barrett[3], Denise Murphy[1], Seamus Fagan[1], Fiona McKeever[3], John Moriarty[4], Miceál Casey[4] and Frank Hynes[5]

[1] *DAFM Athlone Regional Veterinary Laboratory, Coosan, Athlone*
[2] *DAFM Kilkenny Regional Veterinary Laboratory, Leggatsrath, Kilkenny.*
[3] *DAFM Sligo Regional Veterinary Laboratory, Doonally, Sligo*
[4] *DAFM Central Veterinary Research Laboratory, Backweston, Celbridge, Co. Kildare*
[5] *Teagasc, Animal & Grassland Research & Innovation Centre, Mellows Campus, Athenry, Co. Galway*

Take Home Messages

- Good Flock Health is a key component of profitable sheep enterprises.
- There is very little accurate data on mortality rates and the causes of mortality on Irish sheep farms.
- To improve profitability and welfare on Irish sheep farms, farmers need to record accurate data on mortality rates, what age it is occurring at and try to determine what caused the deaths.
- Farmers should set KPI (Key performance indicators) for mortality rates in their flocks.
- Good targeted flock health plans can then be used to achieve these KPIs.

Introduction

Good flock health is a key component of profitable sheep enterprises. A literature search showed that very little information is available to Irish sheep farmers on the level and causes of mortality on Irish sheep farms. This survey was conducted to provide some baseline data on the levels and causes of mortality on Irish sheep farms.

Methods

In conjunction with Teagasc sheep advisors 35 flock owners were approached to take part in the survey. All mortality in their flocks was to be submitted to their local Regional Veterinary Laboratory (RVL). Three of the six RVLs, located in the more populous sheep areas of Ireland, Sligo, Athlone and Kilkenny were involved in the work. The main criteria for inclusion in the study were the enthusiasm of the farmer to be involved and their proximity to the RVL. A total of 33 flocks were involved and there was very good compliance in the submission of carcasses. A representative sample of sheep in each flock was bled for abortion agent serology. A standard post

mortem protocol was carried out on all foetuses submitted. A post mortem was carried out on all carcasses and any additional tests deemed necessary were performed, including culture, virology, serology, biochemistry and histopathology. A combination of carcass collection by the RVLs and delivery by the flock owners was used. All fees for post mortems and diagnostics associated with the survey were waived.

Results

Combined Flock Profile:

- Farms: n=33; Flock size: Median 195 ewes;
- Sheep only = 12 farms; Sheep & cattle = 21 farms
- Lambing start dates: Dec (1 flock); in Jan (4); in Feb (6); in Mar (22)
- Carcase submission proportion per adult female: Average 0.079 (7.9%)
- Foetus submission rate per adult female: Average adjusted 0.076 (7.6%)

An actual mortality rate can't be calculated here because the denominator was changing throughout the season. A suitable proxy is the number of submissions per adult females on farm. Assuming that all mortality is submitted this should be reasonably accurate. The mean and median are very close (7.3% and 7.1% , respectively) which suggests that it is normally distributed. 'Adjusted' refers to the values when the 3-4 lowest submitting flocks are omitted. These 3-4 only submitted 2-3 carcases or 1-2 foetuses each even though they have >100 adults on farm. They are unlikely to have submitted all mortality so the adjusted figure is probably a better reflection of the real 'mortality' rate in Irish flocks.

Table 1. Seroprevalence of abortion agents from flock blood sampling

	Flock-level			Vaccination
Abortion agent	**Positive**	**Negative**	**Seroprevalence**	**Freqency**
Toxoplasma Ab (Agglutination)	5	22	18.5%	54.5%
C. abortus ELISA	17	10	63.0%	15.2%
Salmonella OH titre	3	27	10.0%	-
Border disease Ab ELISA	2	12	14.3%	-
Schmallenberg virus Ab	5	22	18.5%	-
Q fever Ab	3	27	10.0%	-

Disparity exists between what farms are vaccinating against and the apparent exposure of these flocks to abortions agents. We are basing our estimate on a small sample bleed – nevertheless with EAE there are only 5 flocks vaccinating but 17 have exposure.

Table 2. Infectious agents identified in abortion/stillborn foetuses

Agent	Foetuses (n=324)	Flocks (n=27)	Flock prevalence
Toxoplasma gondii	39	16	59.3%
Escherichia coli	13	7	25.9%
Chlamydophila abortus	12	5	18.5%
Bacillus licheniformis	3	3	11.1%
Campylobacter spp	4	2	7.4%
Trueperella pyogenes	3	2	7.4%
Streptococcus uberis	3	1	3.7%
Bibersteinia trehalosi	1	1	3.7%
Listeria monocytogenes	1	1	3.7%
Mannheimia haemolytica	1	1	3.7%
Staphylococcus aureus	1	1	3.7%
Streptococcus spp	1	1	3.7%

Toxoplasma gondii was the most common agent identified – 39 out of 324 foetuses (12%). With a flock prevalence of almost 60% toxoplasma gondii is a major issue on Irish sheep farms. Bacteraemia/septicaemia (Presence of bacteria in the blood) was the most common diagnosis with an incidence of 15.3%. The most common bacteria identified in bacteremia/septicaemia were *E. Coli, Staphylococci, Salmonella, Trueperella pyogenes and Streptococci*. Young animals are most susceptible and the two most common entry points are the navel and through the intestine/mouth. Failure to get adequate colostrum in a timely manner and poor hygiene are the major risk factors for bacteremia and septicaemia.

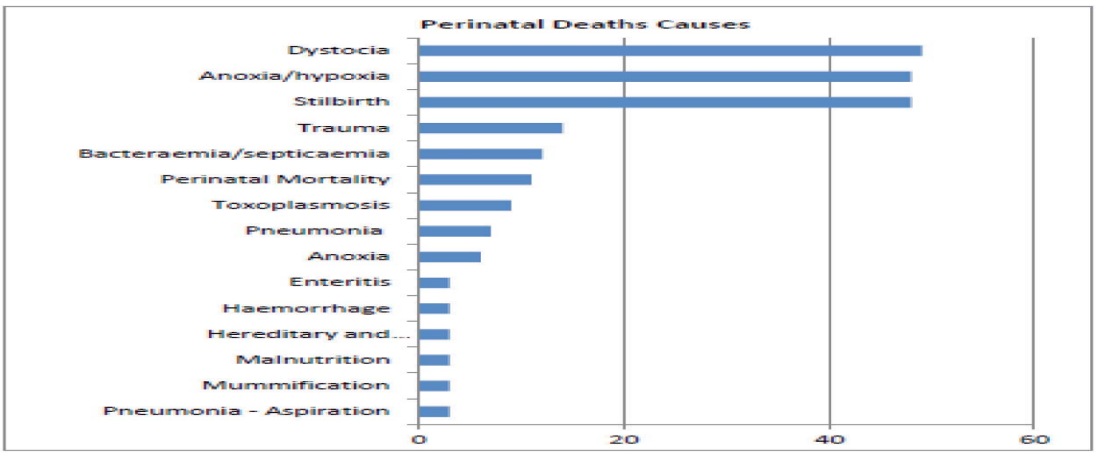


Figure 1. Post mortem results for Perinatal deaths(<48 hrs old). All other diagnoses were detected in ≤ 2 cases. Many of the dystocia and trauma cases would not normally be submitted. In total 254 perinatal deaths were examined.

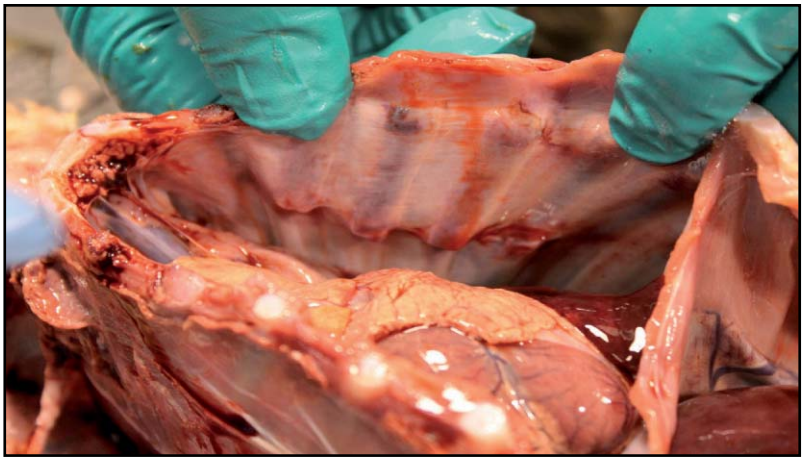


Figure 2. Broken Ribs in perinatal lamb

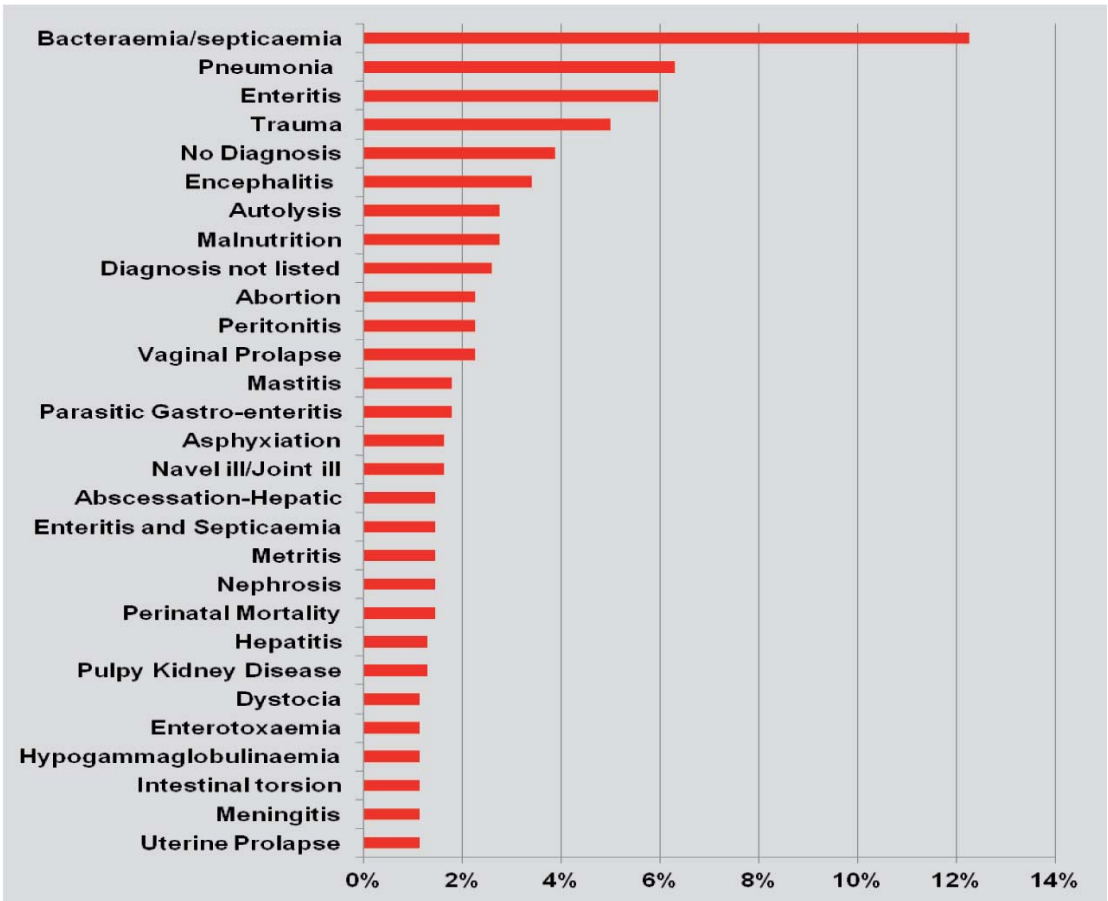


Figure 3. Causes of death identified in all lambs and sheep older than 48 hrs.

Figure 4. Liver abscesses due to *Listeria* in a lamb.

Conclusions

The majority of sheep mortality is due to abortion and deaths in the first 48 hours. Proper investigation of abortions and perinatal mortality is vital to reduce these losses as it allows proper preventative measures to be put in place. Losses during the first month of life can often be traced back to lambing time – bacteraemia/septicaemia, navel ill/joint-ill, and hepatic abscessation. Good hygiene and colostrum management are two key issues in preventing these losses. Accurate recording of adult sheep and lamb mortality and accurate diagnosis of reasons for mortality are key steps in the overall health management and profitability of sheep flocks.

GENETICS & BREEDING

An Irish New Zealand animal comparison – The INZAC Flock

Fiona McGovern[1] and Nóirín McHugh[2]

[1] *Teagasc, Athenry Animal & Grassland Research and Innovation Centre, Athenry, Co. Galway*

[2] *Teagasc, Moorepark Animal & Grassland Research and Innovation Centre, Fermoy, Co. Cork*

Take Home Messages

- Genetic affects are cumulative and permanent over time.
- New Zealand genetics are currently being investigated within an Irish grass based production system
- Preliminary results of the Irish maternal replacement index validation shows that high index Irish ewes are outperforming low index Irish ewes.
- Preliminary results on the elite New Zealand genetic ewes have shown increased lamb output and lower assistance required at lambing.

Introduction

Profitable sheep enterprises require a ewe that efficiently reproduces lambs with good weight-for-age from a grass-based production system, annually. The use of genetics in animal production is a powerful tool that allows farmers to select superior animals to become parents of the next generation. Genetics involves the passing of genes (favourable and unfavourable) from parents to offspring and unlike nutrition or other management factors it is permanent and cumulative over time. It has been shown that genetics is responsible for over half of the production gains achieved across livestock species. In 2009, the Sheep Ireland €uro-star indexes were introduced with the aim of providing sheep farmers with an additional tool for the selection of breeding animals. Genetic gains achievable to date have been small (30c/lamb/year) but it must be remembered that these gains are permanent and cumulative. Genetic evaluations in New Zealand have been established since 1999 and, to-date, have resulted in considerably greater rates of genetic improvement to date (€1.00/lamb/year). As a result the INZAC flock, involving the importation of genetically elite Suffolk and Texel sheep from New Zealand was established with three major objectives;

1. To validate the Irish replacement €uro-star index (1★v's 5★★★★★).
2. To compare Irish versus New Zealand genetically elite animals in a common environment.
3. To establish genetic linkage between the Irish and New Zealand national sheep flocks.

Irish and New Zealand maternal sheep indexes

The traits included in both the New Zealand and Irish genetic evaluations are similar however, to-date, animals of high genetic merit from New Zealand and Ireland have not been compared or evaluated within a similar environment. The sheep value €uro-star index is calculated individually for each animal based on the results from genetic evaluations. The evaluations incorporate individual animal performance data for example lambing difficulty, survivability and live-weights; in addition to performance data from the animal's relatives (i.e. sire and dam).

1. Irish Replacement Index; for the identification of animals suitable for breeding and selecting high profit replacement animals. This index includes maternal traits for example ease of lambing, lamb survivability and ewe milk yield. Terminal traits are also included to account for progeny of the dam that are destined for slaughter.
2. New Zealand Dual Purpose Index; incorporates all of the trait indexes including representing maternal and terminal traits. It enables the identification of sires suitable for breeding high profit replacement animals which have desirable growth and meat characteristics.

Each trait used within the genetic evaluation is weighted based on its economic value (€/lambs born) to farm profitability and given an overall €uro value. Animals are then ranked, using a star rating system where 1 star = bottom 20%; 5 stars = top 20% of the breed. This enables farmers to visualise the ranking of animals for both overall indexes and for individual traits within the genetic evaluation; thus allowing for animal comparison within each breed.

Flock structure

The INZAC flock was established in Teagasc Athenry between 2014 and 2015 with the purchase of ewes and rams from Ireland and New Zealand. The flock consists of 180 ewes from two main breeds, Texel and Suffolk (as shown in Figure 1). Texel and Suffolk represent the two most commonly used terminal breeds within Ireland, and by default Texel and Suffolk genetics also represent a large amount of the Irish commercial ewe population. Texel and Suffolk are also used within the New Zealand sheep industry and, therefore, were chosen for use within the INZAC flock. When selecting Irish bred animals only those with three generations of accuracy >60% within the maternal line for the replacement €uro-star index and originating from farms with a Sheep Ireland data quality index (DQI) of >60% were chosen for the study. New Zealand ewes were within the top 30% of their dual purpose replacement index and had well established links to the central progeny test farms within the New Zealand breeding programme. Ewes and rams were selected from a total of eight farms, across both the north and south island and from both up-land and lowland farms. The study commenced in autumn 2015 when the ewes were mated, within group using artificial insemination (A.I) and is expected to run for a four year period with an expected end date of December 2019.

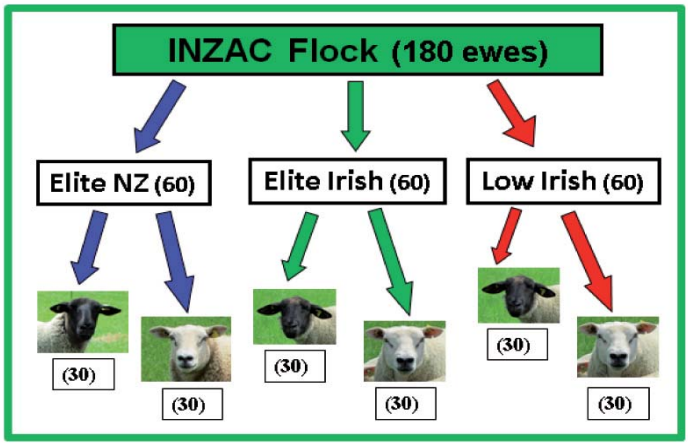


Figure 1:
INZAC flock structure.

Flock management and performance

The INZAC flock incorporates a total area of 15ha and is split evenly into three 5ha farmlets. Replicating previous research carried out on the Athenry sheep research demonstration farm the stocking rate for INZAC flock is 12ewes /ha with a chemical nitrogen input of 130kg per ha per year. The flock is mid-season lambing within a grass based production system. Throughout the study various aspects of both animal performance and grassland parameters are being investigated as outlined in Figure 2.

Preliminary results

To date, there is no effect of ewe genotype on mature live-weight however NZ ewes have a higher body condition score (BCS) at lambing when compared to the Elite and Low index Irish ewes; 3.29 vs. 3.11 vs. 3.06 BCS units, respectively. Ewe conception rate to A.I and ewe barren rates have been similar between all groups thus far while NZ ewes have had higher scanning rates and litter size when compared to the High and Low index Irish ewes; as shown in Table 1.

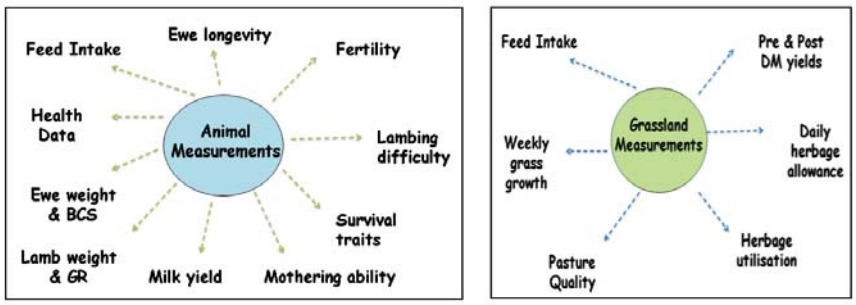


Figure 2.
Parameters being monitored within the INZAC flock study.

INZAC ewes began lambing on the 25th February with approximately 80% of all ewes lambed down within two weeks. New Zealand ewes have lower lambing difficulty when compared to the other two groups, as recorded on the Sheep Ireland lambing

difficulty scale (scale, 1= lambed without help and 4 = manual delivery difficult). While the Elite Irish ewes have a numerically higher lambing difficulty (+4 percentage points) in comparison to the Irish low index ewes, there was significantly less lamb mortality within this group (Table 1).

Table 1. Effect of ewe genotype on reproduction traits and lambing performance

	New Zealand	Elite Irish	Irish Low
Held to first service, %	75	74	74
Barren, %	5.3	7.5	10
Scan rate	1.76	1.62	1.49
Litter Size	1.85	1.75	1.66
Mean lambing date	7th March	8th march	8th March
Lambing difficulty, %	2.2	13	9.0
Lamb Mortality, %	6.0	3.6	9.7

Lamb birth weight was higher for elite Irish lambs compared to New Zealand lambs with low index Irish lambs being intermediate. Pre-weaning, elite Irish and New Zealand lambs were heavier than low index Irish lambs and subsequently had a higher growth rate recorded within the first 100days of life. This was reflected in the weigh-suckle-weigh milk yield recording which was carried out on a selection of ewes within each group; where New Zealand and Elite Irish ewes had higher milk yield than the Low index Irish ewes. Overall lambs within the New Zealand and Elite Irish groups had higher ADG post-weaning and subsequently higher lifetime ADG when compared to the Low index Irish lambs. Consequently, low index Irish lambs took longer to reach slaughter weight when compared to Elite Irish lambs (+14 days) and New Zealand lambs (+23 days), as shown in Table 2. This further resulted in a lower percentage of Low index Irish lambs being drafted from grass; as show in Table 2.

Table 2. Effect of genotype on lamb performance.

	New Zealand	Elite Irish	Irish Low
Weight, (kg)			
Birth	4.9	5.2	5.0
40 days	17.8	18.4	16.9
Weaning	32.6	31.2	30.6
Growth rate, (g/day)			
Birth to 40d	307	314	283
Lifetime	272	264	238
Days to slaughter (days)	155	164	178
Percentage lambs drafted from grass, %	96	82	69

Summary
Results to date from the INZAC flock are demonstrating the suitability of New Zealand sheep genetics to the Irish grass based production system. The importance of genetic selection and the use of the Sheep Ireland replacement index are being highlighted through the improved performance of the Elite Irish group when compared to the Low index Irish animals.

Acknowledgements
We would like to acknowledge the Department of Agriculture, Food and the Marine for funding this project through their stimulus funding.

Sheep genetics in Ireland

Nóirín McHugh[1], Thierry Pabiou[2] and Eamon Wall[2]

[1] *Teagasc, Moorepark Animal & Grassland Research and Innovation Centre, Fermoy, Co. Cork*

[2] *Sheep Ireland, Highfield House, Bandon, Co. Cork*

Take Home Messages

- Genetic indexes are a powerful selection tool that allow farmers to make more informed selection decisions
- When selecting a ram pay careful attention to the star ratings, the traits of interest for your production system and the accuracy of the indexes
- New research will focus on the inclusion of health traits, and the introduction of across-breed evaluations and genomic selection for the sheep industry

Introduction

Genetics is a powerful tool that allows farmers to select superior animals to become the parents of the next generation and has been shown to be directly responsible for over half the production gains achieved across livestock species. Genetics involves the passing of genes, both favourable and unfavourable, from parents to offspring and, unlike feeding or management, it is permanent and cumulative. The national genetic indexes operated by Sheep Ireland are a crucial tool to enable farmers to make more informed breeding decisions and thereby increase productivity and profitability across a range of traits. Rapid rates of genetic gain have been achieved by the dairy and beef industry in Ireland, while the rate of genetic progress in sheep has increased albeit at a slower than desired level. This paper will review the progress achieved to date in sheep breeding in Ireland and highlight future improvements that will accelerate genetic improvement for the national sheep population.

Sources of genetic information

The Sheep Ireland €uro-star indexes were introduced in 2009 with the aim of providing sheep farmers with an additional tool for the selection of breeding animals. The genetic indexes aim to identify a low cost, easy care sheep with good maternal characteristics, but that also produces a good quality lamb that reaches slaughter at an early age. Each animal's indexes are calculated based on its individual animal performance (such as lambing information and weights) as well as the performance of the animal's relatives (i.e. sire and dam). A prerequisite for the inclusion of an animal's data into the Sheep Ireland indexes is the availability of parentage information on all animals; unfortunately this limits the volume of data that is recorded. Currently, animal

performance data and parentage information is available to Sheep Ireland from two main sources: commercial and pedigree data. Commercial farm data are collected on large numbers of commercial animals through the Teagasc BETTER farm programme and the Central Progeny Test (CPT). In the commercial flocks rams from different breeds are mated to a central group of diverse commercial ewes and their progeny performance is recorded. Information on the progeny managed in a commercial environment feeds back into the genetic indexes of the pedigree rams used and also all his relatives. Data from approximately 5,000 commercial animals are currently included in the genetic evaluations. In addition to the commercial data, detailed animal performance information is also recorded by pedigree breeders through the LambPlus scheme with currently over 700 pedigree breeders are entering data on their pedigree animals for the national genetic evaluations.

Sheep value indexes

The establishment of a genetic index involves two main steps, firstly a list of traits or animal characteristics that influence the selection of an animal must be identified, thereafter each trait is weighted based on its economic value (€/lambs born) to farm profitability. A star rating is also assigned to each trait that allows farmers to visualise the ranking of animals within their breed (1 star = bottom 20%; 5 stars = top 20% of the breed). The Sheep Value indexes provide a measure of the genetic ability of the animal's progeny to generate profit at farm level for a combination of traits. The Sheep Value breeding indexes are split into two indexes:

Terminal index - ranks animals based on their ability to produce live, fast growing terminal progeny with little lambing difficulty. This takes into account the progeny's growth rate, carcass characteristics, days to slaughter and also lamb survival and lambing difficulty.

Replacement index - ranks animals on the expected maternal performance such as milk yield, lamb survival and the ease of lambing, however, it also includes some terminal traits to account for the efficiency at which animal's progeny are finished.

Defining the ideal ram for your flock

Before selecting a breeding ram each producer must determine what characteristics are most suitable in sheep for their production system. For example, if farmers are interested in finishing the majority of their lambs then they should focus on the terminal index. On the other hand, if a farmer is looking to retain replacements then they should focus on the replacement index. Irrespective of the type of animal that is needed, careful attention should be placed on the €uro-value, star rating but also

the accuracy associated with the index or trait of interest. The higher the accuracy the greater the information that is known about the animal and the greater the confidence we have that their index value will reflect their true performance potential and thereby reduce the fluctuations in animal star ratings. In addition the Data Quality Index (DQI) is now available for each flock entering data into the Sheep Ireland system. The DQI is an index that rates flocks based on the quality, quantity and completeness of the data recorded on the Sheep Ireland system. Flocks with higher DQI's (80% of greater) have accurately recorded data on each animal within their flock in a timely manner.

Future plans

Although a considerable progress has been undertaken in sheep genetics to date, similar to the Irish dairy and beef industry, research is always necessary to further demonstrate the importance of sound breeding decisions on profitability. A new health sub-index has been launched in 2017 – this will allow producers to rank rams on two health traits lameness and dag score. Additional health traits such as mastitis and worm burden are current under study and will be included in the index once sufficient data is available. Across-breed evaluations are required by the industry to enable producers to rank rams irrespective of breed across the traits of interest, research into across-breed star ratings is on-going and it is envisaged that these star ratings will be available in 2018. Genomic selection is a new technology that could potentially revolutionise Irish sheep breeding and will result in an increase in the accuracy of a rams indexes, genomic information is current available on over 12,000 animals and will be added to a rams index in 2018.

Accelerating genetic gain using genomics

Áine O' Brien[1], Nóirín McHugh[1], Eamon Wall[2], Thierry Pabiou[2] and Donagh Berry[1]

[1] *Teagasc, Moorepark Animal & Grassland Research and Innovation Centre, Fermoy, Co. Cork*
[2] *Sheep Ireland, Bandon, Co. Cork.*

Take Home Messages

- Accurate parentage is essential to maximise genetic gain and identify the best parents of the next generation
- Population structure is useful in designing optimal breeding programmes particularly for crossbreds and composite breeds
- Genomic screening enables the monitoring of major genes and lethal mutations throughout the population
- Genomic evaluations will increase the accuracy of the national breeding indexes

Introduction

Genomics is the study of DNA. Genes, which are made up of DNA, remain the same throughout an animal's life, and are identical in every cell in the body. Knowing the genes of a lamb at birth, and how these genes affect performance, facilitates the accurate prediction of how that animal (and its progeny) will perform. Known as genomic selection, this process has been used in the Irish dairy and beef national genetic evaluations since 2009 and 2016, respectively. Research on the role of genomic selection in the national sheep population is on-going through the progression of the OVIGEN project, with the DNA profile of over 12,000 animals already generated.

Parentage

Accurate parentage of an individual is essential to ensure accurate genetic evaluations, aiding in the identification of genetically elite candidate parents. Correct parentage is also crucial when developing a breeding program to avoid inbreeding, particularly within smaller populations. Furthermore, incorrect parentage can have a substantial impact on genetic gain, depending on the trait. For example, for a trait such as number of lambs born (NLB), a 10% parentage error rate, and assuming 50 recorded daughters per sire could result in a 2-3% reduction in genetic gain. Using DNA information available on potential sires, dams, and their progeny accurate parentage can be assigned. Based on the OVIGEN project, 11.5% of the sires recorded were incorrect while 8% of the recorded dams were incorrect; however this is expected to improve with on-going genotyping.

Major genes

Major genes are genes that have a large influence on a characteristic of an animal; examples of major genes include BMP15 (increased ovulation rate) and GDF8 (degree of muscling). Genomics offers the possibility to monitor these major genes within a population. In the case of the BMP15 prolificy gene, one copy of the gene is known to increase ovulation rate, while two copies of the gene results in a sterile animal. Across the whole genotyped Irish population, the prevalence rate of one copy of the BMP15 gene is 0.07% while in the Belclare breed, the prevalence is 9.78%. The Belclare ewes that had one copy of the BMP15 gene had an increased ovulation rate resulting in, on average 0.53 more lambs born per ewe.

Population structure

DNA information can also be used to investigate the relationship between individual breeds. Knowledge of the population structure of Irish sheep breeds (Figure 1) is useful to determine the optimal crossbreeding strategies by ensuring that the maximum heterosis (or hybrid vigour) is generated between the two parental breeds thereby improving performance of the resulting progeny. For composite breeds such as the Belclare, knowledge of individual animal breed composition can be useful for designing breeding programs. It is clear from figure 1 that the Belclare, Charollais, Suffolk, Texel and Vendeen breeds are not closely related. However, both the Texel and the Beltex DNA clusters overlap, indicating a close relationship between the breeds furthering the possibility to derive accurate genomic predictions for Beltex animals from the DNA information of the Texel animals.

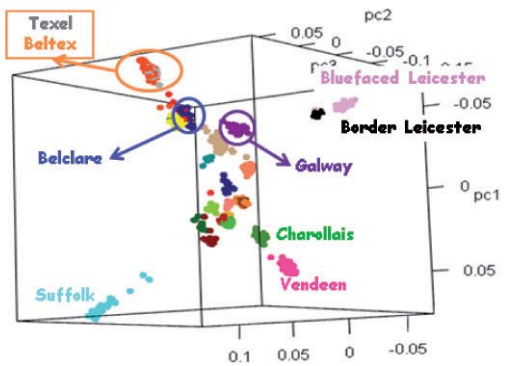


Figure 1. The population structure of genotyped Irish sheep

Karyotyping

Karyotyping assesses the number and appearance of chromosomes in a cell and identifies missing, extra or abnormal chromosomes. Recently two female hoggets were identified as having a chromosomal abnormality. All females should have two X chromosomes; both of these females only had one X chromosome (Figure 2). Both females were diagnosed with Turner

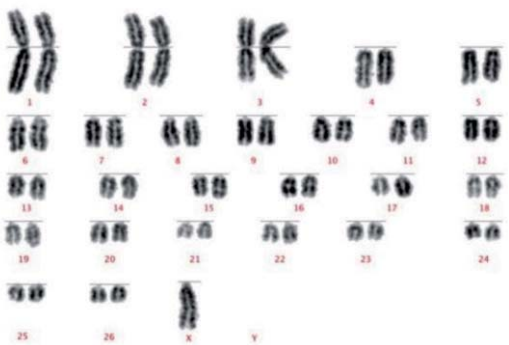


Figure 2. Karyotype of a female sheep with a missing X chromosome

Syndrome; a syndrome also seen in humans with a prevalence of one in 2,000 to 5,000 live births, but not widely documented in ruminants. Females with Turner Syndrome are unable to become pregnant due to abnormal reproductive organs but do not appear to have any external physical abnormalities. A karyotype for an individual animal costs €80 (in addition to genotyping costs); however, algorithms have now been developed at Teagasc to detect such chromosomal abnormalities using routinely available genotype data. Hence where young animals are genotyped (i.e., potential breeding candidates), females with Turner Syndrome can easily be detected before resources are wasted attempting to get the female pregnant. Furthermore, other chromosomal abnormalities can now be detected from routinely available genotype data using a similar approach at no additional cost.

Genomic evaluations

Genomic breeding values, those derived from an animal's (and its relative's) DNA are expected to increase the accuracy of the Sheep Ireland breeding indexes. Research is on-going on genomic evaluations with roll-out planned for 2018. A prerequisite to the inclusion of genomic evaluations for individual breeds is the recording of large amounts of accurate data (e.g., growth data) on the Sheep Ireland database. Therefore it is envisaged that genomic evaluations will initially only be available for five breeds: Belclare, Charollais, Suffolk, Texel, and Vendeen.

Designing a new health sub-index for the national breeding indexes

Áine O' Brien[1], Alan Bohan[1], Thierry Pabiou[2], Nóirín McHugh[1] and Donagh Berry[1]

[1] *Teagasc, Moorepark Animal & Grassland Research and Innovation Centre, Fermoy, Co. Cork*

[2] *Sheep Ireland Bandon, Co. Cork.*

Take Home Messages

- Compromised health contributes to poorer sheep welfare and greater costs of production
- Dagginess and lameness have been recently included in a new health sub-index
- Both dagginess and lameness are under a degree of genetic control

Introduction

Genetics is the study of genes and genetic variation. All improvements made with genetics are permanent and cumulative and are therefore passed from one generation to the next. Therefore selecting sires with superior health sub-index values will result in reduced flock prevalence of lameness and dagginess in the future. While other factors (i.e., environment and management practices) can change throughout the animal's life, the genetics of the animal remains constant and is fundamental to the performance of the animal. The heritability of a trait is an estimate of the performance that is under genetic control. Despite the well-known implications of poor flock health; traits related to animal health have not previously been included in many international sheep breeding goals including those in Ireland, until now.

Health traits

Health data were available on over 37,000 animals, with the majority of the data collected on flock-book recorded animals participating in the OVIGEN project between the years 2015 and 2016. All health data were scored by trained Sheep Ireland technicians. For a trait to be included in a breeding index, both the extent of genetic control (i.e., heritability) and the economic importance of the trait must be quantified.

Lameness

Lameness was measured on a 3-point scale where 0 indicated no sign of lameness, 1 indicated slight lameness, and 2 indicated moderate to severe lameness. The cause of lameness was not identified. Lameness will be measured on a two point scale in the future – where 0 indicates no lameness and 1 indicates any sign of lameness. The

heritability of lameness in Irish sheep is 12% in lambs and 6% in ewes. Therefore the genetics of a lamb is responsible for 12% of the differences observed in lameness among individuals. Differences existed among sire groups in the prevalence of lameness of their progeny (Figure 1). All sires included (in Figure 2) had a minimum of 50 progeny and in at least two flocks. Given that management and environment were expected to be the same for progeny of all sires in the same flocks, this would indicate that genetic differences between sires accounts for most of the difference in prevalence of progeny lameness. Therefore, future lameness within the flock can be reduced by choosing sires with superior breeding values for lameness.

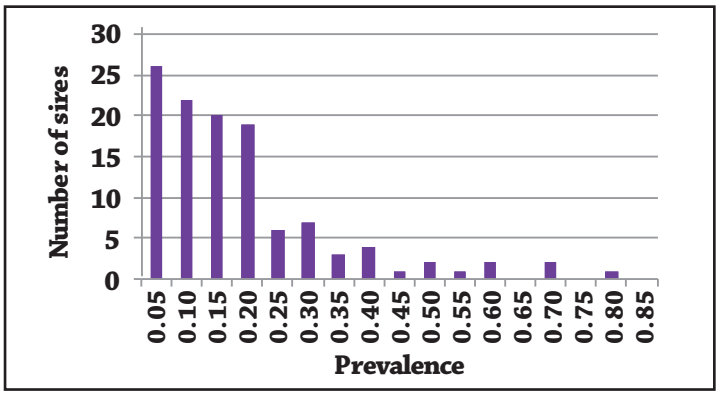


Figure 1. The prevalence of lameness in sire progeny

Dagginess

Dagginess, the accumulation of faecal material surrounding the hind-quarter of the animal, is scored on a 5-point scale (Figure 2). The heritability of dagginess in Irish sheep is 15% and 14% in lambs and ewes, respectively; the genetics of the dam also accounts for a further 5% of the variation of dag score in lambs. Similar to lameness, the prevalence of a high dag score (i.e., a dag score of 3, 4 or 5) in the progeny of sires varied. This further supports the selection of rams with an superior dagginess breeding value in order to reduce the prevalence of a high dag score in a flock. Furthermore, as dag score is associated with flystrike, selecting such rams would reduce the risk of flystrike.

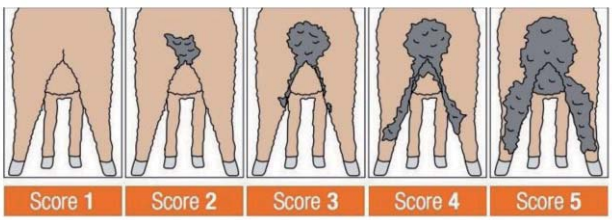


Figure 2. The dag score scale. (AWI)

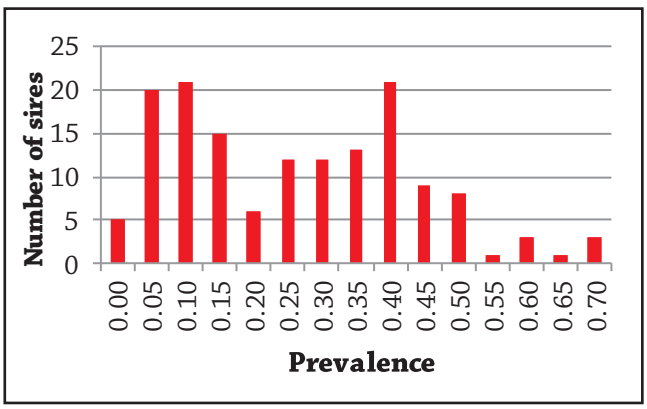


Figure 3. Prevalence of a high dag score (i.e.,3, 4 or 5) in sire progeny.

Economic values

An economic value is the profit generated from higher breeding value in a trait (in the case of lameness and dagginess, this represents a worse score) holding all other traits constant. The cause of lameness in ewes and lambs can differ dramatically; therefore both ewe lameness and lameness are treated as separate traits in the index. For both lambs and ewes, the cost of zinc sulphate for foot bathing, antibiotic spray and long acting antibiotic injections and additional labour costs were taken into account. Economic values calculated for lameness are -€0.071 and -€0.246 for lambs and ewes, respectively; therefore, for every one percentage unit reduction in lameness, the profit per lamb would increase by €0.071. For example, given a 100 ewe flock with a lameness prevalence of 8%; if the prevalence of lameness were to decrease by 1% (to 7%) this would increase the profit per ewe by €0.246. However, if the lameness prevalence were to decrease to 6% (decrease of 2%) this would result in an increase in profit of €0.492 (i.e., €0.246 * 2) per ewe. As the causes (and treatment) of dagginess is similar in both ewes and lambs, just one economic value was generated for dagginess. Factors taken into account included penalisation at slaughter of excessively daggy lambs at slaughter, crutching of lambs, treatment for flystrike and additional labour costs. The economic value is -€0.311 per each percentage unit increase in dag score.

Conclusions

While the introduction of the health sub-index is not expected to greatly affect the ranking of sires, long-term improvements will be seen in the health of the flock by choosing sires with superior health sub-index values. As more data are collected, more traits will be added to the health sub-index; possibly mastitis and faecal egg count.

European Research Area Network Research Project on Sustainable Sheep Production (SusSheP)

L. Abril-Parreño[1,4], Eamon Wall[2], Thierry Pabiou[2], Philip Creighton[3], Michael G. Diskin[3], Kieran Meade[4], Nóirín McHugh[5] and Sean Fair[1]

[1] *Laboratory of Animal Reproduction, Department of Biological Sciences, University of Limerick, Ireland.*
[2] *Sheep Ireland, Bandon, Co. Cork, Ireland.*
[3] *Animal & Grassland Research and Innovation Centre, Teagasc, Mellows Campus, Athenry, Co. Galway, Ireland.*
[4] *Teagasc, Animal & Grassland Research and Innovation Centre, Grange, Dunsany, Co. Meath, Ireland.*
[5] *Teagasc, Moorepark Animal & Grassland Research and Innovation Centre, Fermoy, Co. Cork, Ireland.*

Take Home Messages

- Sheep Production Systems (SPSs) must be sustainable.
- Identification of the most environmentally and labour efficient SPSs is important so that the sheep industry can develop in sustainable direction.
- Ewe longevity impacts on profitability but we need to identify easier ways to record data for use in genetic evaluations.
- An artificial insemination (AI) method used by farmers themselves would rapidly increase the dissemination of genetics from elite rams and facilitate linkages between flocks.

Introduction

This recently funded EU project, Sustainable Sheep Production (SusSheP), is the coming together of a multidisciplinary transnational consortium involving 8 partners across 4 countries (Ireland, Norway, UK and France) and will run from 2017 to 2020. The overall aim of SusSheP is to increase the sustainability and profitability of European Sheep Production by addressing key industry focused problems.

Project outline

This innovative proposal spans three main themes of investigation (Figure 1):

1. Ewe longevity

Sheep are unproductive (but carbon productive) until they produce their first lamb crop, normally at 2 years of age and, on average, ewes only produce 4 crops of lambs in their lifetime. Despite its importance both from an economic and environmental

perspective ewe longevity is not included in many sheep breeding indexes across Europe.

Ewe longevity data is difficult to capture on commercial farms due to the issues surrounding the recording of parentage as well as the date and reasons for culling of ewes. SusSheP aims to learn from experiences in other European countries on how ewe longevity data is best captured on-farm, with a view of developing a simple-to-use recording protocol. SusSheP will, also, establish the factors affecting ewe longevity (eg mastitis, tooth loss, reproductive problems etc), under different sheep production systems (SPSs) and will assess if early life predictors (eg birth weight, rearing rank, 40 day weight, weight change through first winter etc) can be used to predict ewe longevity. Once the factors have been established, their heritability will be calculated and the key traits will be incorporated into the national maternal breeding indexes.

2. Characterising labour input and carbon hoof-print

SusSheP will identify the most carbon and labour efficient sheep production systems under different management systems (eg prolific vs. non-prolific sheep breeds; ewe managed using precision livestock farming vs conventional management) to enable the development of strategies to reduce the labour input and carbon hoof print per kg of output. In parallel to this, a complete Life Cycle Assessment will be performed on the differing sheep production systems to evaluate their actual emissions or nutrient surpluses. This is a technique to assess environmental impacts associated with all the stages of sheep production and will assess on and off-farm environmental impacts associated until the main product(s) is sold.

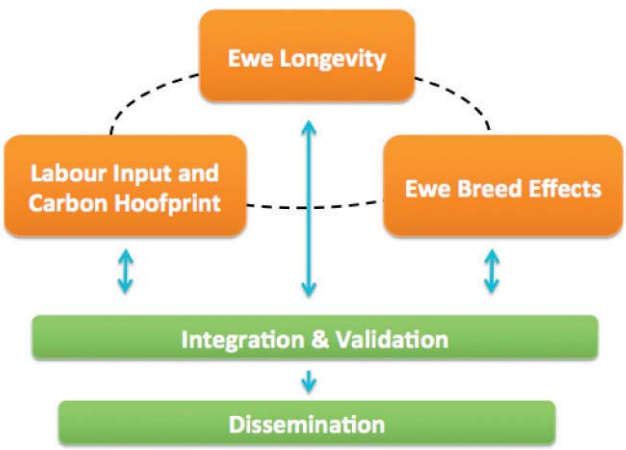


Figure 1: Flow chart of project tasks in SusSheP.

3. Ewe breed effects

The breeding of more efficient sheep has been hampered internationally by the lack of sheep AI, as the only effective method for use with frozen-thawed semen is a laparoscopic procedure, whereby, semen is injected directly into the uterus but this requires veterinary expertise and is welfare unfriendly. The only exception to this is in Norway, in which vaginal deposition of frozen-thawed semen to a natural oestrus ewe yields good pregnancy rates (~60%). Research in Ireland has demonstrated this is due to the breed of the ewe used in Norway, whereby sperm can transverse the cervix in greater numbers than in other breeds, leading to higher pregnancy rates in Norwegian sheep.

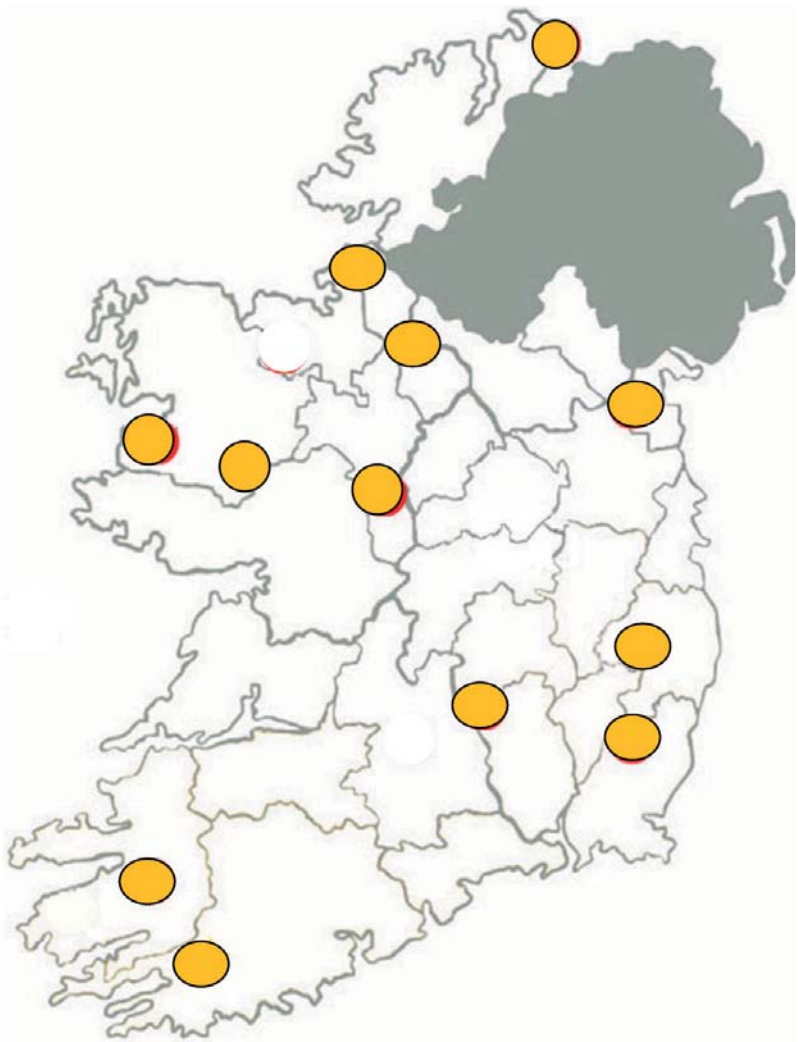
Therefore, the focus of this task is to characterise the differences across breeds in cervical biology and its secretions (genes, proteins and glycans) with the long-term view of developing an AI method which farmers can use themselves.

Conclusions

We have assembled a multi-disciplinary European wide consortium of experienced researchers, industry personnel and sheep farming representatives, which have shaped this cross-cutting innovative proposal towards interrogating industry problems that are holding back European Sheep Production. As the results from SusSheP begin to flow they will be disseminated to industry, farmers and the scientific communities – so watch this space.

BETTER FARMS

Business **E**nvironment and **T**echnology through
Training **E**xtension and **R**esearch



BETTER Farms Sheep Programme

Frank Campion[1], Ciaran Lynch[2] and Michael G. Diskin[1]

[1] *Teagasc, Animal & Grassland Research and Innovation Centre, Athenry, Co. Galway.*
[2] *Teagasc, Ballyhaise, Co. Cavan*

Take Home Messages

- The BETTER farms sheep programme has shown that farm productivity and financial margins can be improved through a modest level technology adoption
- Adopting the latest messages in grassland management for sheep farms has had a very positive effect on the lowland BETTER sheep farms
- Hill farmers need to have a clear breeding policy and be prepared to sell lambs shortly after weaning to free up grass for ewes prior to mating
- BETTER farms should be used by discussion groups and farmers to see the benefits of technology adoption first hand

Introduction

The overall aim of the BETTER farm sheep programme is to establish focal points for the on-farm implementation, development and evaluation of technology that is relevant to the sheep sector. Implementation of the BETTER farm sheep programme is based around the collaboration of Teagasc researchers and advisors in addition to the programme farmers. Currently, there are 12 flocks in the programme situated throughout the country (Figure 1.): 7 lowland flocks, 2 hill flocks and 3 flocks with both hill and & lowland flocks. Each farm has an individual farm plan drawn up between the farmer and their local advisor, sheep specialist and BETTER farms technologist. The aim of each farm plan is to improve to productivity and profitability of the flock over 3-5 years using the latest technologies and messages from the research programme. While each plan is tailored to be farm specific all the plans focus around four broader themes; grassland management, flock breeding policy, production systems and flock health.

An integral part of the BETTER farm programme is the sharing of the messages from the programme to the wider sheep industry. This is done predominantly through farm walks, discussion group visits and print media such as Teagasc client newsletter updates. In 2016 there were 5 national events held on the BETTER sheep farms with 3 lowland farm walks and 2 hill breeding events held. Similar events are held every year to allow farmers to see the farms and to hear from the individual farmers their experiences and how they have increased the productivity of their flock

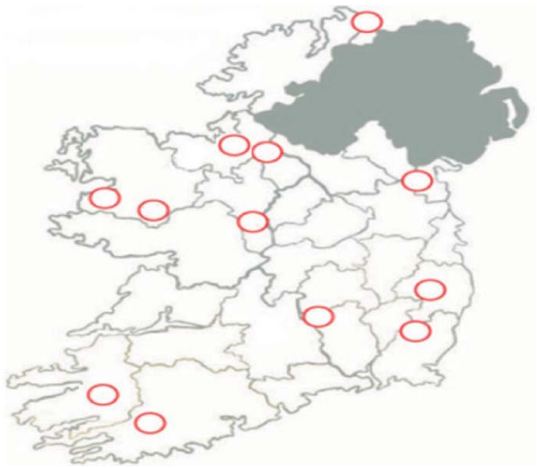


Figure 1. Location of the 12 BETTER farm sheep flocks.

Updates from the lowland flocks

A key message coming from the Teagasc sheep research programme and the BETTER Sheep Farms is the importance of grassland management. This is a one of the main routes being adopted to improve financial margins. By making changes to their approach to grassland management on these farms substantial improvements in grass production and grass utilisation have been achieved. This was achieved by firstly addressing soil fertility issues with lime applications to address pH issues and targeted fertiliser application to improve soil P & K indices.

Improving grazing infrastructure has also been a key aim on the farms. Paddock sizes were reduced using permanent and temporary divisions in order to increase paddock numbers and reduce residency periods. Reducing residency periods (the number of day's ewes and their lambs spend in a paddock) is crucial not only to increasing the ability of the farm to grow grass but also improving grass utilisation (picture below).

Use of temporary fences on Co. Louth BETTER farm to reduce paddock size and control residency periods.

Finally, all the farms are measuring grass growth rates, entering the data to Pasturebase Ireland system. Grass management decisions are then based on the on the grazing wedge generated and grass growth rates on the farm. As presented in Figure 2 some of the lowland BETTER farms grew on average 12.7 tonnes of DM/ha. The farms presented in Figure 2 come from farms across the country and have shown significant improvements in grass production as result of changes in grassland management practices.

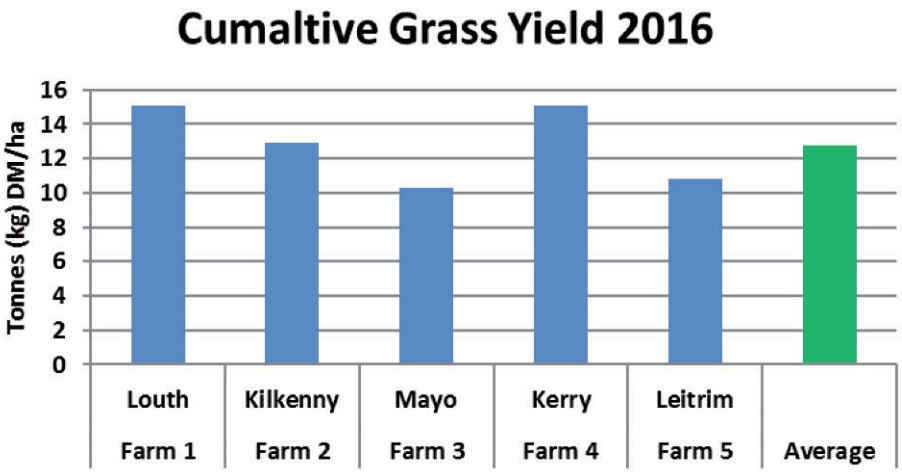


Figure 2. Cumulative grass yield on five of the BETTER sheep farms in 2016.

The use of high genetic merit rams is another important management practice carried out across these farms as part of their breeding policy. Rams are selected based on their Euro star indexes as much as possible in combination with the physical appearance of the ram. These rams are progeny tested and the data fed into the Sheep Ireland data base to improve the accuracies around the rams used and also as part of a wider study to evaluate these indexes on commercial farms. The results of this study are currently being analysed. Results to-date suggests that there is significant difference among rams for lamb survival. This requires further study.

Updates from the hill flocks

There are five of the BETTER sheep farms operating hill sheep enterprises. One of the key messages coming from the hill flocks to date has been the importance of having a defined breeding policy and having a strategic plan for the sale of lambs post-weaning. Most hill producers will sell their lambs as stores in late August onward as is the case on these farms. To increase output from these flocks requires an increase the

potential value of the store lamb. A key part of the breeding policy on the BETTER hill flocks has been the use of cross breeding on a cohort of the ewes to increase the sale weight and market value of the lamb produced. The other approach is a longer term project on the farms which involves performance testing rams to identify superior rams for breeding. This data feeds into Sheep Ireland to help build Euro star indexes for hill breeds.

For one of the flocks' performance testing has been in place for a number of years. In Table 1 the performance of rams on one of the farms during the 2015 and 2016 season is summarised. There can be potentially significant differences in birth weights, growth rates, weaning rates and mortality between different rams used on flocks. These differences can lead to large differences in weaning rate and weight of lambs at weaning time. As presented in Table 2 within the Lanark rams used over 2 years on the Donegal BETTER sheep farm there were only minor differences in weaning weight but substantial differences in lamb mortality. The use of cross breeding on this farm increased weaning weight by 2.1 kg. However, the use of cross breeding is dependent on expected weaning rate so as there are sufficient purebred replacements available to be retained on the farm following weaning. For this particular flock weaning rates in 2015 and 2016 were approximately 1.2 lambs weaned per ewe joined both years, so this allowed the farmer to join 25% of his ewes to a crossing sire

Table 1. Progeny Performance during the 2015 and 2016 season on the Donegal BETTER Sheep Farm

Ram	No. of Progeny	Birth Weight (Kg)	Weaning Weight (Kg)	Mortality[1] (%)
Lanark 1	101	4.09	25.6	8.9
Lanark 2	95	4.09	25.7	15.8
Lanark 3	101	4.30	25.9	6.9
Belclare	84	4.97	27.6	8.3

[1] Combination of mortality at birth and lambs not presented at weighing's

Conclusions

Results to date from the BETTER farms programme presented at numerous events have shown that production gains and increase in farm grass margin are achievable through a modest level of technology adoption on each farm. This paper highlights a couple of specific farm practices for lowland and hill farmers that can lead to significant improvements in production and gross margins for sheep farmers.

BETTER Sheep Farmers Here Today

Three of the BETTER farm participants are here today along with their Teagasc advisors to talk about the programme and the messages coming from their farms. There will also be a number of walks held on the BETTER sheep farms over the coming months which will be advertised accordingly.

Farmer: John Curley
Teagasc Adviser: James Kelly

Together with his son Paul, John is farming a 36 hectare sheep and beef farm near Four Roads Roscommon. The sheep flock is mid-season lambing flock lambing from early March onwards and finishing the majority of lambs off grass only. The flock is a mixture of Belclare, Suffolk and Texel cross ewes. He has been participating in the BETTER farm programme since 2009.

Farmer: John Doyle
Teagasc Adviser: Martina Harrington

John and his wife Hannah and five children, are farming 66 Ha in Ballinacoola near Bunclody Co. Wexford. It is a mixed farm with sheep, cattle and tillage enterprises, with the sheep enterprise divided into both early and mid-season lambing flocks. The flock is made up of Belclare and Suffolk cross ewes. He has been participating in the BETTER farm programme since 2011.

Farmer: Patrick Dunne
Teagasc Adviser: Declan Byrne

Patrick farms near Rathdrum, Co. Wicklow and runs hill sheep, lowland sheep and suckler cow enterprises on the farm. The hill flock is made up mainly of Cheviot ewes grazing commonage in the Wicklow Mountains most of the year. The lowland flock was purchased last year to stock newly rented land adjacent to the farm yard and is made up of Lleyn and Suffolk cross ewes. He has been participating in the BETTER farm programme since 2015.

HILL SHEEP

Potential of the national hill flock

Ciaran Lynch[1], John Cannon[2], Seamus Campbell[3], John Noonan[4] and Michael G. Diskin[5]

[1] Teagasc, Ballyhaise, Co. Cavan,
[2] Teagasc, Letterkenny, Co. Donegal,
[3] Teagasc, Carndonagh, Co. Donegal,
[4] Teagasc, Westport, Co. Mayo.
[5] Teagasc, Animal & Grassland Research and Innovation Centre, Mellows Campus, Athenry, Co. Galway.

Take Home Messages

- Improving ewe live weight and body condition score prior to mating will reduce barrenness and improve litter size.
- There is scope in some hill flocks for crossbreeding using either maternal or terminal sires
- There is significant potential set up producer group to organise the sales of female and males lambs

Introduction

The Hill Sheep farming a major role in the sheep industry and is an integral part of Irish agriculture and the environmental landscape. As such its potential contribution to the overall sector cannot be underestimated. Despite the often challenge conditions these farms are operation in, there is potential to increase their return and add value to the farming enterprise. This paper will outline the role in the industry and highlight some of changes or initiatives that may bring about change in the sector from a flock productivity basis.

Firstly, to put the hill flock into context nationally based on the 2016 census return, published by the Department of Agriculture earlier this year, the national breeding flock totals over 2.6 million breeding ewes over 1 year old. It should be noted that this is an 8 year high. Within that figure 'Mountain ewes' account for 29% of the national breeding ewe flock with 768,937 breeding females over 1 year old being recorded. In addition 'Mountain Cross' ewes accounted for further 17% or 455,994 ewes. Overall "hill sheep genetics" comprise, in some part, almost 46% of the national breeding flock. However, output from this flock is typically low. Various National farm surveys reports have indicated that the hill flocks are typically weaning in the order of 0.8 lambs per ewe joined.

Hill sheep farming is carried out on a diverse range of land quality and farming systems. These are predominantly in the coastal counties with Mayo, Galway, Kerry

and Donegal accounting for the majority of hill ewes. A full breakdown by county is summarised in Table 1. In addition the relative importance of the sector within the counties overall ewe population is also summarised. The potential to increase the contribution to the overall national sheep sector need has likely increased, in part as a by-product of the decline in traditional markets for light lamb, with an increasing number being taken to a higher finished weight often on lowland farms – as discussed in another section of this booklet. Improving the overall linkage between the hill and lowland sectors must benefit the overall industry as both can have a synergistic effect on productivity of their respective systems

Table 1. Mountain and Mountain cross ewe numbers by county

	Mountain		**mountain cross**		
County	**No.**	**% of County**	**No.**	**% of County**	**Total**
Mayo	158,802	52%	46,218	15%	205,020
Kerry	138,994	58%	68,490	28%	207,484
Donegal	123,232	36%	74,671	22%	197,903
Galway	71,796	25%	21,343	7%	93,139
Wicklow	61,480	38%	42,348	27%	103,828
Cork	44,047	36%	34,017	27%	78,064
Sligo	33,437	35%	20,359	21%	53,796
Waterford	24,794	52%	8,333	17%	33,127
Tipperary	20,324	25%	11,067	14%	31,391
Leitrim	20,264	26%	38,808	50%	59,072
Kildare	15,557	20%	9,283	12%	24,840
Carlow	8,679	11%	12,123	16%	20,802
Louth	7,653	21%	7,417	20%	15,070
Cavan	5,896	12%	11,570	23%	17,466
Wexford	5,261	6%	10,237	11%	15,498
Meath	4,685	4%	7,373	7%	12,058
Dublin	4,583	26%	2,340	13%	6,923
Roscommon	4,380	3%	7,690	6%	12,070
Limerick	4,291	30%	2,075	14%	6,366
Kilkenny	2,633	5%	4,490	9%	7,123
Westmeath	1,774	3%	5,713	10%	7,487
Offaly	1,685	3%	2,614	5%	4,299
Longford	1,486	6%	1,841	7%	3,327
Laois	1,416	4%	3,497	10%	4,913
Clare	1,095	6%	1,247	7%	2,342
Monaghan	693	2%	830	3%	1,523
TOTAL	768,937	29%	455,994	17%	1,224,931

Source: National Sheep and Goat census 2016

Ewe output

Work from the BETTER hill farms in recent years and previously from Leenane has shown that Scottish Blackface ewe weight and condition score at mating has a major influence on hill ewe productivity. Although, this is not a new concept; nevertheless it is one area that is often inadequately addressed at farm level. Slight increase in ewe weight and condition will increase ewe litter size and improve pregnancy rate. Results from the work carried out on the hill flocks in the BETTER Farm programme have shown that increasing ewe weight by 5 kg at at mating time will lead to an increase in litter size of 0.075. Furthermore and perhaps of more relevance is the effect of improving condition from a score 2 to a score of 3, this improvement has been shown to increase in pregnancy rate by 13.5% on average (see Figure 1.). Potentially this could lead to a 10 to 15 % increase in lambs produced from the hill sector.

Table 2. Target ewe weight and condition score at Tupping for different hill types

Grazing conditions	Ewe weight (kg)	Condition Score
Harsh hill	40 to 45	2.5
Moderate Hill	45 to 50	3
Upland	50 to 55	3.5

For all hill flocks ewe health issues need to be addressed in a timely manner at key stages of the season. To to improve ewe conditions will frequently be dictated by the availability of semi improved, improved or lowland pasture and how much access the flock had to these areas. Where access to green land is limited, ewes should be drafted onto the lowland areas on the basis of condition with priority given to more venerable categories e.g. light hogget's and older thin ewes. Depending on the increase in live weight / body condition required, ewes may need to be drafted from the hill up to eight weeks prior to mating.

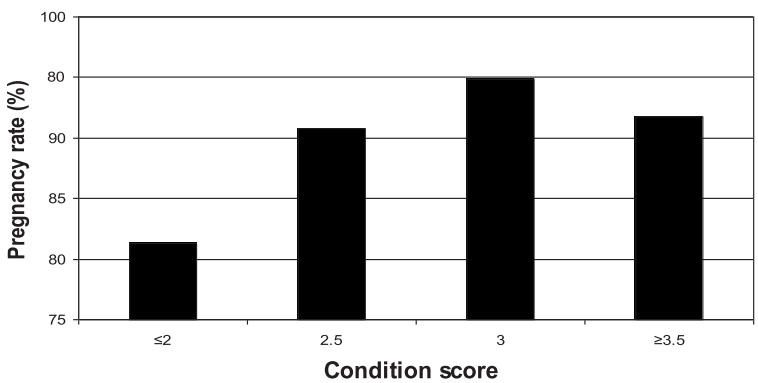


Figure 1. Effect of ewe condition on pregnancy rate in hill flocks

In the context of where these hill sheep are grazing as some of these suggested improvements, particularly in attepting to improve weight or body condition score at mating, may be unrealistic on harder hills. Suggested weight and condition score targets for Scottish Blackface ewes are outlined in Table 2. For Cheviot ewes live weight needs to increase by 5 kg or 10 kg on moderate and upland hills, respectively.

The Scottish Blackface ewe is very response to improved nutrition in terms of increased litter size and lower barrenness rates

Crossbreeding

A large proportion of hill flocks have the scope to increase the use of crossing rams (eg Texel, Suffolk, Bluefaced Leicester) in their flocks. The progeny produced can increase the level of output per ewe and financial returns.

Potential benefits are as follows:

- More saleable cross bred wether and ram lambs.
- Heavier lambs (3-4 kg at weaning)
- Improved selling price
- Prolific females for lowland farms such as Mule, Greyface and Belclare crosses,
- Better performance during the finishing period

The potential level of crossbreeding within an individual flock ultimately depends on the level of ewe productivity (weaning rate) and replacement requirement. Whilst not all flocks are in a suitable position to produce crossbred lambs particularly female breeding stock, the spin off effect of these sales is an increased demand for draft or cast ewes coming off the hill.

Producer Groups

Organised producer groups have the potential to provide a market place for larger numbers of breeding stock or store lambs. Specialised, well-promoted, sales could be organised or the producer groups could facilitate both the sellers and purchasers and increase linkage between the hill and lowland sectors. There are a number of well

Crossbred lambs are:

- **3-4 kg heavier at weaning**
- **Higher growth rate 270-350 grams day**
- **More efficient (1kg less meal /kg LWT gain**
- **Leaner**
- **Heavier carcasses**
- **Better conformation**

organised groups already well established with a few new ones recently established. In addition to the groups, local marts have begun facilitating store lambs purchasers with more direct sales to store lamb finishers, thereby, removing some of the perceived hassle in acquiring these lambs.

Genetic improvement

Unfortunately the hill sector has been lagging behind when it comes to implementing a genetic improvement programme. Inherent difficulties with recording, given the farming environment has hindered progress. The absence of a flock book with parentage information is also a major limitation. This is being actively addressed in a number of areas through a hill recording initiative that is facilitating getting with greater numbers of sheep being recorded on the Sheep Ireland system. Progress may be slow but it provides a starting point to build on for the coming seasons.

Conclusions

The hill sector is an integral and important part of the national sheep sheep industry. There is significant scope for hill flocks to improve productivity at farm level and to increase the level of crossbreeding. Greater linkage between the hill and lowland sectors is needed to increase overall output and returns generated from the sector.

Finishing hill store lambs on Autumn pastures

Michael G. Diskin[1], Noel Claffey[1], Michael Gottstein[2], Frank Hynes[1], Ciaran Lynch[3], Philip Creighton[1], Ivan Kelly[1], Damien Costello[1], Frank Campion[1].

[1] *Teagasc, Mellows Campus, Athenry, Co. Galway*
[2] *Teagasc, Macroom, Co. Cork*
[3] *Teagasc, Ballyhaise, Co. Cavan.*

Take Home Messages

- If planning to finish store lambs prepare a budget in advance and assess all options.
- On hill farms, if good quality autumn grass is scarce or not available, it is advisable to sell the store lambs in August/September and prioritise available grass and feed supplies to improve the body condition of ewes and ewe replacements.
- Best live weight gains from grass are achieved in August to end of October but grass quality must be good and well managed at all times.
- Purchase lambs early in autumn and subject all lambs to a flock health and biosecurity programme

Introduction

The majority of Blackface sheep and their crosses are maintained on hills or marginal land that is not suited to other sheep breeds or other farm enterprises. The majority of the hill breeds are purebred with an emphasis on producing flock replacements for retention or for sale. A proportion of the ewes, particularly in the more favourable hill areas are crossed with either maternal breeds to produce quality replacements or crossed with a terminal breed producing lambs for slaughter. Typically the crossbred lamb would be 3-4 kg heavier at weaning than the purebred hill lamb. Profits from these hill sheep enterprises is very much dependant on prices obtained for lambs sold. A large proportion of these lambs become available for sale annually from August onwards. Many hill lambs are sold to lowland finishers and reappear in the market place as hoggets the following spring. In recent years, prices for hill lambs and in particular light hill lambs in the autumn have been variable while the factory price for hoggets in the spring has been moderate to good. Here we examine the performance of store lambs on autumn pasture.

Market

Traditionally, Ireland had been relying on the Mediterranean markets including Portugal, Spain and Italy to take the lambs from the hill flocks. In the past, these markets required carcases from 10kg and upwards, with preferences for carcases from 12 to 15kg but the demand from these markets have declined in recent years. There

has been a 54% decline in the level of exports to the three Mediterranean countries, and an 87% decline in the combined Portuguese and Spanish markets.

Performance of store lambs on lowland pastures.

Ireland's strength in sheep production lies in its ability to produce meat from an almost entirely grass-based diet thus giving us a competitive advantage over many of our EU competitors. Potential exists to finish store lambs from the hills or more marginal land on lowland grassland farms. Tables 1 and 2 outline the typical lamb growth rates and weight gain achievable from lambs grazing high quality grass swards. Various lamb finishing options are outlined below but regardless of system the aim is to achieve as much live weight gain from grass as possible as this is the most economical feed we have available. Consideration must be given to the quantity and quality of grass that will be available on the farm as this will dictate the number of lambs and what weight gain will be achieved over a given time period. Consideration also needs to be given to the demands of other stock on the farm for grass as the autumn and winter progresses. Formulating a plan in July or early August as to how you plan to provide sufficient high quality grass for the finishing period will be critical to its success or failure. An example here might be the strategic application of nitrogen to boost supply and division of the grazing area available with temporary fencing to improve grass utilization and animal performance by allowing lambs regular access to fresh grass.

Table 1. Typical performance of lowland terminal sired lambs on good quality grass

Time period	ADG (g/day)	Kg gain/week
Aug/Sept	160	1.1
Oct/Nov	115	0.8
12 weeks gain (kg)		11.7 kg
Dec/Jan	<50	<0.35

Typical performance of hill bred lambs on good quality grass is shown in Table 2.

Table 2. Typical performance of hill bred lambs on good quality grass

Time period	ADG (g/day)	Kg gain/week
Aug/Sept	115	0.8
Oct/Nov	60	0.4
12 weeks gain (kg)		7.2
Dec/Jan	<50	<0.35

In the autumn of 2014 Teagasc purchased Scottish Blackface wether and ram lambs from 5 farms in Mayo, Galway and Sligo area. On arrival lambs were quarantined for 48 hours. All lambs were foot bathed and inspected subsequently for any signs of lameness. They were treated for liver fluke with a closantel-based product and for gastrointestinal nematodes with a group 5 -SI–and a Group 3 –ML anthelmintic. Lambs also received an 8:1 clostridial and pasturella vaccination as well as and orf vaccination. Lambs were placed on pasture and their performance measured until December 2015. Interestingly, the performance of the light lambs (<25 kg) surpassed the performance of the heavier lambs (see Table 3). This might indicate that there was some compensatory growth in the lighter lambs. From Mid-October to mid-November the performance of all lambs declined to an average of 45 g/day. After mid-November daily liveweight gain declined to 0 g /day. During the autumn grazing period the performance of ram and wether lambs was similar (Table 3).

Hill flock options for dealing with male hill lambs

Because of the variability among hills and in the amount of green land available, there is no single option that best fits all hill farms.

Table 3. Performance of Scottish Blackface male lambs on lowland pastures at Athenry

	Lamb Weight Category (kg)		
	≤25	**25.1-30**	**>30**
Wt on 1st August (kg)	24.3	27.3	30.5
ADG to 10th October (g/day)	145	110	104
10 week gain (kg)	10.2	7.7	7.3
Wt 10th October (kg)	34.9	35.3	38.1

Option 1: Sell at weaning

If good quality autumn grass is scarce or not available, it is advisable to sell the store lambs in August and prioritise available grass and feed supplies to improve the body condition of ewes and ewe replacements.

Advantages	**Disadvantages**
● Extra grass made available for ewe lambs and breeding ewes.	● Poor prices for light lambs
● Savings on flock health costs	● Limited markets.
● Improved cash flow	● Lamb potential not exploited by primary producer

Option 2: Graze and sell mid-November

This requires excellent quality grass and grassland management. Usually lambs fail to perform for the first 2 weeks after purchase or going onto new pasture. This option would apply to purchasers of store hill lambs. Where lambs are being bought for autumn grazing it is important that they are purchased early in the autumn to maximise the gain from grazed grass.

Advantages
- Heavier lambs
- Greater sale options
- Possibly higher lamb prices

Disadvantages
- Less grass for ewe lambs and breeding ewes.
- Additional flock health costs
- Delayed cash flow

Expected Lamb performance
- August – end Sept: 115g/day or 0.8 kg/ week
- 1st Oct – mid Nov: 60g/ day or 0.4 kg/week
- Total liveweight gain: After 12 weeks = 7.2 kg

Option 3: Graze + Supplementary meal feeding at pasture and sell mid-November

This also requires excellent quality grass and grassland management + meal feeding (300g/lamb/day) by trough. The direct cost of the meal consumed per lamb will vary from €6.30 per lamb (€250/ tonne) to €8.82 (€350/ tonne). The key question is will the extra liveweight gained (expected to be about 4 kg) by the lamb be covered by price obtained for the lamb in November?

Advantages
- Heavier lambs
- Greater sale options
- Possibly higher lamb prices

Disadvantages
- Less grass for ewe lambs and breeding ewes.
- Additional flock health costs
- Cost of concentrates (€6.30/lamb)
- Delayed cash flow and cash required to purchase meal

Expected Lamb performance
- August – End Sept: 155g/day or 1.1 kg/ week
- 1st Oct – mid Nov: 100g/day or 0.7 kg/ week
- 6-9kg concentrates required for 1 kg liveweight gain.
- Total gain after 12 weeks = 11kg.

Option 4. Graze for a period followed by finishing on all-meal diet

With this option the lambs are grazed until end of October or even longer when kept at a low stocking rate. During this period lambs would be expected to gain on average about 7-10 kg if grazed on very good quality grass. At the end of grazing period lambs are housed and finished on an all meal diet. This is in fact the system that is followed by many lowland purchasers of store lambs. Then lambs are purchased in the autumn and grazed on grass until December and then finished on an all concentrate diet.

Advantages

- Heavier lambs at start of meal feeding period
- Reduced meal requirement
- French lamb prices achievable
- Typically higher prices in January-March.
- Reduced finishing period

Disadvantages

- Less grass for ewe lambs and breeding flock
- Additional flock health costs
- Facilities
- Delayed cash flow

The finishing of store lambs in the autumn and winter period can be achieved using a range of different feeding options.

Finishing store lambs on an all-concentrate diet.

Michael G. Diskin[1], Noel Claffey[1], Michael Gottstein[2], Frank Hynes[1], Ciaran Lynch[3], Ivan Kelly[1], Damien Costello[1], Brian Garry[4], Frank Campion[1].

[1] *Teagasc, Mellows Campus, Athenry, Co. Galway.*
[2] *Teagasc, Macroom, Co. Cork.*
[3] *Teagasc, Ballyhaise, Co. Cavan.*
[4] *Teagasc, Moorepark, Fermoy, Co. Cork.*

Take Home Messages

- If finishing lambs on an all concentrate diet, ensure diet is formulated for this purpose, initially offer 300 g/lamb/day and increase by 200 g/lamb/days every 3 days until full feeding, and continue to offer a small quality of long roughage (hay, silage, or straw).
- Ensure that lambs have water at all times
- When on a full concentrated feeding, regularly weigh lambs and market as they become fit.
- Wether lambs, particularly Scottish Blackface lambs can be overfat at relatively light weights
- Differences between different strains of Scottish blackface lambs are small and almost all (98%+) hill lambs are capable of meeting French market specification.

Introduction

Frequently with light hill lambs a period of meal or concentrate feeding is required to finish these lambs. Here key areas to ensure optimal lamb performance and minimise lamb mortality when finishing lambs on concentrates are outlined.

Concentrate feeding of lambs

The purpose of supplementing lambs with concentrate feed is to provide them with a concentrated form of energy and protein in a digestible form which is also balanced to provide essential vitamins and minerals. Growing lambs (less than 35kg) have an additional requirement for protein and should receive a diet containing 13-14% crude protein. Lambs that have begun the finishing phase will not benefit from dietary crude protein levels above 11 or 12%. Rations should consist of high quality ingredients as outlined in Table 1.

Table 1. Energy density of various ingredients when included in lamb finishing diets.

High Energy	Medium Energy	Low Energy
Cereals (Maize, Barley, Oats, Wheat)	Maize Gluten	Pollard / Wheat feed
Pulps (Citrus & Beet)	Soya Hulls	Palm Kernal
Soyabean Meal	Rapeseed Meal	Sunflower
Distillers Grains		Oatfeed
Peas & Beans		Cottonseed
Molasses (<5%)		
Oil (small quantities)		

Performance of Scottish Blackface and Texel X Scottish Blackface lambs on an all concentrate diet

In recent years, Teagasc at Athenry have conducted a number of studies on the finishing of wether and ram Scottish Blackface and Texel cross Scottish Blackface store lambs on an all concentrate diet. The ration fed was 70% cereal and soya bean ration with 15% protein and had a UFL =1. The diet was formulated for this purpose and contained 0.5% ammonium chloride to mitigate the risk of urinary calculi. The ration was initially offered at 300 g/lamb/day and increased by 200 g/lamb/days every 3 days until full feeding (ad libitum) was achieved. This usually took 10-12 days. A small quality of silage (400 g/day fresh weight) was offered to lambs.

Study No 1. The performance of light and medium Scottish Blackface and Texel cross lambs are summarised in Table 2. The Texel cross lambs had higher performance than the Scottish Blackface lambs, had higher intake and were more efficient converters of ration to liveweight gain and had better carcass conformation. Almost all lambs reached French market specification of > 16 kg carcass weight.

Study No. 2: In a subsequent study lambs were purchased at the end of July and grazed for period during the autumn and then housed and finished on an all concentrate diet. When housed, diet and feeding arrangements were similar to Study 1. These lambs were heavier compared to lambs in study 1 when first placed on the all-concentrate diet. Lamb mortality in this study was 1 lamb from 200 or 0.5 %. Results are summarised in Table 3.

Rams lambs of both breed types had a higher daily gain and were more efficient converters of ration to live weight gain than castrated wether lambs. As expected rams lambs had lower killing out rates, particularly Scottish Blackface ram lambs. Scottish Blackface lambs had significantly poorer conformation than Texel cross lambs.

Table 2. Performance of light and medium weight Scottish Blackface and Texel cross Scottish Blackface when finished on an all concentrate diet.

	Scottish Blackface		Texel x Scottish Blackface	
	Light	**Medium**	**Light**	**Medium**
Starting weight (kg)	24.8	29.1	24.9	29.9
Days on full diet	73	61	65	60
Total meal intake (kg)	89.4	72.6	82.2	77.6
Daily intake (kg)	1.24	1.19	1.26	1.3
ADG (g/day)	206	197	277	230
FCE	6.4	6.8	4.6	5.7
Liveweight gain (kg)	14.2	11.3	17.0	13.2
Slaughter weight (kg)	39.0	40.4	41.9	43.1
Carcass weight (kg)	17.1	17.6	17.4	19.3
Carcass Conformation: % 'U'	0%		20%	
% 'R'	80%		80%	
% 'O'	20%		0%	
KO%	43.81	43.63	41.60	44.60
% Carcass > 15 kg (French)	96		100	

Table 3. Performance of heavy Scottish Blackface and Texel X Scottish Blackface lambs on an all concentrate diet

	Scottish Blackface		Texel x Scottish Blackface	
	Ram	**Castrate**	**Ram**	**Castrate**
Start weight(kg)	36.9	36.0	40.8	41.2
Final live weight(kg)	46.3	43.8	54.1	52.9
Days on full diet	36	36	36	36
ADG (g/day)	255	218	364	315
Total Gain(kg)	9.2	7.8	13.1	11.3
Daily feed intake(kg)	1.42	1.41	1.66	1.63
FCE	6.29	7.08	4.73	5.51
Carcass weight (kg)	20.7	20.5	25.6	25.8
Kill out (%)	45.0	47.1	47.0	48.1
Carcass fat score (1-5)	3.22	4.21	3.04	3.77
Carcass grade (1-5)	2.57	2.57	3.72	3.68

At carcass weights of 20.5 kg, the carcasses from Scottish Blackface wether lambs were becoming over fat. This would suggest that when finishing Scottish Blackface wether lambs on an all concentrate diet the target carcass weight should be not more 18.5-19 kg. Rams lambs can be brought to a heavier carcass weight without becoming over fat.

Comparative performance of Cheviot, Connemara-Mayo, Lanark and Perth Scottish Blackface (SB) type males lambs.

Teagasc have recently undertaken to examine the performance of Cheviot, Connemara-Mayo, Lanark and Perth type male lambs when finished on an all-concentrate diet. All lambs were castrated. Preliminary results are presented in Table 4. The performance of the Cheviot lambs, measures as average daily gain (ADG), was significantly higher than the 3 Scottish Blackface breed types which were all similar. The Connemara-Mayo Scottish Blackface had a similar kill out percentage (KO %) to the Cheviot lambs. However, both Cheviot and Connemara-Mayo Scottish Blackface lamb types had significantly higher KO% that the Lanark and the Perth types. Connemara-Mayo Scottish Blackface bred type tended to be fatter and have poor conformation that the other 3 breed types which were all similar. All lambs were deemed suitable for the French market and achieved premium price.

Shearing of lambs.

Results from a study just completed in Athenry recorded no effect of shearing of the lambs at the start of the indoor feeding period had no effect on average daily gain, feed intake feed conversion efficiency or final carcass weight. Not surprisingly kill out percentage (KO %) was 1.2 percentage points higher in shorn lambs. Based on these results there is no benefit to shearing lambs at start of indoor feed period. If contemplating shearing of hill lambs it is probably best to do it in August when lambs are still at grass and shearing will reduce the risk of fly strike.

Variation in lamb performance.

A significant feature of all of the recent studies at Athenry has is the significant variation in the live weight performance of lambs on an all concentrate diet. Much of this variation in performance is directly related to the intake of concentrate feed by the lamb. Lambs with high intakes of 1.8-2.0 kg per day will grow at close to 450-500g per day while lambs eating less than 1 kg per day will grow at about 100 g per day. Therefore, in any group of lambs there is going to be a mixture of low and high performing lambs. To avoid lambs becoming overweight and over fat it is vitally important to weigh lambs on a regular basis particularly as they approach slaughter weight.

Table 4. Comparative performance of Cheviot, Connemara-Mayo, Lanark and Perth type males lambs on an all-concentrate diet.

	Breed type			
	Cheviot	**Connemara-Mayo SB**	**Lanark Scottish SB**	**Perth Scottish SB**
Weight at Start (kg)	29.5	29.9	29.0	28.9
Days on diet	62	62	62	62
ADG (g/day)	226	191	200	202
Final weight (kg)	42.6	40.9	41.4	41.5
Carcass weight (kg)	19.2	18.3	17.8	17.7
Kill out (%)	45.0	44.7	43.0	42.5
Conformation score	2.5	2.2	2.5	2.6
Fat Score	3.0	3.3	2.9	2.8

Selecting lambs for slaughter

The weight at which lambs are drafted for slaughter will depend on market specification, particularly the maximum carcass weight paid, kill out rate (KO%) which, is very much a function of breed, gender, diet and degree of finish. Producers should also avoid over-fat carcasses as these are discounted and it is expensive to lay down fat. Carcass fatness is mainly affected by gender (ram, wether or ewe lamb) and breed.

Table 5. Suggested minimal drafting weights for male lambs finished on an all-concentrate diet.

Breed	**Gender**	**Target Carcass weight (kg)**	**Expected KO%**	**Minimal weight at drafting (kg)**
Scottish Blackface	Wether	18	46	38
Scottish Blackface	Ram	20	44	43
Texel x Scottish Blackface	Wether	21	47	42
Texel x Scottish Blackface	Ram	23	46	47

Scottish Blackface wether lambs reach an adequate carcass fat cover (fat class 3) at about 18 kg carcass weight with Texel x Scottish Blackface wether lambs having an adequate fat cover at 20 kg. For lambs on an all concentrate diet, KO % will increase by approx. 5 percentage points by comparison to un-supplemented lambs. Rams lambs reach heavier carcass weights before adequate fat cover is achieved. Suggested

minimal drafting weights are presented in Table 5. If lambs are recently shorn minimal drafting weight can reduced by 1 kg. Lambs can be drafted at lower weight but will result in lower carcass weights. There may also a lack of fat cover on ram lambs when drafted at lower weights.

Lambs that refuse to eat

It's been our experience that a small proportion (<2%) of hill lambs refuse to eat or a very shy feeders. Usually they stand at the rear of the pen when meal is fed and get progressively thinner with time. It's best to remove them and put them on pasture. Good stockmanship is vital as is avoiding overcrowding and having large numbers of lambs in a single pen.

Factors affecting margin per lamb.

The impact of varying meal prices, factory lamb price and mortality on margin per lamb is presented in Table 6. The impact of changes in meal prices is most significant when feeding lighter lambs and aiming to bring them to "French" weights reflecting the fact that they require larger meal inputs. Increasing factory lamb price has a consistent effect across the different lamb weight ranges. The impact of increased lamb mortality is greatest with heavier lambs reflecting the increased value of a heavier lamb at the start of the feeding period.

Table 6. The impact of varying meal prices, factory lamb price and mortality on margin per lamb

	Lamb starting Weight (kg)		
	25	**30**	**35**
€20 increase in meal price	€-1.78	€-1.24	€-0.70
20 cent increase in lamb factory price	€3.80	€3.80	€3.80
1 Percentage point increase in lamb mortality	€0.56-0.59	€0.63-0.70	€0.69-0.75
Impact of grass quality (August to Mid Oct) on margins			
Poor-Average	€4.11	€4.11	€4.09
Average – Good	€3.18	€3.18	€4.41
Total Poor-Good	€7.29	€7.29	€8.50

Teagasc has developed a Store Lamb Finishing Calculator which can be used to examine the impact of varying lamb purchase and sale prices, concentrate price, performance at pasture, lamb mortality, veterinary costs, lamb type (hill or crossbred), gender (wether or ram) on gross margin. This is available to all Teagasc advisers and provides much useful information on factors affecting gross margins.

Key points when finishing lambs on concentrate diets

- It may be necessary to train lambs to eat concentrates 2-3 weeks prior to housing – outdoor with creep feeders or indoors with access to roughage.
- If finishing lambs on an all concentrate diet, ensure diet is formulated for this purpose, initially offer 300 g/lamb/day and increase by 200 g/lamb/days every 3 days until full feeding level is achieved, and continue to offer a small quality of long roughage (hay, silage, or straw). Ensure that lambs have water at all times.
- Pen size should not be more than 30 lambs and each lamb should be allocated at least 0.8m^2 of floor space.
- Ensure that the sheep house is well ventilated and adequately bedded in straw bedded sheds.
- Ensure that there is adequate trough space for lambs – especially during the time that they are being built-up to ad-lib concentrates. (Need 30cm per lamb of trough space).
- If lambs are being fed indoors ensure that a clean fresh supply of water is available at all times.
- Avoid too much starch or finely ground ingredients.
- Coarse or slightly cracked ingredients are more slowly digested and, therefore, create a safer feed. The downside, however, is that coarse feeds tend to attract birds and lambs tend to sort and leave behind unpalatable ingredients (rapeseed, distillers etc.).
- Look at ingredients to assess quality.
- Mineral vitamin inclusion essential for longer feeding periods.
- By-products ingredients such as distiller grains can vary in copper content and use limited in diet of lambs especially in ad lib feeding systems.
- If finishing males lambs include ammonium chloride for long keep lambs to prevent urinary calculi. Inclusion rate is 0.5%.
- There should be no need for additional mineral vitamin supplementation where properly balanced concentrates are being fed.
- When on a full concentrated feeding, regularly weigh lambs and market as they become fit. A proportion of lambs can finish very quickly.
- Wether lambs become over fat at lighter weights than ram lambs.
- Hill lambs become over fat at lighter weights than crossbred or lowland lambs.
- If lambs are being fed indoors ensure that concentrate feed is available at all times.

Flock health issues with store lambs

Barbara Good[1], Michael G. Diskin[1], Michael Gottstein[2], Frank Hynes[1], Ciaran Lynch[3], Ivan Kelly[1].

[1] *Teagasc, Mellows Campus, Athenry, Co. Galway.*
[2] *Teagasc, Macroom, Co. Cork.*
[2] *Teagasc, Ballyhaise, Co. Cavan.*

Take Home Messages

- Attempt to purchase lambs from a reliable source a preferably vaccinated prior to purchase
- If purchasing, quarantine procedures should be followed once lambs arrive on the farm
- Lambs should be vaccinated against clostridial diseases and pasturella, possibly orf (if purchased) and dosed for internal parasites including liver fluke. Scab prevention should also be considered.
- When administering any products to food producing animals, producers must be cognisant of withdrawal dates. For some products the withdrawal dates are long. The current weight of the lamb and expected slaughter dates must be considered when selecting products to be administered.

Introduction

If purchasing lambs, it is always preferable to purchase lambs from a known source and with known flock health and vaccination records. Purchased lambs should, on arrival on the farm, be given a "quarantine" dose for gastrointestinal worms and liver fluke, foot bathed and housed for 48 hours. They should be vaccinated against clostridial diseases and pasturella pneumonia. Alternatively, it would be preferable if lambs had received their full (primary + poster) vaccinations programmes on their farm of birth. Lambs should remain segregated from other sheep on the farm for at least 4 weeks. If lambs are to be housed it's recommended that lambs have their full vaccinations programmes completed 2 weeks before housing.

Anthelmintic resistance in worm populations is a real threat and so quarantine drenching is important to avoid inadvertently importing resistant worms and fluke. For instance, results from a study in Athenry which screened the purchase of 350 store lambs from 32 farms recorded liver fluke in 9 % of flocks. Lameness is also significant and can lead to very poor performance in store lambs. When animals are housed, lameness spreads quickly as sheep are in close proximity to each other. The most frequent way that footrot or contagious ovine digital dermatitis (CODD) enters a farm is through the importation of infected sheep. All lambs should be foot bathed on arrival (see Table 1). Any lame lambs must be treated as a separate group. Regular

foot bathing, such as every two to three weeks is advisable during the housed period. Lame lambs should never be purchased. A treatment for sheep scab is also advised as it should be considered a threat with all purchased sheep.

Withdrawal dates

When administering any products to food producing animals, producers must be cognisant of withdrawal dates. For some products the withdrawal dates are long. The current weight of the lamb and expected slaughter dates must be considered when selecting products to be administered. Seek advice from your veterinary practitioner to choose the most appropriate products for bio security whose meat withdrawal periods do not surpass the expected time frame to slaughter .

Table 1. Treatment plan for purchased lambs

Reason	Treatment †	Comments
To prevent the introduction of resistant roundworms, to kill resistant and susceptible worms	**Option 1** Moxidectin‡ plus monepantel (Zolvix) **Option 2** Moxidectin‡ plus Derquantel (STARTECT)	Keep off pasture for a minimum of 24 hr and turn out to contaminated ground preferably the driest part of the farm if fluke is also a consideration (see below)
To prevent the introduction of resistant liver flukes	**Option 1** Closantel eg Flukiver **Option 2** Nitroxynil eg Trodax **Option 3** Rafoxanide eg. Ridafluke	Put to graze on driest part of the farm a minimum of 4 weeks and repeat treatment 6 or 7 weeks later for closantel and nitroxynil respectively
To prevent the introduction of more virulent footrot strains or Contagious Ovine Digital Dermatitis (CODD) *	Examine sheep. All lame sheep should be segregated, maintained as one group and treated according to clinical presentation / diagnosis. All animals should be footbathed zinc sulphate /copper sulphate solutions); Any of these will cure Scald, prevent and control footrot but has no effect on CODD. There is no licensed product available for CODD although "lincomycin and spectinomycin soluble powder or tylosin soluble powder (100g per 200L of water) have been used in early cases of CODD with some success. This can be repeated after 48 hours if necessary"*.	Stand sheep on a dry surface for 1 hour after footbathing. Place on pasture where sheep have not grazed forat least 2 weeks. Maintain isolated from the main flock for a minimum of 4 weeks . Continue to monitor sheep throughout this period for any signs of lameness. Isolate any lame sheep and treat as necessary

continued over

To prevent the introduction of scab	**Option 1** Plunge dip **Option 2** Macrocyclic Lactone group (injectable formulation)	Maintain isolation from the main flock
Vaccinations to prevent clostridial diseases and pasturella pneumonia	Use multivalent vaccines according to manufacturer's recommendations. Unvaccinated lambs or lambs of unknown status require a primary course consisting of two injections four to six weeks apart.	Most cases of clostridial disease are fatal. Pasteurellosis can also be fatal. These vaccines are probably the two most effective vaccines used in sheep and will substantially reduce these losses
Orf	When orf is already present in your flock or it appears in bought in lambs, isolate the affected lambs and vaccinate all other lambs.	If orf is not present on your farm and you do not expect it in purchased lambs, do not vaccinate as you will be introducing the problem.

† All treatments should be administered in accordance with the manufacturer's instructions with attention to withdrawal periods. Do not mix products.

‡ Moxidectin is available in oral and injectable formulations. The use of injectable formulation of moxidectin will incur a long withdrawal period but will cover prevention for scab. The use of the oral formulation of moxidectin has a shorter meat withdrawal period (14 days) but does not prevent scab so the use of a plunge dip would be indicated to prevent scab. Plunge dip meat withdrawal periods vary between 24 and 35 days depending on the brand.

* Adapted from O'Leary (2010) Eradication and control of Lameness of Sheep. Veterinary Ireland Journal I Volume 4 Number 7

QUALITY MEAT AND RUMEN FUNCTION

Effects of breed and gender on carcass traits and meat quality attributes of male lambs

Noel Claffey and Michael G. Diskin

Teagasc, Mellows Campus, Animal & Grassland Research and Innovation Centre, Athenry Co Galway

Take Home Messages

- Ram lambs produced leaner carcasses while wether lambs may become over fat especially when finishing to high carcass weights.
- Small differences in tenderness and colour between breeds and genders, however, both genders and breeds were acceptable.
- Little advantage to castrating lambs from a meat quality point of view, however, castration may be needed in some systems as a management tool and to provide meat for some markets

Introduction

Castration of lambs has become less frequent in Ireland given the superior production performance of ram lambs compared to wether lambs. There is however a perception about the meat quality of ram lambs compared to wether lambs, regarding tenderness and physical appearance. This study is one of the first to examine the carcass traits and meat quality attributes of ram and wether lambs from mountain and mountain cross breed lambs and was done so following an intense ad libitum 36 day indoor finishing period.

Study design

Two Hundred lambs were included in the study, 100 rams and 100 wethers of two breeds, Scottish Blackface (SB) and Texel X Scottish Blackface (TXSB). Lambs were born in April, purchased on farms in the west of Ireland in early August before been slaughtered between October and April. Prior to slaughter animals were finished on an intensive 36 day ad libitum concentrate indoor finishing period. Following slaughter animals were weighed and graded for carcass conformation (EUROP scale) and fat score (1-5 scale). Following dissection, samples of the loins were collected for further analysis. Meat colour, intramuscular fat (IMF), pH and a range of chemical tests were completed, Tenderness was determined using the Warner Bratzler Shear Force method following cooking of the meat samples to an internal temperature of 70^{o}C.

Carcass traits

Texel cross Scottish Blackface lambs produced leaner carcasses of greater weight

compared to SB lambs. As has been shown extensively in recent studies by these authors, ram lambs are more efficient at converting feed to live weight gain and will have higher growth rates compared to wether lambs, they also produced heavier and leaner carcasses although wether lambs did produce slightly more conformed carcasses. Carcass fat score of 3 is the recommended specification for many export and domestic markets.

Small differences were observed for pH at 25 hours post slaughter in wether and ram lambs while no differences were observed between the two breed types, while there were no differences in temperature at 25 hours post slaughter between breeds or genders. Tenderness values, measured by the Warner Bratzler Shear Force, indicate the force required to cut through a piece of meat and is measured in Newton's (N). This test indicated that meat from SB lambs was of greater tenderness than TXSB lambs, while wether lambs had an increased tenderness compared to ram lambs, however it must be noted that neither meat was deemed unacceptably tough. Cooking loss indicates the percentage weight of the meat lost during the cooking process, this can be an indicator of juiciness of meat and was higher in TXSB lambs than SB, while no differences were noted between genders.

Table 1: Carcass and various meat quality attributes of SB and TXSB ram and wether lambs.

	SB	TXSB	Wether	Ram
Carcass traits,				
Slaughter weight, kg	45.66	53.70	48.89	50.46
Kill out,%	45.46	47.96	47.63	45.79
Carcass weight, kg	20.71	25.74	23.31	23.14
Carcass fat score, 1-5	3.77	3.21	3.91	3.07
Carcass grade, 1-5	2.63	3.38	3.10	2.92
25 Hour pH	5.61	5.55	5.52	5.65
25 Hour temperature	6.16	6.11	6.19	6.19
Tenderness, N	34.15	37.20	34.20	37.10
Cooking loss, %	27.55	30.35	28.69	29.21
Chemical analysis,				
Moisture, %	74.21	74.47	73.95	74.74
Protein, %	21.24	21.60	21.15	21.33
Intramuscular fat, %	3.23	2.57	2.98	2.81
Ash, %	1.11	1.14	1.12	1.13
Colour,				
Whiteness	45.22	46.55	45.94	45.81
Redness	15.72	15.86	17.79	15.41
Yellowness	6.40	6.04	6.86	6.39

Chemical analysis & colour

Intramuscular fat can be a key indicator of meat eating quality, IMF levels of between 3% and 5% are said to result in the best eating quality. Scottish Blackface lambs had higher levels of IMF compared to TXSB while no difference's was seen between genders for IMF. Protein, ash and moisture levels did not differ between either breed or gender.

The colour of the meat is important to consumers at time of purchase as an indicator of freshness. Consumers will generally choose meat which is bright and red rather than darker meat. Whiteness values indicate how bright the meat was, SB meat was brighter than TXSB. Redness readings were higher in wether lambs compared to ram lambs. As age at slaughter increased (7 to 13 months) the whiteness values of meat decreased while redness readings increased.

Conclusions

Meat from SB and wether lambs was of greater tenderness than TXSB and ram lambs respectively, however meat from both breeds and genders were acceptable. Texel cross Scottish lambs had brighter meat in comparison to SB lambs, while wether lambs produced meat of greater redness colour compared to ram lambs.

Is there a difference in the eating quality of lamb from rams compared to castrates?

Vasiliki Gkarane[1,2], Noel Claffey[2,3], Michael G. Diskin[3], Paul Allen[1], Alan Fahey[2] , Rufielyn Gravador[2], Aidan Moloney[4], Nigel Brunton[2] and Frank Monahan[2]

[1] *Teagasc, Food Research Centre, Ashtown;*
[2] *School of Agriculture and Food Science, University College Dublin;*
[3] *Teagasc, Animal & Grassland Research and Innovation Centre, Athenry;*
[4] *Teagasc, Animal & Grassland Research and Innovation Centre, Grange.*

Take Home Messages

- Relatively small differences exist in the eating quality of lamb from rams and castrates
- There is no evidence for consistent off-flavour in the meat from ram lambs
- Preliminary data show that consumers do not dislike lamb from ram lambs

Introduction

In lamb production, raising rams as opposed to castrates improves animal performance and production efficiency which directly affects profitability. However, there is anecdotal evidence that the meat industry and consumers perceive the quality of lamb from rams to be inferior to that of castrates. In particular, reference is often made to 'stronger' or 'off' flavours or so called 'ram taint' in meat from rams. We undertook a study to determine the effect of gender (ram *vs* castrate) and age at slaughter on the sensory quality, particularly the flavour characteristics, of lamb meat.

Study design

Two hundred lambs (100 rams, 100 castrates) of two breed types (Texel x Scottish Blackface (TxSB), Scottish Blackface (SB)) were sourced on Irish farms in March 2014. Lambs were raised at pasture from birth and selected for slaughter in groups of 40, following a 36 day period on a barley/maize-based concentrate, in October 2014, November 2014, January 2015, March 2015 and April 2015. Lamb samples were grilled and rated for sensory quality by a trained sensory panel. The panelists rated the cooked lamb on a 0 – 100 scale (0 = low intensity 100 = high intensity) for 38 different flavour, aroma and texture attributes. The number of lamb samples exceeding a defined threshold value, i.e. they could be considered extremes, for selected sensory attributes was calculated. Furthermore, a subset of 40 lamb samples (20 from rams, 20 from castrates) was presented to a panel of 100 consumers to determine overall acceptability.

Table 1: Percentage of animals per gender and breed that exceeded a defined threshold for each sensory attribute.

	Rams	Castrates	TxSB	SB
No Lambs	97	96	97	96
Intensity of Roast Meat aroma	0	0	0	0
Intensity of Lamb aroma	6	3	0	9
Grassy aroma	3	0	1	2
Aromatic / Herbal aroma	3	6	6	3
Metallic / Bloody aroma	3	4	4	3
Animal smell / Farm smell	14	2	9	7
Woolly aroma	9	5	10	4
Buttery aroma	2	3	2	3
Fatty aroma	6	5	4	7
Rancid aroma	5	1	4	2
Manure / Faecal aroma	7	2	6	3
Sour aroma	8	6	10	4
Sweaty aroma	4	1	4	1
Soapy aroma	13	6	16	3
Earthy aroma	2	5	4	3
Intensity of Roast Meat flavour	1	2	2	1
Intensity of Lamb flavour	3	2	0	5
Grassy flavour	1	2	0	3
Metallic / Bloody flavour	14	11	9	16
Aromatic / Herbal flavour	3	0	2	1
Soapy flavour	9	2	8	3
Rancid flavour	15	4	11	8
Farmyard flavour	16	10	18	8
Sour flavour	7	3	8	2
Sweet flavour	3	8	8	3
Off-flavours	6	0	4	2
Tenderness	1	0	1	0
Juiciness	3	4	3	4
Chewiness	3	1	4	0
Fattiness / Greasiness	9	3	6	6
Stringiness / Fibrousness	1	1	2	0
Stickiness	0	1	0	1
Intensity of Lamb aftertaste	5	8	4	9
Soapy aftertaste	5	5	6	4
Metallic / Bloody aftertaste	8	8	7	9
Fatty/ Greasy aftertaste	10	6	5	11
Dry aftertaste	4	4	6	2
Astringent aftertaste	6	14	13	7

Results

There were relatively small differences in the average sensory scores for rams vs castrates (data not shown here). Table 1 shows the percentage of animals, across gender and breed, with scores that exceed the threshold value defined above for each of the sensory attributes. While a higher percentage of rams had scores that exceeded the threshold (i.e. "high" scores) for some attributes (e.g. *lamb aroma* and *animal smell*), some castrates also had high scores. There was no consistent effect of age at slaughter on sensory attributes; however, lamb from animals slaughtered in November and/or January had higher scores for *tenderness*, *sour aroma*, *sour flavour* and *earthy aroma*. Preliminary data from consumer evaluation of the *overall acceptability* of lamb indicated that lamb from both genders was liked, with lamb from castrates scoring slightly higher than that from rams.

Conclusions

Relatively small differences exist in the sensory attributes of lamb from rams and castrates. A small percentage of both rams and castrates exceed threshold scores for sensory attributes. Consumers found both ram and castrate lamb to be acceptable.

Understanding the rumen microflora to enhance nutrient utilisation and reduce methane emissions in sheep

Emily McGovern[1], Nóirín McHugh[2], Philip Creighton[3] and Sinéad Waters[1]

[1] *Animal and Bioscience Research Dept., Teagasc Grange, Dunsany, Co. Meath.*
[2] *Animal and Bioscience Research Dept., Teagasc, Moorepark, Co. Cork.*
[3] *Grassland Research Dept., Teagasc Athenry, Co. Galway.*

Take Home Messages

- Internationally, agriculture is faced with the major challenge of preparing for a dramatic increase in food requirements for a rapidly increasing human population, while adhering to strict environmental legislation.
- In ruminants including sheep, the rumen microflora influences the efficiency in which feed is utilised by the host animal as well as on the quality of ruminant products.
- Feed efficient animals have lower daily methane emissions.
- Methane yield varies naturally in sheep and has been identified as a heritable trait that can be used to select animals that yield less methane per unit of feed eaten

Challenges facing the agri-food industry

The *Food Harvest 2020* report has set ambitious growth targets in the agricultural production including an increase of 20% for sheep meat production, by 2020. Similarly *Food Wise 2025* envisages a growth in the sheep production output with an overall aim to increase agri-food exports by 85%. However, almost one third of anthropogenic CH_4 emissions are due to enteric fermentation in livestock. This is predicted to rise further due to an increased worldwide demand for other animal protein. However, in Ireland, agriculture accounts for a higher proportion of national greenhouse gas emissions than any other EU country. Methane emissions resulting from fermentation in the rumen of livestock are responsible for approximately 50% of this. Consequently, if targets of projected increases in output are to be met in an economically and environmentally sustainable manner, major improvements in the efficiency of these production systems at farm level is necessary.

Nutrient digestion and utilisation is enhanced by the rumen microbiome

The rumen microflora play a major role in aiding animals to effectively digest fibrous material such as forages in a process called fermentation. The volatile fatty acids generated through this process can contribute up to 70% of the energy requirements

of the animal. The rumen 'microbiome' is a complex and dynamic ecosystem of thousands of species of microbes. A greater understanding of the rumen microbiome will facilitate development of new strategies to manipulate rumen fermentation and improve nutrient utilisation from feed. Recent advances in DNA sequencing technology now allow deeper analysis of the rumen microbiome in much greater depth than was previously possible. Using this technology, we and other international research groups have been studying the extent to which the rumen microbiome influences the efficiency of feed utilisation by sheep.

Rumen methanogenesis, feed efficiency and the rumen microbiome

Unfortunately, fermentation by the rumen microbiome is accompanied by the production of methane, a potent greenhouse gas. Methane is produced by methanogenic archaea which convert the hydrogen produced by ruminal fermentation into methane. Although this process helps maintain rumen pH by preventing accumulation of hydrogen ions in the rumen, it also results in high methane emissions from sheep production. In addition, methane production in the rumen is an energetically wasteful process, accounting for up to 15% of dietary gross energy. Methane yield varies naturally in sheep and has been identified as a heritable trait that can be used to select animals that yield less methane per unit of feed eaten. Feed particle retention time and rumen volume are thought to contribute to the phenotype. Feed accounts for up to 80% of the direct costs in sheep production. Therefore, improving the efficiency of utilisation of ingested feed by sheep is central to economic sustainability. The objective of Irish sheep production systems is to maximise the utilisation of forage-based diets to reduce reliance on expensive feedstuffs. Feed efficiency is another heritable trait that has also been correlated with reduced methane production in ruminants. Feed efficient animals are those that consume less feed than their contemporaries of similar body weight and growth performance. There is some emerging evidence to suggest that feed efficient ruminants may emit less methane, though the biological mechanisms involved are not fully understood. Studies are in progress in Teagasc investigating the microbiota of sheep divergent for feed efficiency.

Identifying rumen microbes that are associated with feed efficiency in ruminants has and will continue to elucidate factors influencing methane production by rumen microbes. This information will enable development of rumen modifiers and breeding initiatives that can limit unfavourable microbes (e.g., vaccines) leading to new technologies for stimulating and establishing desirable microbes in the rumen. Studies will commence this year at Teagasc Athenry employing portable accumulation chambers for the measuring of methane in sheep. These unique chambers have only ever been utilised previously in New Zealand. The portable system can be used in the field to estimate methane emissions in sheep with minimal ancillary equipment and

infrastructure and with a through-put 10–20 times higher than that which can be achieved with respiration chambers in a non-invasive fashion. The application of these chambers has the potential to facilitate the individual measurement of methane and feed intake on the large numbers of sheep generally required for selective breeding programs. In addition, we will, for the first time, using this technology, be able link the rumen microbiome to methane emissions and the host animal genetics in sheep.

Figure 1. Portable accumulation chambers for the measuring methane in sheep

Conclusions and implications

This research will facilitate the development of strategies focused on improving feed efficiency and methane abatement without compromising animal performance. This will ultimately give sheep producers a competitive advantage by reducing the environmental footprint of Irish agriculture.

ENVIRONMENT

Sustainable grazing of uplands

Catherine Keena[1], Declan Byrne[2]

[1] *Teagasc Countryside Management Specialist, CELUP;*
[2] *Teagasc Adviser, Tinahely, Co Wicklow*

Take Home Messages

- Timing of grazing and number of grazing days on uplands is critical to sustainable management
- Economic returns is the main driver for grazing the uplands
- Income from all schemes (BPS, ANC, Greening and GLAS) should be included when examining the economics of hill sheep, to advise and lead hill sheep farmers in the correct direction as these payments could become dependent on farmers grazing the uplands.
- Farming is the only way to manage the uplands to achieve the three pillars of sustainability - social, economic and environmental.

Background

A guiding principle to meet sustainability goals within FoodWise 2025 will be that environmental protection and economic competitiveness be considered as equal and complimentary; one will not be achieved at the expense of the other. The three pillars of sustainability – social, economic and environmental – are equally important and carry commensurate weight. FoodWise 2025 Strategic Environmental Assessment Report recognises under-grazing as a threat to Natura 2000 sites. These lands offer key values in terms of quality and an opportunity for Ireland's agricultural produce to be linked to and marketed as a high-end environmentally sustainable product. Farmers with Natura uplands (Special Areas of Conservation) are obliged to maintain their uplands in Favourable Conservation Status. Article 6(2) of the Habitats Directive sets out the requirements of Member States, that within European sites, they maintain and restore those habitats to Favourable Conservation Status (FCS). While there are currently areas of undergrazing and overgrazing, overall the priority for the future must be to increase farming activity on the upland areas in order to keep these areas in a suitable agricultural and environmental condition. This will involve increasing numbers of grazing animals on the actual upland areas and vegetation rejuvenation in some areas.

Economic returns

The main reason given by farmers in a Teagasc Wicklow upland study for reduced sheep grazing on the uplands related to economic returns, so that should be the first

issue to be addressed. It has been suggested that there should be a price premium for lambs that were produced from the upland areas based on the environmental benefits to habitats/biodiversity, operated through local hill lamb schemes. This requires much work in setting up and marketing, but could definitely be a long-term option for increasing the profitability of hill sheep farming.

Teagasc profit monitor results for 2015 show hill sheep have a gross margin of €30/ewe, and a net margin of €0/ewe. However, when examining the income from hill ewes, all forms of income should be taken into account, including agricultural and agri-environmental payments received by farmers, i.e., BPS, Greening, GLAS and ANC. When the Single Farm Payment was replaced by the Basic Payment Scheme and the Greening Payment in 2015, entitlements are subject to convergence towards 90% of the 2019 national average. By 2019 all entitlements will have a minimum value of 60% of the national average value. This will result in large increases in money paid to farmers with upland areas, where payments were traditionally low. To put this into perspective and using the data from the farmers who were part of the Wicklow study is set out below. Average area of lowland was 32ha which is roughly the maximum area for payment under the ANC scheme, so it could be drawn down on the enclosed area alone without farming any upland area. The average area of upland/commonage was 51ha, and with an average the GLAS payment of €5,000 over the whole upland area, the average GLAS payment per hectare is of €98. For BPS and Greening, at 2019 rates, this is €150/ha. This gives a payment from BPS, Greening and GLAS on the upland area of €240 per ha.

DAFM Minimum Stocking Rate (SR) on upland areas varies according to the carrying capacity of the land and is available on the Commonage Container on DAFM website. Examples below calculate scheme payments per ewe for 2 hills with different carrying capabilities.

Scheme Payments on upland area = €240 per ha

- If DAFM Minimum SR is1.4 ewes/ha on the uplands – Scheme Payments = €171/ewe
- If DAFM Minimum SR is 2 ewes/ha on the uplands – Scheme Payments = €124/ewe

Because farmers have been receiving payments under BPS and agri-environment schemes on upland areas without putting stock there themselves (provided grazing by some stock occurred) they do not see these direct payments as income from the hill sheep. If farmers must be actively farming the uplands to be eligible for BPS, ANC, Greening and GLAS, then this income can be attributed to ewes grazing on the upland area, which make them very profitable.

Sustainable stocking rate

Grazing uplands at a sustainable level is the ideal management for farming and biodiversity. The Guide to the completion of the GLAS Commonage Plan (August 2015) sets out sustainable stocking rates for undamaged uplands.

Habitat Type (Undamaged)	Stocking Rate: Ewe Equivalents / ha
Upland Grassland	1.5 - 5
Dry Heath	1 – 1.5
Wet Heath	0.75 - 1
Blanket Bog	0 – 0.75

Upland grassland is dominated by low-growing grasses, such as bents, fescues, sweet vernal-grass, wavy hair-grass and mat-grass. If undergrazed, grass is replaced with bracken or gorse, (whins or furze). Heath includes areas where the vegetation is openand there is at least 25% of dwarf shrubs. Peat depth in dry heath is usually less than 15 cm. Dry heath is species poor, typical components include ling (calluna) and bell heather; and bilberry. They are species poor, dominated by heathers - calluna (ling) and bell heather. If overgrazed, heather disappears and if undergrazed heather becomes tall and woody and unsuitable for grazing. Wet heath is typically on a peat layer between 15 and 80cm. Vegetation includes ling (calluna), cross-leaved heath, purple moor-grass and sedges. If overgrazed, wet heath is slow to recover. The species rich sward is replaced with a monoculture of mat-grass and purple moor-grass. In extreme cases the peat layer can erode especially on slopes, leaving the underlying bedrock exposed. Blanket bogs usually have a peat depth over 80 cm, but it can be much deeper in pockets. Vegetation is typically dominated by deergrass, cottongrasses, ling (calluna), cross-leaved heath and bilberry. Cover of sphagnum mosses is usually high in areas of undamaged bog. There may be specialised insectivorous plants like sundews and butterworts. Very little grazing is required and they are easily damaged.

Habitat Condition	Stocking Coefficient
U* = Rank & Undergrazed	1-1.25
U = Undamaged	1
MU = Moderate Undamaged	0.80-0.99
MM = Moderate Damage	0.40-0.79
MS = Moderate Severe	0.2-0.39
S = Severe	0-0.19
S* = Very Severe	0

A further stocking co-efficient is applied, depending on the level of damage. The minimum and maximum stocking numbers are calculated as a deviation from the calculated Sustainable Stocking Rate. This deviation will vary depending on the dominant habitat type. Where the habitat is blanket bog or wet heath, stocking rate may be adjusted by up or down by 20%, while dry heath stocking rate can be adjusted by 10%.

Grazing management

In addition to grazing levels, timing of grazing is critical for sustainable management. Purple moor grass has a high grazing value, but only in spring and early summer, thereafter digestibility drops off quickly. Dead material remaining over the winter has negligible nutritional value and is relatively indigestible. Purple moor grass grows in tussocks and at the end of the growing season, an abscission layer at the base of the leaves similar to deciduous trees, results in the leaves breaking. Where grazing levels are low, the leaves shed in autumn build up producing a dense litter layer. This has the potential to smother out other species; hence it is important to prevent such a dense layer from building up. Cattle are more likely than sheep to eat purple moor grass.

Good examples of purple moor grass dominated habitat will contain other plant species, a habitat for the rare and protected marsh fritillary butterfly or potentially nesting sites for wading birds. Poor examples of this habitat will be dominated by purple moor grass to the exclusion of most other species. Abundance of this species tends to be associated with a reduction in cattle grazing or too frequent burning. As purple moor grass is a fire tolerant species, burning exacerbates the problem.

Rejuvenation of overgrown vegetation

Intervention to rejuvenate overgrown vegetation should only be considered if it is the plan to follow this with sustainable levels of livestock grazing. A combination of control options may be required. Consultation with the National Parks and Wildlife Service (NPWS) is necessary if carrying out work (Activities Requiring Consent) in Natura areas. Prescribed burning of dry heaths with overgrown woody heather can be very effective where the age distribution of the heather is too skewed towards old heather and all grassland areas are lost to a full stand of heather. The aim is to return the habitat to optimum condition for farming and biodiversity which is a mosaic of heather and grassland with a good distribution of heather of all ages.

Prescribed burning, in patches, of tall strong heather must be carried out, in accordance with the DAFM Prescribed Burning Code. Mechanical cutting of heather can be used to make fire breaks and fire control lines for prescribed burning at a later date. For effective fire breaks, vegetation must be cut immediately prior to burning or the cut material removed before burning commences. Vegetation takes about eighteen months to rot down to be suitable as a fire break, if not removed. Cutting out lines of heather can facilitates the planning of patchwork burning.

GLAS commonage management planning

Commonage Management Plans are currently being completed for farmers in GLAS 1, GLAS 2 and GLAS 3, which will determine the minimum ewe equivalents for each farmer in GLAS. In exceptional cases, derogation from the rules on stocking levels may be sought by means of appeal to the Commonage Implementation Committee (CIC).

A Commonage Management Plan cannot exceed the total maximum ewe equivalents for the commonage at any time during the GLAS contract.
Each GLAS 3 farmer must have their individual minimum number of ewe equivalents by 31st December 2017 and retain these for the remainder of GLAS. Each Commonage Management Plan must reach the total minimum number of ewe equivalents for the commonage by 31st December 2018.

Rush control and water quality

Tim Hyde

Teagasc, Athenry, Co. Galway

Take Home Messages

- Beware! Spraying rushes can very easily lead to breaches of the drinking water standard for pesticides, particularly if using MCPA.
- All MCPA products for rush control have a 5m buffer zone from watercourses (this includes any dry drains that could hold water)
- MCPA products cannot be used in weed lickers
- All MCPA containers should be triple rinsed after use with the rinse put into the sprayer.
- All foil lids from MCPA containers should be put back into the triple rinsed containers.
- Mechanical control should be the first option and then spray the regrowth and target only the rush affected areas.
- Do not fill sprayers from watercourses.
  Ensure that the sprayer operator is aware of any drinking water abstraction points or wells in the local area (5m to 200m Safe Guard Zones)

Introduction

Rush control normally takes place in June and July and involves the use of MCPA products, however in recent years drinking water monitoring results for Ireland show that a number of herbicides commonly used on grassland, such as MCPA have been detected in drinking water.

- MCPA is water soluble and takes several weeks to break down.
- Rushes thrive in poorly drained areas (with a water table near the surface) which are prone to runoff to nearby water bodies.

Herbicides can enter water bodies from:

- **Point sources** (mainly in the farm or farmyard) – leaks from storage areas; spills or drips from handling operations such as mixing, filling and washing; or
- **Diffuse sources** (mainly in the field) – inputs arising during or after application from processes such as spray drift, runoff and drainage.

What to do

- Use non-chemical control methods e.g. cutting, drainage, sward improvement.
- If spraying, target only the rush affected areas and, cut rushes one month before or one month after spraying to improve the effect of the spray.
- Consider weed wiping with an appropriate herbicide (not MCPA) as a rush control option.

- It is essential to take great care and follow best practice procedures when using any pesticide and particularly so in the case of herbicides used on grassland.

Weeds in grassland

- Don't underestimate basic grassland husbandry such as applying lime, fertilizer, topping or reseeding as weed control measures.
- Low levels of weeds do not affect grass production and are beneficial to the environment.
- A vigorously growing grass sward can out-compete weeds and prevent new weeds growing.
- Spraying at the right time doubles the effect of the spray.

DO's when using herbicides

- **DO** read the product label instructions carefully and plan the treatment in advance.
- **DO** inform yourself of the location of all nearby water bodies (ditches, streams, ponds, rivers, lakes and springs).
- **DO** find out if any groundwater body or surface water body in your locality is used as a drinking water source and, if so, the location of the nearest abstraction point.
- **DO** ensure that herbicide and pesticide products are stored in a secure, dry area which cannot result in accidental leaks or spills. Empty, triple-rinsed containers should be disposed of in accordance with the Good Practice Guide for Empty Pesticide Containers.
- **DO** ensure that application equipment is properly calibrated and in good working order.
- **DO** take every precaution during mixing and preparation to avoid spills and drips. Minimise water volumes (rain and washings) on the handling area.
- **DO** consider using drift-reducing nozzles if spraying. Keep the spray boom as low as possible to the ground and use the coarsest appropriate spray quality.
- **DO** clean and wash down the sprayer at the end of the day, preferably in the field and well away from water bodies or open drains. Tank washings should be sprayed onto the previously sprayed area, on a section far away from any water body, observing the maximum dose for that area.

DON'Ts when using herbicides

- **DON'T** perform handling operations (filling, mixing or washing the sprayer) near water bodies, open drains or well heads. Maintain a distance of at least 10 metres and preferably 50 metres, where possible.
- **DON'T** fill the sprayer directly from a water body.

- **DON'T** spray if the grass is wet or if heavy rain is forecast within 48 hours after application. DON'T spray during windy conditions.
- **DON'T** spray near open drains, wells or springs.
- **DON'T** spray on waterlogged or poorly draining soils that slope steeply towards a water body, drain, well or on any other vulnerable area that leads directly to water.
- **DON'T** discard sprayer washings down a drain or onto an area from which they can readily enter a water body.

Safeguard zones

- Statutory 'no-use' zones (called safeguard zones) apply around drinking water abstraction points, ranging from 5 metres to 200 metres depending on the size of the supply. Your Local Authority or The National Federation of Group Water Schemes can advise on this.

Remember

- Careless storage, handling or use of pesticides can easily cause breaches of the legal limit for pesticides/herbicides in drinking water.
- A single drop of pesticide/ herbicides lost to a water body such as a typical stream (1 metres wide, 0.30, metres deep), for example can be enough to breach the legal limit for pesticides/herbicides in drinking water of 0.1 part per billion along 30km of its length.
- Check how near water bodies (ditches, streams, ponds, rivers, lakes, etc), drains or wells are to where you are working.
- Find out if the treatment area is in the vicinity of a drinking water abstraction point or well.

- For GLAS LIPP (Low Input Permanent Pasture) "Where present, rushes must be controlled either mechanically, by weed wiping and/or by spot spraying. While weed wiping and/or spot spraying can take place between 15th March and 15th July, topping to control rushes cannot take place between these dates"
- For GLAS (Traditional Hay Meadow) - Where present, rushes must be controlled either mechanically by weed wiping and/or by spot spraying. While weed wiping and/or spot spraying can take place between 15th March and when the meadow is mown annually, topping to control rushes cannot take place between these dates.

For further information on related topics such as container storage, triple rinsing, Integrated Pest Management or a list of approved Pesticide Advisors visit: **www.pcs.agriculture.gov.ie**, **www.teagasc.ie** or **www.epa.ie**

How farmers can help bees

Catherine Keena[1], Una Fitzpatrick[2]

[1] *Countryside Management Specialist, CELUP and All Ireland Pollinator Plan Steering Group;*

[2] *National Biodiversity Data Centre, Beechfield House, WIT West Campus, Carriganore, Co Waterford and Chair All Ireland Pollinator Plan Steering Group*

Take Home Messages

- Bees (Bumble bees, solitary bees and the honey bee) are important for pollination and are part of our 'green' image.
- Irish bees are in decline
- Farmers can help bees by allowing space on farms for wildflowers to grow and bloom

Importance of bees

There are 98 species of bees in Ireland. There are 77 species of solitary bees, 20 bumble bees and the honey bee. Bees are important for pollination. Along with hoverflies they pollinate food crops such as oilseed rape, peas, beans, apples and soft fruit. They also pollinate wildflowers and trees in the countryside, providing a supply of seeds fruit and berries for wildlife. The evidence is that a variety of pollinating insects gives better pollination.

A healthy population of bees is important for our green image. Food Harvest 2020, a report which set the scene for our agri-food, drinks, fisheries and forestry sector for the next decade, sets out a vision based on Smart, Green Growth. Capitalising on Ireland's association with the colour 'green' is pivotal to developing the marketing opportunity for Irish agri-food. (DAFM, 2010). However the report states that this 'green' image must be refined, be substantiated by scientific evidence and communicated effectively over the coming decade if Ireland's commitment to sustainability and the implementation of world-class environmental practices is to become a platform for export growth. Biodiversity is a key area of environmental concern.

Honey is produced by honey bees. There are over 3,500 individual beekeepers in Ireland who are very conscious of the requirements of bees. The Federation of Irish Beekeepers Associations (FIBKA) is an association of the Beekeepers Associations in Ireland. The Federation represents 59 local member associations.

Decline in bees

Bees are declining because there has been a reduction in flowers in the Irish countryside. Flowers provide pollen and nectar. Pollen is protein and nectar is carbohydrate. A

serious concern is the lack of continuity of flowers from January to December (see Table 1). Bees need food all year round requiring a diversity of flowering plants in the landscape.

A lack of nesting sites is also of concern. Traditionally bees nested in hay meadows and old pastures, both in the soil and in grass tussocks. They are now mainly dependent on field margins for nesting. Only old dry pastures and hay meadows where the soil has not been disturbed for decades are likely to good for nesting as well as foraging habitat

Insecticides affect bees. Fungicides can have a negative effect on the immune system of bees which subsequently leads to bee decline

Table 1. Flowering plants used as a source of pollen and nectar by bee

	Trees / shrubs	Climbers	Wildflowers	
January	Willow		Primrose	Bluebell
	Hazel		Dandlion	Clover
	Blackthorn		Vetches	Thistles
	Holly	Dog rose	Field scabious	Yellow rattle
	Crab apple	Honeysuckle	Hawkbits	Knapweed
	Whitethorn	Blackberry	Heather	Willowherb
December	Gorse/furze/whins	Ivy		

Allow space for a diversity of flowers to grow and flower

The key message is that we need more flowers in the countryside at all times of the year - along roadsides, in towns and villages and on farms. The quest for neatness in recent years has often resulted in margins and rough grass areas and corners being sprayed or cut as lawns, leaving no flowering plants. While safety obviously takes precedence on public roads, space can be left for wildflowers to grow. In the Tidy Towns competition, The Let's Get Buzzing Local Authority Pollinator Award aims to encourage TidyTowns groups to take simple pollinator-friendly actions in their towns and villages. Similarly farmers should allow space for wildflowers in field margins, field corners and along farm roadways for wildflowers to flourish. Management of all habitats should take bees into consideration.

Field margins

Field margins are strips of rough grass around field boundaries of all types, whether hedgerows, stone walls, watercourses, banks or permanent wire fences. They provide valuable habitat for wildlife. They provide food, shelter, breeding and corridors of movement. A variety of natural vegetation provides flowers for bees, seeds for birds, cover for small mammals and nest sites for ground nesting birds. Never plough field

margins, which is important to remember when reseeding grassland. The intention is to build up diverse natural vegetation. Do not allow pesticides (including herbicides, insecticides, fungicides, slug pellets and growth regulators) in field margins. Spray drift from adjacent crop spraying destroys this habitat and creates conditions for the growth of annual weeds. Keep fertiliser out. Nutrients from manures or fertiliser encourage aggressive species such as cleavers, thistles and nettles to thrive at the expense of more sensitive plants. Fencing is recommended but should be cut or grazed after flowering

Best practice hedgerow management for bees

Routinely trimmed hedgerows should not be cut just to look neat. If birds and bees are to use hedgerows, best practice is to side trim to a triangular shape, leaving the peak as high as possible, sloping both sides from a wide base. This allows light to the base encouraging dense growth at ground level. Hedgerows with a dense base require trimming to maintain them and prevent them growing up into relict hedgerows of mature trees with distinct boles and full canopies. It is possible to cut the growing point at the top of the hedgerow without creating a flat top. There are more birds and bees in hedgerows containing occasional mature trees, including thorn trees. Best practice is to leave occasional new thorn saplings mature and flower at irregular intervals within hedgerows.

Relict hedgerows where individual shrubs have grown up and matured with a full canopy have lost their dense base and become gappy. However they still have a very high ecological value, providing large quantities of flowers, seed and fruit for wildlife. Best practice is to leave alone. Fencing off prevents further deterioration caused by stock tramping through gaps and should extend their lifespan.

Escaped hedgerows where individual shrubs have grown up but not yet deteriorated can be rejuvenated by laying or coppicing provided there are sufficient thorn stems (at least one per metre). Alternatively escaped hedgerows can be allowed grow into relict hedgerows

Nesting sites

Retain clay banks, bare soil areas and grass tussocks. Retain old pastures and hay meadows where soil has been undisturbed for decades. Install bee boxes or sand habitats for bees. Under GLAS over 4,000 farmers have erected over 19,000 bee boxes and almost 14,000 farmers have created over 25,000 sand habitats for solitary bees.

Spraying and honey bees

If spraying insecticides in crops, spray early morning or late evening when honey bees are less active. Notify local beekeepers who can keep the bees in the hive during spraying.

The All-Ireland pollinator plan

Irish pollinators are in decline. The problem is serious and requires immediate attention to ensure the sustainability of our food production, avoid additional economic impact on the agricultural sector, and protect the health of the environment. The All Ireland Pollinator Plan is a shared plan of action. This Plan was initiated by Úna FitzPatrick (National Biodiversity Data Centre) and Jane Stout (Trinity College Dublin), and then developed by a fifteen member All-Ireland steering group. The final Plan was produced by the steering group following a consultation phase, which included both public and stakeholder engagement. By working together we can collectively take steps to reverse pollinator losses and help restore populations to healthy levels.

Objectives of the plan

1. **Making Ireland pollinator friendly**
   By focusing on actions that can be taken on farmland, public land and private land, we want to achieve a joined-up network of diverse and flower-rich habitats to support pollinators across Ireland.
2. **Raising awareness of pollinators and how to protect them**
   By working together we want to achieve an increased awareness of the importance of pollinators and the resources they need to survive.
3. **Managed pollinators – supporting beekeepers and growers**
   By supporting beekeepers and growers we want to achieve healthy, sustainable populations of managed pollinators that can play a full role in delivering pollination services.
4. **Expanding our knowledge on pollinators and pollination service**
   By continually addressing gaps in our knowledge through research, we want to achieve an evidence base that directs us towards the best and most cost-effective ways to protect our pollinators into the future.
5. **Collecting evidence to track change and measure success**
   By building up our knowledge on where pollinators occur and how they are changing (including in response to management actions) we want to achieve a dynamic Plan that is targeted and effective.

For further information visit: **http://www.biodiversityireland.ie/projects/irish-pollinator-initiative/all-ireland-pollinator-plan/**

Campaign for Responsible Rodenticide Use (CRRU)

Catherine Keena[1], Mark Lynch[2], John Lusby[3]

[1] *Teagasc Countryside Management Specialist, CELUP and CRRU Ireland TaskForce*
[2] *Chair CRRU, Ireland, Glendine, 36 Ludford Drive, Dundrum, Dublin 16, Ireland*
[3] *BirdWatch Ireland, Unit 20, Block D, Bullford Business Campus, Kilcoole, Co. Wicklow and CRRU Ireland TaskForce*

Take Home Messages

- Control of rodent populations is essential in agriculture
- The use of rodenticides can result in the unintended exposure of non-target wildlife
- The **C**ampaign for **R**esponsible **R**odenticide **U**se in Ireland (CRRU Ireland) was established to ensure best practice use of rodenticides and prevent exposure to wildlife.
- Farmers in GLAS should comply with CRRU
- Compliance with CRRU is a suggested meeting topic under the Knowledge Transfer Programme

Background

Demands of consumers for high quality and safe food mean that there is a requirement for high standards in all stages of food production, including strict quality assurance requirements from buyers, such as supermarkets and food processing companies. Among these requirements is the need for the effective control of rodents, which pose significant economic and health related risks, as they can consume and contaminate food stuffs, damage property and transmit disease. Control of rodent populations is therefore essential in many agricultural and urban environments and is principally achieved through the use of anticoagulant rodenticides.

Although rodenticides can be effective in controlling Brown Rat and House Mouse populations for which they are the targeted, their mode of action is not species-specific and their use can also result in the unintended exposure of non-target wildlife. Contamination can occur when a non-target species consumes bait directly (primary exposure), or when a predator or scavenger consumes an animal which has been previously exposed (secondary exposure). Exposure in significant proportions of avian and mammalian predators has been documented throughout Europe and North America. Small mammal predators are considered to be at greatest risk of secondary poisoning, however there is increasing evidence of exposure in other non-target predators which do not routinely feed on rodents, indicating that the toxins may be entering the food chain through pathways other than rodents.

There is a requirement to ensure better stewardship and best practice use of rodenticides to reduce and prevent exposure to wildlife. The **C**ampaign for **R**esponsible **R**odenticide **U**se in Ireland (CRRU Ireland) was established to meet this requirement. Under the banner "Think Wildlife", CRRU Ireland promotes best practice and responsible rodent control, to reduce wildlife from rodenticide exposure. As rodenticide products are authorized following the EU approval of their active substances, compliance with the Best Practice Requirements will be required for the mitigation of the risks for human health and the environment associated with their use. Risk mitigation measures and practices required for the authorization of rodenticide products, will be specified on product labels. Accordingly, compliance with the Best Practice Requirements will be an essential requirement for the use of authorised rodenticide products.
To facilitate correct usage of rodenticides thereby minimising the exposure of wildlife, CRRU Ireland has prepared Best Practice Requirements for Rodent Control and Safe Use of Rodenticides, delivers 'Wildlife Aware' training and accreditation for professional pest controllers and works with government agencies, rodenticide industries and relevant stakeholders to improve standards of rodent control in Ireland.

CRRU code

1. Always have a planned approach

- Before treatment begins, a thorough survey of the infested site is an essential key to success when using any rodenticide.
- Environmental changes which could be made to reduce the attractiveness of the site to rodents should be noted for implementing after the treatment. Usually this will involve rodent proofing and removing rubbish and weeds that provide harbourages and cover. However, the site should not be cleared before treatment since this will disturb the rodent population and make bait acceptance more difficult to achieve.
- Obvious food, such as spilled grain, should be removed as far as possible and any food sources covered.
- Rodenticide baits should only be used for as long as is necessary to achieve satisfactory control.
- In most cases, any anticoagulant bait should have achieved control within 35 days. Should activity continue beyond this time, the likely cause should be determined and documented. If bait continues to be consumed without effect, a more potent anticoagulant should be considered. If bait take is poor, relative to the apparent size of the infestation, consideration should be given to re-siting the bait points and possibly changing to another bait base, as well as making other environment changes.

2. Always record quantity of bait used and where it is placed

- A simple site plan or location list identifying areas of particular concern pertinent to the site should be drawn up and retained on file.
- A record of all bait points and the amount of bait laid should be maintained during the treatment. Activity should be noted at each bait point, including any missing or disturbed baits, as the treatment progresses.
- By carefully recording the sites of all bait points responsible users of rodenticides are able to return to these sites at the end of the treatment and remove uneaten bait so that it does not become available to wildlife.

3. Always use enough baiting points

- Users should follow the label instructions regarding the size and frequency of bait points and the advice given regarding the frequency and number of visits to the site.
- By using enough bait points the rodent control treatment will be conducted most efficiently and in the shortest possible time. This will restrict the duration of exposure of non-target animals to a minimum.

4. Always collect and dispose of rodent bodies

- The bodies of dead rodents may carry residues of rodenticides and, if eaten by predators or scavengers, may be a source of wildlife exposure to rodenticides.
- It is essential to carry out regular searches for rodent bodies, both during and after the treatment period. Bodies may be found for several days after rats have eaten the bait and rats may die up to 100 metres or more away from the baited site.
- Any rodent bodies should be removed from the site and disposed of safely using the methods recommended on the label.

5. Never leave bait exposed to non-target animals and birds

- Care should be taken to ensure that bait is sufficiently protected to avoid accidentally poisoning other mammals and birds. Natural materials should be used where possible.
- Bait stations should be appropriate to the prevailing circumstances. They should provide access to the bait by rodents, while reducing the risks of non-target access and interference by unauthorised persons. They should protect the bait from contamination by dust or rain. Their design, construction and placement should be such that interference is minimised.

6. Never fail to inspect bait regularly

- Where the risk assessment or treatment records show that multiple visits are required, then those should be made as frequently as is considered necessary. Daily inspection may be required in some circumstances.
- At each visit, baits should be replenished according to the product label and a thorough search made to ensure that bodies and any spilled bait are removed and disposed of safely. Records of such visits should be maintained.

7. Never leave bait down at the end of the treatment

- Bait left out at the end of a treatment is a potential source of contamination of wildlife.
- On completion of the treatment, records should be updated to signify that the infestation is controlled and that, as far as reasonably practical, all steps have been taken to ensure that the site is now free of rodenticide bait.

For further information, visit **http://www.crru.ie**

FORESTRY

Forestry and farming – opportunities for sustainable diversification

Noel Kennedy

Teagasc, Forestry Development Department, Athenry, Co.Galway

Take Home Messages

- Forestry is a sustainable option for marginal and fragmented land.
- Establishment grants cover the cost of planting in most cases with 15 year annual premiums offering secure long term income.
- Eligible land planted with forestry retains Basic Payment.
- Forest design, scale and good management are key to maximising crop quality, timber value and environmental contribution.
- Forest owners should be actively involved from the start!
- Forestry is a permanent land use change subject to a replanting requirement.
- Teagasc provides a comprehensive independent advisory service.

Introduction

Over the past twenty five years 19,000 landowners, mainly farmers, have decided to convert some of their land to forestry as a more economic and productive option to complement their other farm enterprises. Forestry is a rapidly expanding competitive sector, from planting to harvesting and to timber processing. There is increasing recognition of the economic, social and environmental contribution from forestry including its crucial role in greenhouse gas mitigation.

Forestry can improve the returns from marginal land

Afforestation grants and premiums

The Afforestation Grant and Premium Scheme provides funding for the planting of new

forests. The Scheme is administered by the Forest Service, DAFM. Grants are available to plant a range of forest with differing objectives including:

- **Afforestation** - focus on timber production
- **Native Woodland Establishment** - focus on nature creation
- **Agro-Forestry** - combining trees with pasture
- **Forestry for Fibre** - growing trees for fuel

The most common grant and premium category (GPC) planted is :
GPC3 10% Diverse conifer.
This involves the planting of a main **Sitka spruce** crop and 10% other species.
The total available Afforestation grant for GPC 3 is **€3650 per hectare**.
The premium for GPC3 is €510 per hectare per annum for 15 years.
The Afforestation Grant covers the cost of planting and associated works plus maintaining the forest for 4 years. It is paid in two instalments – 75% after planting and the remaining 25% four years later subject to the trees being established satisfactorily.
Annual premiums are **paid for 15 years**. The highest rate of annual premium is €635 per hectare for the planting of Native Woodland Establishment. Annual premiums are exempt of income tax but are subject to payment of the Universal Social Charge (USC) and a PRSI contribution at 4% where the applicant is under 66 year old.

How do I apply for an afforestation grant?

All afforestation pre-planting grant applications must be submitted through a registered forester.
A list of registered Foresters is available from your local Teagasc Forestry Development Officer, the Teagasc Forestry website or from the Forest Service, Department of Agriculture, Food and the Marine, Johnstown Castle, Co.Wexford 1890 200509, 053 9163400.
As well as organizing the grant application the registered foresters can also organize the planting works when the application is approved. There is also the option for the applicant to do some or all of the work themselves.
Irrespective of which option is chosen , all the paperwork at pre- planting, post-planting and at the second instalment stage must be prepared by a Registered Forester working on your behalf.

Will my land qualify for an afforestation grant?

The land must be in agricultural usage and be capable of growing a commercial crop of timber. Certain types of land will not qualify for an Afforestation grant. This includes bog, land that floods, extensive marl, shallow soil, environmentally designated land, exposed mountain and coastal land. However, some environmentally designated land may be eligible for planting under Native Woodland Establishment.

Forestry and the Basic Payment Scheme (BPS)

Land with valid entitlements will be eligible for Basic Payment following planting if it meets the following eligibility rules:

- The land to be planted was declared and deemed eligible on a 2008 SPS application.
- The applicant who declared that land was paid under the 2008 SPS.
- Following planting at least 3 hectares or 10% of eligible land, whichever is the greater, remains available for farming.

Protecting and enhancing the environment

The protection of the environment is at the heart of the planting and management of forests. During planting operations and subsequent management a series of environmental guidelines must be observed to ensure compatibility with best environmental practice. These include:

- 15% of area left unplanted for biodiversity enhancement. Measures include:
- Unplanted setbacks from watercourses, houses and roads.
- Retention of all hedges and trees.
- Creation of new habitats.

The annual premium is paid on this biodiversity area.

Getting the most from your forest – be involved!

Forestry is an unfamiliar crop to many farmers. To get the most from your forest it is important that owners are involved from the start and begin to learn about how the forest grows and how best it should be managed.

Teagasc holds regular forest management events

Getting the most from your forest starts from the day it is planted. Successful early establishment should be followed by good management planning to prepare the forest for thinning and eventual clear-felling. This gives the best chance to maximise returns from timber sales and for the forest to contribute in many environmental and practical ways to farming activity.

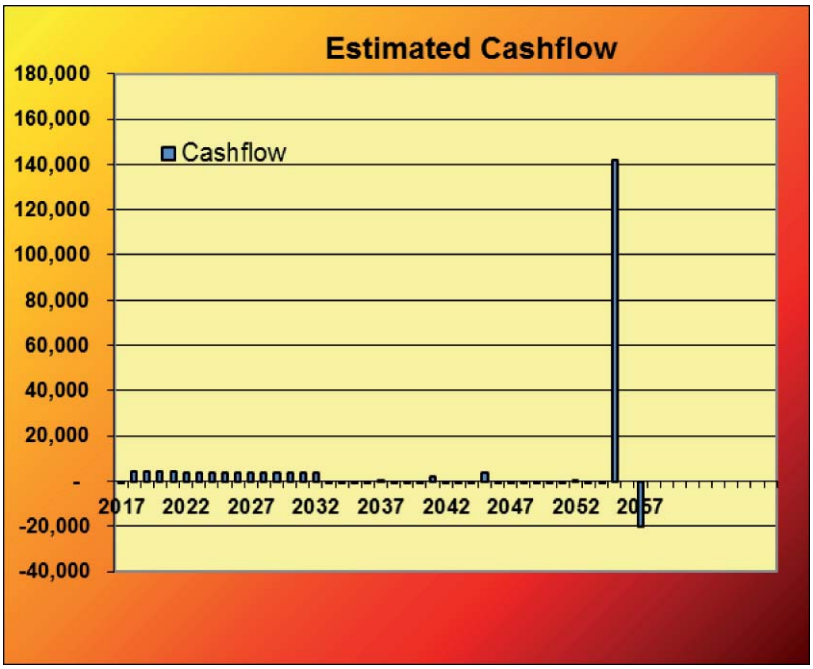


Figure 1. Example of FIVE graphic for Estimated Cash flows for 8 ha Sitka spruce

Projecting the potential value of your forest

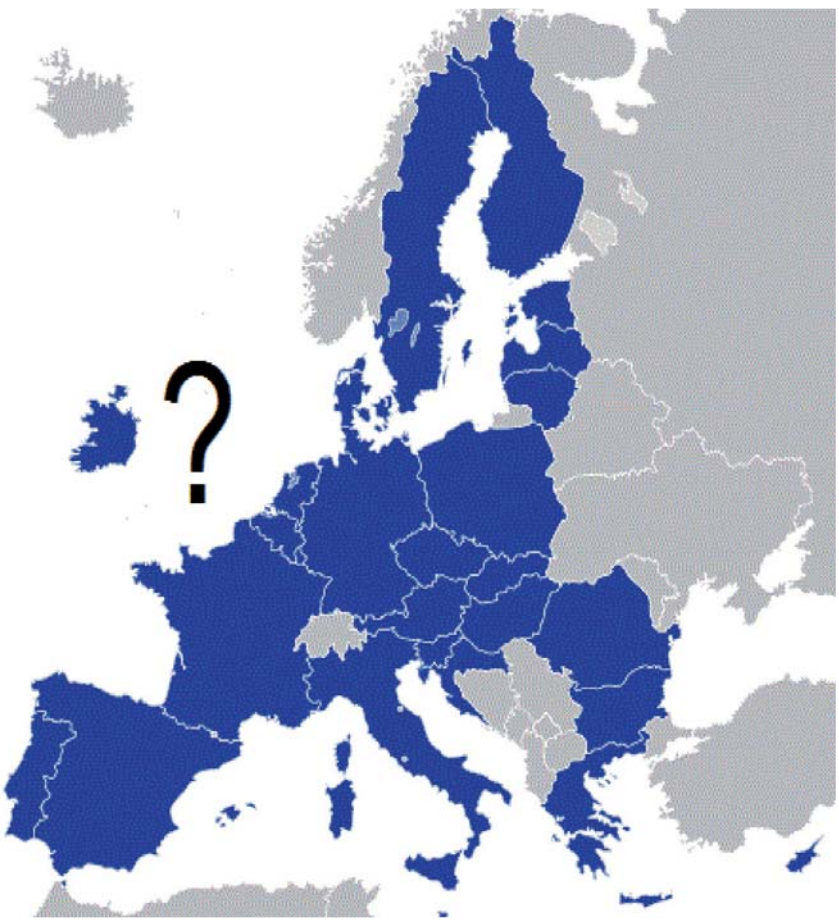
For farmers considering a forestry enterprise and for owners of older forests, it is important that they are in a position to quantify the potential value of a forest to assist with investment or management decisions. The Teagasc FIVE program is a decision-support tool to model indicative financial returns for new planting and management scenarios. For more information about FIVE contact your local Teagasc forestry adviser.

Teagasc can help you…

Teagasc's Forestry Development Department provides and independent advisory service to all landowners considering a forestry option and to existing forest owners. Teagasc forestry advisers are available to provide advice and information including one to one consultations and site visits.

A range of local and national public events - forest walks, demonstrations, clinics and networking events are organised throughout the year. Our website provides details on all of the above plus information on a host of other forestry topics. A range of helpful You Tube videos are also available.
Visit the Teagasc forestry website at: **www.teagasc.ie/forestry**

BREXIT



Brexit and the Irish sheep industry

Kevin Hanrahan[1], Trevor Donnellan[1] and Fiona Thorne[2].

[1]Teagasc, Agricultural Economics and Farm Surveys Department, Athenry and Ashtown
[2]Teagasc, Ashtown, Dublin 13.

Take Home Messages

- Brexit represents an enormous competitiveness challenge for the Irish agriculture and food industry
- There is the possibility that a hard Brexit, that sees UK exports excluded from EU27 markets, will lead to higher Irish sheep prices.
- The EU is a large net importer of sheep meat. The impact of Brexit on sheep markets will be affected by how sheep meat Tariff Rate Quota (TRQ) are managed post-Brexit.
- Average Irish sheep farm family farm income is very dependent on CAP subsidies. Brexit is likely to reduce the EU and CAP budgets and the direct payments Irish sheep farmers receive from the CAP.
- Because of Brexit is likely to lower CAP payments and negatively affect most agricultural output prices our preliminary static assessment is that family farm income on Irish sheep farms could be reduced by over 20%.

Introduction

In this paper we review the importance of the UK to Irish and EU sheep meat markets and look at what impact Brexit might be expected to have on the EU lamb supply and use balance. We then consider what tariffs might apply to bilateral trade in sheep meat in the event that the UK and EU trade relations revert to what are known as WTO rules. A key "known unknown" is how existing EU sheep meat Tariff Rate Quota (TRQ) will be allocated between the exiting UK and the remaining EU27. Results of recent static analysis of the impact of Brexit on average specialist sheep and other farm system incomes from the Teagasc NFS is presented

UK, Irish and EU Sheep meat supply and use

The UK is the largest producer and the largest exporter of sheep meat in the EU. In 2016 the UK accounted for 40% of EU28 sheep meat production. By comparison in that year Ireland accounted for 8% and France 12% of EU production. The UK is also a significant importer and exporter of lamb. The evolution of the UK supply and use balance for sheep meat is shown in Figure 1. An aspect of the UK sheep meat supply and use balance that distinguishes it is the role of non-EU imports. Imports from non-EU sources account for the vast majority of UK imports of sheep meat. Due to the large share of UK sheep meat production in total EU sheep meat production and

the role of the UK as both the largest exporter of sheep meat within the EU and the largest importer of sheep meat into the EU, Brexit will have a significant impact on EU sheep meat supply and use and prices.
Following Brexit, the sheep meat "deficit" in the EU27 markets will tighten as compared to a world where the UK remained part of the EU. The trade rules that will govern EU-UK trade are at this point unknown but there will be non-tariff barriers and possibly tariff barriers to trade between the UK and the EU. The nature of these tariff and non-tariff barriers will be determined in the soon to begin Brexit negotiations between the UK and the EU. Brexit is likely to drive a wedge between UK and EU27 prices, with EU27 prices likely to increase and UK prices likely to fall.

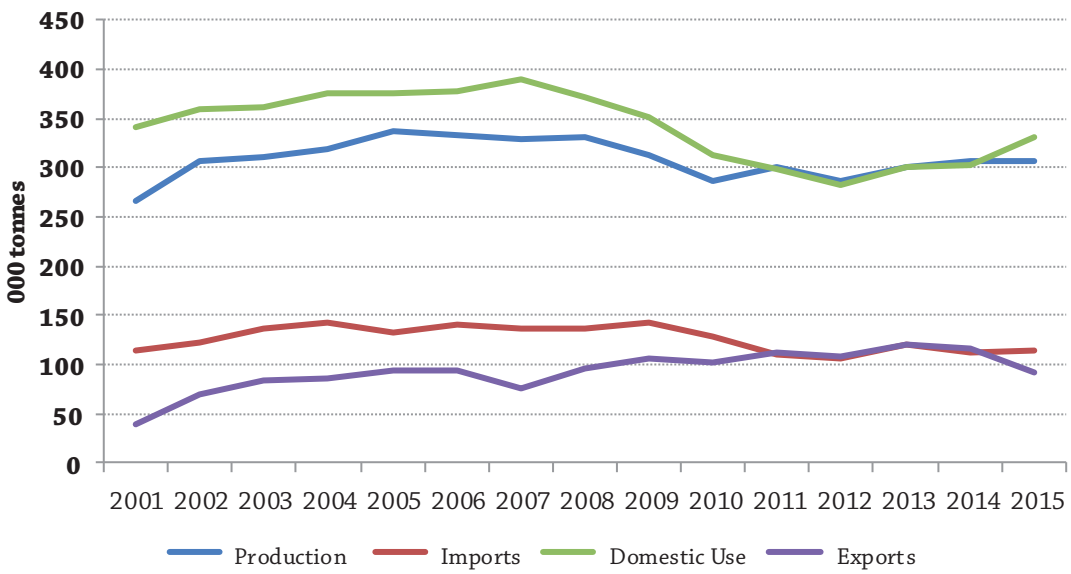


Figure 1. UK Sheep meat supply and use 2001-2015.

Whether or not EU imports of lamb from non-EU sources (New Zealand and Australia) fall following Brexit will depend on how the EU, the UK as well as countries such as New Zealand and Australia decide to allocate the existing EU28 sheep meat tariff rate quota (TRQ) between the UK and the remaining EU27. If the EU27 retains all of the EU TRQ the positive impact of the UK exit on EU sheep meat prices would be mitigated.

MFN tariffs on UK – EU sheep meat trade

In the event that the EU and the UK fail to reach a Free Trade Agreement the tariffs that will be applied to agricultural trade with the UK by the EU are detailed in the EU tariff schedule. Using data at the tariff line level on UK imports of sheep meat

we have calculated the ad valorem equivalents of the 15 tariffs that apply to trade in sheep meat. The ad valorem equivalents (AVE) of the EU tariffs on sheep meat are presented in Figure 2. For all of the sheep meat and lamb tariff lines the AVE of the EU mixed tariffs are in excess of 30%. The trade weighted average of the 15 tariff lines presented in Figure 2 is just under 50%. The highest rates of duty apply to fresh and frozen deboned sheep meat and lamb.

The impact of tariffs on trade is to increase the price of the imported good so as to reduce the demand for the imported good and provide protection to domestic producers. The punitive and prohibitive levels of the tariffs that apply under the EU WTO Most Favoured Nation tariff schedule are sometime surprising to those unfamiliar with EU agricultural trade rules. The very high levels of protection accorded to agri-food markets by the EU tariff schedule are a reflection of the "community preference" principle of the EU Common Agricultural Policy (CAP) that gives first preference to EU suppliers in the EU agri-food market.

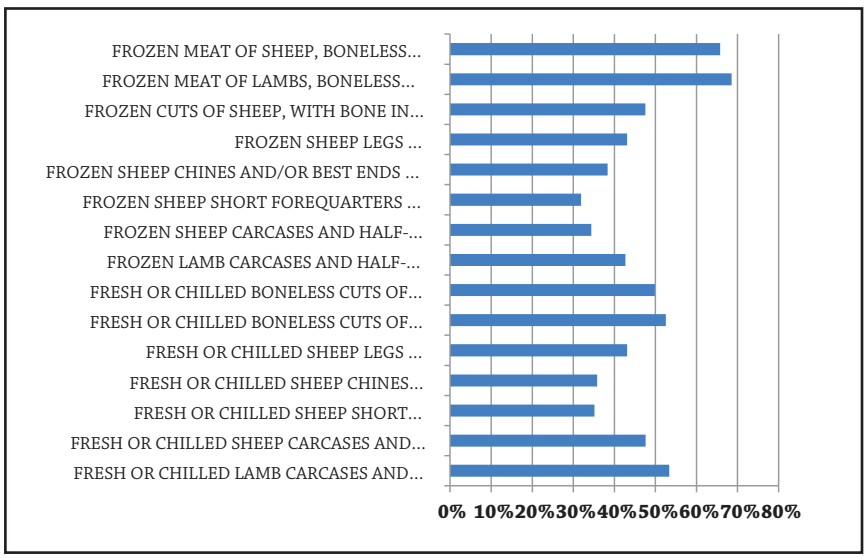


Figure 2. Ad Valorem Equivalent of the EU Tariff Schedule Bindings

The impact of tariffs on trade depends on what economist call the elasticity of import demand. This tells us what change in import demand will occur in response to a 1% change in price. At any plausible import demand elasticity a tariff (or tax) of 50% would render the much if not all of UK exports of lamb to EU markets uncompetitive. This would be likely to lead to reduced prices for lamb on the UK market and lead to higher prices on remaining EU27 market. How existing Tariff Rate Quotas for sheep meat, under which almost all imports of sheep meat into the EU from NZ and Australia currently enter, will be allocated between the UK and the EU27 will as noted above significantly affect the impact of Brexit on EU and UK sheep markets.

While Brexit is likely to imply that EU lamb prices could increase and provide a fill-up for Irish sheep farm incomes, gains from higher sheep prices may well be largely offset on many sheep farms by the negative impact of lower cattle prices that are likely to result from Brexit. Another channel through which Brexit will affect Irish sheep farmers (and EU farmers in general) is via the impact of Brexit on the EU budget and on the resources available to the CAP. The UK is the second largest net contributor to the EU budget and a smaller EU budget as a result of Brexit will likely lead to a smaller CAP budget and a reduction in income support levels for Irish farmers. The average Irish sheep farmer's income is still heavily dependent on direct income support payments from the CAP, reductions in the size of the CAP budget and Ireland's receipts from same would have a significant negative impact on incomes in Irish agriculture and on the incomes of Irish sheep farmers.

Static analysis of the impact of Brexit on average sheep farm incomes

Using data from the Teagasc NFS database, assumptions concerning reductions in the EU CAP budget resulting from Brexit and conservative assumptions concerning the market price impact of Brexit, Teagasc have conducted preliminary static analysis of how Irish farm incomes might be affected by Brexit. The impact of Brexit was found to be greatest for those sectors with:

a) A high share of exports destined for the UK market,

b) A high dependence of family farm income on CAP funded direct payments, and

c) Currently high levels of tariff protection.

While dependence on the UK market is relatively low for sheep meat, current levels of tariff protection are high as is the dependence of sheep farm incomes on direct payments.

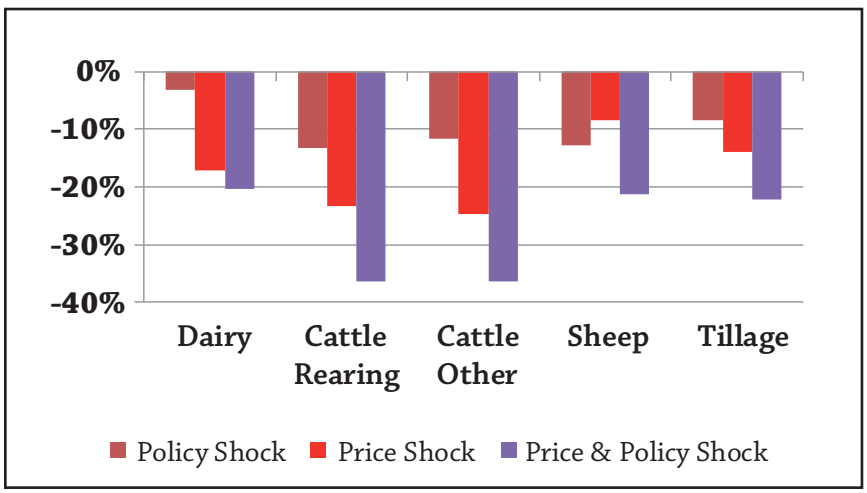


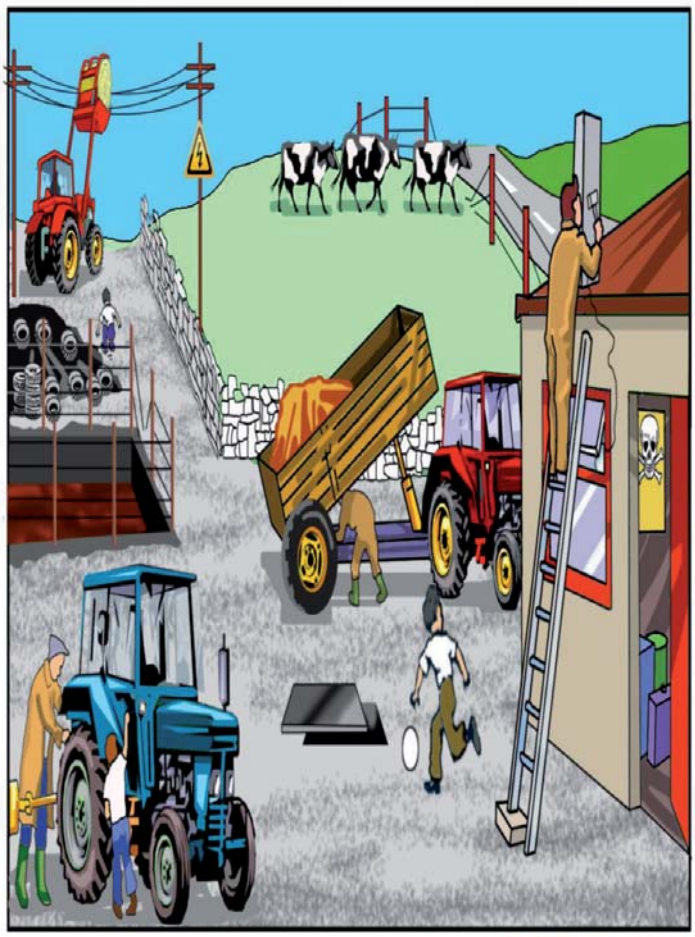
Figure 3. Static impact of Brexit on Irish Family Farm Income

In Figure 3 the results of a static analysis of the impact of Brexit on Irish farm incomes is illustrated. We break the negative impact into a market price impact and a budgetary or policy impact. For sheep farms the impact of the policy shock to farm incomes dominates the price shock impact. Readers should note that this analysis is static and farmers faced with such large negative shocks to their incomes would almost certainly reduce their level of production and this would have further dynamic consequences for farm incomes and upstream and downstream activity in the agri-food and wider Irish economy.

Conclusions

The sheep market seems to offer a glimmer of hope for a positive impact from Brexit. It is not unreasonable to assume that in the event of EU and UK trade relations reverting to WTO rules that UK exports of lamb to the EU could cease or be dramatically reduced. How EU trade with other non-EU countries such as NZ is managed post-Brexit could have an important bearing on the magnitude of the positive impact of Brexit on EU lamb prices. Will Irish sheep farmers be better off because of Brexit? This appears unlikely due to the importance of cattle output on many sheep farms and because of the dependence of Irish sheep farms on CAP direct payments. With Brexit likely to result in lower direct income support payments and lower cattle prices, the higher sheep prices that may result from Brexit are unlikely to lead to increases in average sheep farmer incomes.

HEALTH AND SAFETY



Best practice for health and safety on sheep farms

John McNamara[1], Serena Gibbons[2], Francis Bligh[3]

[1] *Teagasc, Health and Safety Specialist, Kildaton, Co. Kilkenny*
[2] *Teagasc, Galway/Clare Advisory Region, Athenry, Co. Galway*
[3] *Teagasc, Roscommon/Longford Advisory Region, Roscommon, Co. Roscommon*

Take Home Messages

- Level of deaths on Irish farms have risen during the first 5 months of 2017. Examine the way you farm to reduce the risk of accidents and ill health to the lowest possible level.
- Complete or update a Risk Assessment for your farm. This will assist you assess your farm for hazards. Most importantly take action to take action to make your farm safer on an on-going basis.
- Consider if you can apply for grant aid through the Targeted Agricultural Modernisation Scheme (TAMS11) to improve both health and safety and efficiency of your farm.
- Look after your health by undertaking a regular health check and by engaging in health promoting activities.
- Be aware of the revised standards for agricultural vehicle and trailer use on public roads.
- Give the farm safety of both children and older farmers top priority due to the high accident risk with these groups.

Introduction

Farming is one of the most dangerous work sectors in Ireland. Typically about a third of all workplace deaths occur in the agriculture sector. On average about 19 fatal farm accidents occur on Irish farms each year. This year, to the 31st May, 12 farm deaths have occurred, with 8 of these involving tractors and machinery. Childhood deaths are particularly tragic and in recent years there has been a significant increase in the occurrence of these fatalities. Farm accidents causing serious injury occur at the high level of 2,500 per year. These can lead to permanent disability and interfere with a person's capacity to farm effectively.

Farmers, as an occupational group, have been identified with having high levels of preventable ill health. Ill health effects quality of life and a person's capacity to farm effectively. More awareness of health promotion practices are needed among the farming community.

Teagasc and the Health and Safety Authority operate a Prevention Initiative to assist farmers to effectively manage farm safety and health. This initiative is run in association with the farming organisations represented on the Farm Safety Partnership.

Legal duty to complete a risk assessment

All workplaces, including farms have a legal duty under Safety, Health and Welfare at Work (SHWW) legislation to conduct a Risk Assessment to ensure that work is carried out safely. A comprehensive Risk Assessment Document has been prepared for use by farmers and includes a comprehensive list of possible farm hazards to be considered. The requirement to conduct a Risk Assessment replaced the requirement to prepare a Safety Statement for farms with 3 or less employees, which are estimated to make up about 95% of farms nationally. Risk Assessment documents will be available the Sheep Open Day along with guidance on its completion.

Targeted Agricultural Modernisation Scheme (TAMS11).

Grant aid of €675 million is available through the various TAMS Schemes up to 2020. Full details of each scheme are available on the DAFM web site at **http://www.agriculture.gov.ie/farmerschemespayments/tams/**. The principal areas where funding is available include: slurry aeration, access manholes; electrical installations and lighting; livestock handling facilities, safety rails and sliding doors. It is mandatory that all applicants will have completed, within the last five years prior to the submission of their claim for payment, the half-day Farm Safety Code of Practice course (given by Teagasc or other trained persons) or the FETAC Level 6 Advanced Certificate in Agriculture (Green Cert.). Your claim for payment will not be processed until evidence of completion of the course is provided. It is recommended that you discuss your application with your Advisor, to optimise the benefit for your farm.

Preventing machinery accidents

Vehicle and Machinery related deaths account for 48% of all farm deaths. With vehicles, being crushed or trapped (56%) is the most frequent cause of death followed by being struck (13%), overturning (9%) or falling from the vehicle (7%). With machinery, being crushed (42%) or struck (34%) are the most frequent causes of death followed by PTO (10%) and machine entanglement (7%) and falls from machines (7%). The data shows that most fatal accidents occur due to being crushed or struck, so safety vigilance is especially needed when in proximity to moving vehicles/ machines. Entanglement deaths and serious injuries are particularly gruesome and occur most frequently with machines used in a stationary position, such as a vacuum tanker or slurry agitator where contact can occur between the person and the PTO.

Quads (ATV's) are valuable machines on farms for travel and certain task on farms but they have a high risk of death and serious injury if miss-used. At the Sheep Open Day a demonstration of practical Quad use will be held.

Revised standards for agricultural vehicles

The new revised standards for Agricultural Vehicles which includes trailers and attached machines became law on 1st January 2016. The revised standards are based on recent legislation which updated previous law first introduced in 1963. The purpose of the standards is to enhance the safety of road users. A booklet on the revised standards will be available at the Sheep Open Day or can be downloaded from the RSA website at **http://www.rsa.ie/en/RSA/Your-Vehicle/Vehicle-Standards/Agricultural-Vehicles/**

Preventing deaths with slurry

Farm deaths associated with slurry and water account for 10% of farm deaths with the majority of these being drowning. Particular care is needed when slurry access points are open and physical guarding needs to be put in place. Slurry gases are a lethal hazard on cattle farms. Hydrogen sulphide is released when slurry is agitated and in calm weather can be present at lethal levels. The key controls are to pick a windy day for agitating, evacuate all persons and stock from housing and open all doors and outlets. A range of other gases including methane, ammonia and carbon dioxide are produced when slurry due to fermentation in semi-emptied tanks. Never enter a slurry tank as lack of oxygen or the presence of poison gasses could be fatal. Also, never have an ignition source near a slurry tank due to the methane explosion risk.

Safety of children on farms

Safety of children and Young persons must be paramount on farms. The following precaution need to be considered when children are present on a farm:
Provide a safe and secure play area for children away from all work activities and in full view of the dwelling house;

- Where children are not in a secure play area a high level of adult supervision is needed.
- Children should not be allowed to access heights.
- Action should be taken to keep children away from dangerous areas such as slurry tanks;
- All open water tanks, wells and slurry tanks should be fenced off;
- Give children clear instruction on farm safety issues and children to be carried in the tractor cab (aged 7 or older) need to wear a seat belt.

Farmers health

A major Irish study has indicated that farmers have a 5.1 higher 'all cause' death rate than the occupational group with the lowest rate. The major causes where death rates are excessive include cardiovascular disease (CVD), cancers and injuries. A further

Irish study indicated that 59% of farmers had a G.P. health check in the last year compared to 74% for the general population. Among farmers, despite 60% being classified as overweight or obese, just 27% believed that they were too heavy. Low back pain (LBP) was the most prevalent physical complaint occurring with 28% of farmers. As LBP-associated disability can lead to on-going pain and reduced capacity to be physically active it has been shown to be associated with other health conditions like cardiovascular (CVD). Farmers should reduce risk factors for LBP including body weight, devising farm systems which minimise manual handling (MH) and using the correct techniques for MH. Irish Heart Foundation nurses will be on hand at the Sheep Open Day 2017 to conduct blood pressure checks and provide health related advice to farmers. Physiotherapists will be available to discuss strategies to manage LBP.

Preventing the transmission of infection from sheep to human

A booklet entitled 'Staying Healthy on your Farm' which deals with infections called zoonosis contracted from animals is available from the Health Services Executive at: **http://www.hse.ie/eng/services/Publications/topics/Safety/Staying_Healthy_on_your_Farm.html**

A short description of a number of infection associated with sheep is now provided:

Orf is caused by a virus transmissible to humans by contact with infected sheep and is a common infection among sheep farmers. Infection causes skin lesions on hands, arms or face. The lesions may persist for weeks and can be itchy and painful particularly when combined secondary bacterial infection. Farmers contract the disease by direct contact with infected animals or contact with contaminated objects such as fences or feeding troughs. Prevention is by:

- Ensuring general cleanliness of animal housing areas;
- Consult your veterinary surgeon on how to control the disease in your flock;
- Consider using a live vaccine for flocks with an orf problem.
- Wash any known exposed area with soap and water.
- Wear gloves when vaccinating and when working with sheep

Toxoplasmosis is caused by a small parasite which also causes infection in humans. There may be no symptoms or mild symptoms such as aches and pains, a slightly raised temperature and/or 'swollen glands'. Pregnant women are a high risk group. Infection in the unborn child is the result of an acute infection acquired by the mother in pregnancy and passed on to the baby in the womb. The result of this infection can be a miscarriage, or brain or/and eye damage in the newborn child. It is in the cat gut that the male and female parasites combine to produce one of the infective forms. If a suitable host such as a human swallows these then infection may follow. Sheep that are aborting, or lambing may also present as a hazard. Prevention is by:

- Vaccinate sheep used for breeding.
- Ensure hand-washing facilities are available and are kept clean;
- Dispose of cat faeces and litter daily, remembering to wash hands afterwards;
- Control stray cats and prevent them from gaining access to sandboxes and sandpits used by children for play. Sandboxes should be covered when not in use;
- Ensure that pregnant women are aware of the risks and avoid working with sheep.

Enzootic abortion is caused by a bacterial infection that is widespread in animals and can be transmitted to humans. The disease usually arrives on farm for the first time when infected replacements sheep are bought-in or wildlife spread. Infection spreads from ewe to ewe through infected afterbirths, on new lambs and in vaginal discharges for up to two weeks post lambing. This can lead to significant contamination of the bedding. Lambs can also be born already infected from mothers carrying the disease. This infection is a risk to pregnant women assisting at lambing due to the risk of causing miscarriage.
Precautions include:

- Vaccinate sheep used for breeding
- Ensure that pregnant women are kept away from lambing area

Toxocariasis is a chronic infection causing mild disease. It is caused by roundworms (nematodes) of dogs and cats that can be passed on to people. Symptoms in humans include inflammation of lung tissue, chronic abdominal pain and skin rash. Larvae may also enter the eye and cause blindness.
Precautions include:

- Deworm dogs and cats regularly and remove dog and cat faeces
- Ensure hand-washing facilities are available are kept clean and used

Further Information
The key to improving farm health and safety is the genuine interest of farmers.

New and current information can be downloaded at the following web sites:
Teagasc: **http://www.teagasc.ie/health_safety/**
H.S.A.: **http://www.hsa.ie/**

Notes

Notes

Notes

Notes

Notes

Notes

Notes

Printed by Naas Printing Ltd.

Teagasc

Agriculture and Food Development Authority

This is a DAFM approved Knowledge Transfer Sheep Event

Ireland's EU Structural and Investment Funds Programmes 2014 - 2020
Co-funded by the Irish Government and the European Union

"The European Agricultural Fund for Rural Development: Europe investing in rural areas".

Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara