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Reviewing the latest innovations in sheep breeding & management from AgriSearch co-funded research

AgriSearch NI
Farmer Funded Research

Introduction to this publication

Operating in a fast changing and competitive environment, the Northern Ireland sheep industry has faced many challenges in the past 25 years - changing European farming policies, uncertain market conditions, rising input costs and major disease outbreaks. However the industry has survived these challenges and in 2010 contributed around £56m to the NI agricultural economy. Undoubtedly there will be many more challenges to face but, regardless of what lies ahead, improving flock performance while keeping production costs low will be key to the future sustainability of our industry.

Since 1997, AgriSearch has been working closely with the sheep research team at the Agri-Food and Biosciences Institute (AFBI) Hillsborough, to help drive innovation in the industry and tackle the issues facing sheep producers in Northern Ireland. Research jointly funded by the Department of Agriculture and Rural Development (DARD) and AgriSearch have helped develop a strong on-farm research programme, carried out on sheep farms across NI, which is linked to more detailed research programmes undertaken at Hillsborough. This work has led to the development of breeding and management options to increase lamb output per ewe, whilst also tackling issues such as the high labour requirements of sheep systems and the growing problem of anthelmintic resistance. The on-farm element of this research enables selected breeding and management options to be tested under a range of local conditions.

This booklet aims to bring you up-to-date with the most recent research developments in sheep breeding, nutrition and health, and to provide practical help on implementing these new innovations on your farm. I hope that your sheep enterprise will benefit from this work and that together we can move the NI sheep industry forward in the 21st century.

Yours faithfully,

IAN BUCHANAN
Chairman, AgriSearch Sheep Committee

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Section 1: Breeding better sheep

Chapter 1: Crossbreeding on the hills for better lambs

Summary

- Crossbreeding Blackface ewes offers a real opportunity to improve growth rate and carcass conformation in hill lambs.
- Crossbred lambs were worth up to £6.31 more than Blackface lambs at slaughter.
- Sire breeds to consider for producing crossbred hill lambs include
    - Texel: high growth rates pre- and post-weaning. Superior carcass weight and conformation. High level of lambing difficulties is a concern
    - Lleyn: high growth rates pre-weaning. Increased killing out percentage and reasonable carcass conformation. Moderate lambing difficulties and low mortality
    - North Country Cheviot: high growth rates pre- and post-weaning. Small improvement in carcass conformation. High level of lambing difficulties is a concern.
    - Swaledale: small improvement in carcass weight. Growth rate of finishing lambs and carcass conformation are inferior to pure Blackface lambs.

Introduction

The hill sheep sector in Northern Ireland is dominated by hill breeds such as the Scottish Blackface and Wicklow Cheviot. While some of these ewes are crossed with Blue-face or Border Leicester and Suffolk rams to produce replacement stock for the lowland sector, the majority of hill ewes are bred pure. However these purebred lambs have a lower growth potential and poorer carcass conformation, often falling outside prime lamb specifications. Crossbreeding provides an opportunity to introduce desirable traits from a second breed for improved growth or muscling, and exploits hybrid vigour which can benefit health and fitness of the flock. This chapter examines the options for crossbreeding in hill flocks and the implications for ewe and lamb performance.

Ram selection

Breeding goals must be established before selecting a suitable ram for crossbreeding; for example, higher growth rates, better carcass conformation, heavier carcass weights, improved lambing ease, or resistance to parasites and disease. It can be difficult to select a ram that will tackle several of these goals at once so it can be important to use the relevant selection index. Research carried out by AFBI on 6 hill farms around Northern Ireland has investigated five ram breeds as potential crossing sires for a typical Blackface flock – Scottish Blackface, Swaledale, North Country Cheviot, Lleyn and Texel. The breeding goals which led to this choice of crossing sires are listed in Table 1.1.

Table 1.1 Examples of crossing sire breeds to address specific breeding objectives on hill flocks

Sire breed	*Breeding goals*
Scottish Blackface	purebred lambs for comparison
Swaledale	hardiness
North Country Cheviot	growth rate
Lleyn	growth rate, ease of lambing
Texel	growth rate, carcass conformation, muscling

There is very significant genetic variation within any sheep breed. Before deciding which ram to select for crossbreeding, it is important to know the ram's genetic merit for the most desirable traits. Several sheep breeds are now linked to the Signet Sheep Breeding Programme, which produces a list of Estimated Breeding Values (EBVs) for a range of growth and carcass traits. Research carried out using Suffolk and Texel rams at AFBI Hillsborough has demonstrated that using performance recorded rams with a high lean growth potential can increase growth rate by more than 5% and carcass weight by up to 0.5kg compared with using non-recorded rams. Details of performance recorded flocks in Northern Ireland can be obtained by contacting AI Services (Northern Ireland) Ltd.

Crossbreeding for better lamb performance

Improving lamb growth rate on hill flocks is crucial to reduce the time spent on-farm, to ensure efficient conversion of feed into meat, and therefore to reduce the carbon footprint from hill sheep systems. Crossing Blackface ewes is one option that can be used to increase growth rate in their lambs, as shown in Table 1.2.

Table 1.2 Effects of crossing sire breed on lamb performance up to weaning

	Crossing sire breed				
	Blackface	*Swaledale*	*Cheviot*	*Lleyn*	*Texel*
Weaning weight (kg)	29.7	29.7	31.6	31.3	31.8
Live weight gain (g/d)	191	191	203	201	203
Mortality rate (%)	15	13	15	9	13

At weaning, crossbred lambs were on average 1.4kg heavier than the purebred lambs, with Texel-cross lambs achieving the greatest increase in weaning weight (+2.1kg), followed closely by the Cheviot (+1.9kg) and Lleyn-crosses (+1.6kg).

Crossbred lambs were up to **2.1kg heavier** than Blackface lambs at weaning

What drives lambing ease in hill flocks?

Lambing ease is one of the main factors influencing workload around lambing time. Understanding the main risk factors that can lead to additional lambing problems is therefore key to tackling this issue. Four main risk factors have been identified by AFBI: 1) choice of sire breed, 2) lamb birth weight, 3) litter size, and 4) age of the ewe.

Compatibility of the ewe and ram is the main issue to consider in relation to ram effects on lambing ease. The research undertaken by AFBI clearly demonstrates that crossing small Blackface ewes with heavy mature weight ram breeds, such as Texel and Cheviot, leads to heavier birth weights (up to 0.4kg) and consequently a higher incidence of oversized or incorrectly presented lambs (see Table 1.3).

Table 1.3 Lambing difficulties in Blackface ewes crossed with a range of sire breeds

	Crossing sire breed				
	Blackface	*Swaledale*	*Cheviot*	*Lleyn*	*Texel*
Birth weight (kg)	3.7	3.7	4.0	3.9	4.1
% ewes assisted of which:	6	9	14	11	17
Incorrect presentation	3	5	6	6	7
Oversized	3	4	8	5	10

While this may sound small, the net result was a 2- to 3-fold increase in the number of ewes requiring assistance at lambing. Using crossing sires with a mature weight which is more comparable to the Blackface, such as Swaledale and Lleyn, has much less of an impact on lamb birth weight and subsequent lambing ease. Regardless of the ram breed effects on lambing ease, nutritional management of ewes during pregnancy is the other key factor influencing lamb birth weight (see Section 2 *Feeding for performance* for more details on rationing ewes during pregnancy).

Crossbreeding to improve carcass quality

As a hill type breed, Blackface lambs are early maturing, which means they reach finished condition at lower carcass weights (17-18kg) than, for example, Suffolk- and Texel-cross lambs (19-21kg). Driving Blackface lambs to heavier carcass weights is therefore difficult because their growth rate and feed conversion efficiency decline rapidly at heavier weights and there is a greater risk that carcasses will become over fat. Carcass conformation of hill type lambs is also poor, with typically more than 50% Blackface lambs failing to reach the target R grade specification when slaughtered at these light carcass weights. Crossbreeding however provides an opportunity to address each of these issues by introducing desirable traits from other sheep breeds.

The benefits of crossbreeding for lamb performance and carcass quality depend on the breed of ram, as shown in Table 1.4.

Texel X Blackface lambs produced heavier carcasses at a younger age, with improved conformation. On average, they were each **worth £6.31 more** than purebred lambs.

As discussed previously, using heavy mature weight sire breeds such as Cheviot and Texel leads to the greatest improvement in lamb growth rates, enabling lambs to be slaughtered up to 13 days earlier than purebred lambs. Where the objective is to improve carcass conformation and marketability of hill lambs, crossing ewes with a terminal sire breed is most effective, with 83% Texel-cross lambs achieving the target EUR conformation grades compared with just 40% of purebred Blackface lambs. Using maternal breeds crossing sires, such as Lleyn, will also lead to faster growing lambs with better carcass conformation, though to a lesser extent than terminal sire breed rams.

When their heavier carcass weights and superior conformation is taken into account, crossbred lambs were worth up to £6.31 more than purebred Blackface lambs.

Table 1.4 Performance of purebred Blackface and crossbred lambs finished on a range of concentrate-based diets (slaughtered at fat class 3)

	Crossing sire breed				
	Blackface	*Swaledale*	*Cheviot*	*Lleyn*	*Texel*
Initial live weight (kg)	33	32	33	34	33
Live weight gain (g/d)	181	163	223	187	216
Feed conversion ratio[1]	10.3	12.2	9.8	8.3	8.6
Days to finish	87	93	74	79	76
Carcass weight (kg)	19.4	19.7	20.2	20.5	21.1
Kill-out %	42.7	43.5	43.1	44.9	44.9
% EUR grades	40	23	49	62	83
Carcass value (£)[2]	**56.86**	**56.01**	**58.98**	**60.41**	**63.17**

[1] Kg of concentrates needed to produce 1kg of lamb carcass
[2] Base price (R3) £3.00/kg carcass weight

Chapter 2: Crossbreeding on the hills for more productive ewes

Summary
- Crossbreeding is capable of increasing returns by more than £1,500 per 100 ewes.
- Crossbreeding increased lamb output at weaning by up to 18%, with the largest improvement obtained using Lleyn X Blackface and Swaledale X Blackface ewes due to their higher fertility.
- Additional lambing problems were encountered with Texel X Blackface ewes only.
- Lambs from crossbred ewes had higher weight gains up to weaning (with the exception of Swaledale X Blackface)
- Carcasses of lambs from crossbred ewes were up to 1.2kg heavier than those form Blackface ewes but there was only a small improvement in carcass conformation (with the exception of Swaledale X Blackface)
- Mature weight of the crossbred ewes was up to 7kg heavier than Blackface
- Lleyn X Blackface and Swaledale X Blackface ewes were the most efficient ewe types, in terms of lamb output per kilogram of body weight.

Introduction

Lamb output from hill flocks is often constrained by poor fertility (up to 20% ewes barren), small litter sizes (1.2-1.5 lambs born per ewe) and poor growth rates in lambs (<200 g/d birth to weaning). Inadequate supplies of high quality pasture around mating and after lambing are often blamed for these poor levels of performance; however the influence of ewe genotype is often overlooked. The hill sheep sector in Northern Ireland is dominated by purehill breeds. While a small proportion of these ewes are crossed to produce replacement females for the lowland sector, few crossbred ewes are retained on the hill so there is limited scope to introduce new traits for improved fertility and lamb output. This chapter examines the options for producing crossbred hill ewes and the implications for ewe and lamb performance based on AFBI trials carried out on six hill farms around Northern Ireland.

Ram selection

As discussed in Chapter 1, before commencing a crossbreeding programme it is necessary to establish target breeding goals and to rank these in order of importance. In addition to the lamb traits considered previously, there are a range of maternal traits that should be considered when selecting rams to produce replacement females; for example, prolificacy, milk production, mothering ability, ease of lambing, temperament, longevity and health. Many of these traits are readily identifiable with certain sheep breeds. The research at AFBI, carried out on 6 hill farms around Northern Ireland, investigated four breed crosses alongside purebred Scottish Blackface ewes – Swaledale X Blackface, North Country Cheviot X Blackface, Lleyn X Blackface and Texel X Blackface.

Within all sheep breeds there is huge genetic variation so it is important to consider a ram's genetic merit for these key traits before deciding which one to select for crossbreeding. Using sires with performance records is therefore essential. Details of performance recorded flocks in Northern Ireland can be obtained by contacting AI Services (Northern Ireland) Ltd.

Lleyn X Blackface ewes successfully reared **18% more lambs** than the Blackface

Fertility and lamb output of crossbred hill ewes

Fertility is a key driver of lamb output and one of the main constraints on lamb output from hill flocks. However crossbreeding offers a real opportunity to address this issue. Table 2.1 compares the fertility and lamb output of the crossbred ewes investigated in the AFBI trials, averaged over their lifetime (2-6 years old).

Table 2.1 Effects of ewe breed on fertility and weaned lamb output (averaged over 5 lamb crops)

	Ewe breed				
	Blackface (BF)	*Swaledale X BF*	*Cheviot X BF*	*Lleyn X BF*	*Texel X BF*
% barren ewes	8.4	6.4	6.2	5.8	7.7
Lamb born per ewe lambed	1.58	1.68	1.60	1.73	1.63
Lambs born per ewe mated	1.40	1.57	1.46	1.59	1.49
Lamb weaned per ewe lambed	1.31	1.40	1.38	1.47	1.42
Lambs weaned per ewe mated	1.17	1.31	1.26	1.35	1.29

Conception rates were very high in this trial with fewer than 10% all ewes barren so it is not surprising that crossbreeding offered no improvements in this aspect of ewe fertility. However, in all cases, litter size of crossbred ewes was similar to or higher than pure Blackface, especially in the Lleyn X Blackface (+9%) and Swaledale X Blackface (+6%) ewes. These differences were still evident at weaning with Lleyn X Blackface successfully rearing 18 more lambs, and Swaledale X Blackface ewes rearing 14 more lambs, for every 100 ewes that went to the ram.

Ease of lambing

The lambing period is the busiest time of the year on sheep flocks, accounting for around 20% of total labour inputs. Reducing the workload around lambing time should therefore be a priority for all flock owners. The amount of assistance given to ewes at lambing is a key factor affecting labour demands on sheep flocks, not just in terms of the time spent assisting ewes but also with lamb aftercare. Research at Hillsborough has shown that lambs requiring a moderate to high level of lambing assistance are 3 times more likely to die within the first 24 hours after birth, and 1.5 times more likely to die between birth and 7 weeks old, compared with lambs that are given little or no assistance.

Lambing ease of the crossbred ewes is outlined in Table 2.2.

Table 2.2 Lambing interventions required by Blackface ewes and their crosses

	Ewe breed				
	Blackface (BF)	*Swaledale X BF*	*Cheviot X BF*	*Lleyn X BF*	*Texel X BF*
No assistance (%)	76	80	73	74	62
Voluntary assistance (%)	18	15	20	20	27
Moderate assistance (%)	4	3	5	4	7
Major assistance (%)	2	2	2	2	4

Overall, the level of intervention required at lambing was high with 27% ewes needing assistance. These high levels are typical when hill ewes are crossed with terminal sire breed rams, like the Texel and Dorset rams used here. Crossbreeding had little effect on lambing ease in hill ewes, with the notable exception of the Texel X Blackface ewes which required much higher levels of assistance than the other ewe breeds (38% ewes assisted). An added concern with the Texel X Blackface ewes was that a higher proportion of these ewes required either a moderate or major amount of assistance. While there was no evidence of increased mortality due to their added lambing problems, the need to maintain high levels of supervision at lambing is a key constraint on the use of Texel X Blackface ewes, especially within extensive outdoor lambing hill flocks.

Lamb performance pre-weaning

Lamb birth weight is important for both lamb viability and ease of lambing. AFBI research within hill sheep flocks has shown that the risk of lamb mortality increases significantly when birth weight falls below 3kg, while the risk of lambing problems are much greater at birth weights above 5kg. A target birth weight of 3.5 to 4.5kg is therefore desirable. Birth weight is influenced by a number of factors, in particular, the breed of lamb, litter size and nutrient intake of the ewe during pregnancy. The breed of ewe is also important, as shown in Table 2.3.

Lambs born to heavy mature weight Cheviot X Blackface and Texel X Blackface ewes were on average 0.2-0.3kg heavier at birth than the other ewe breeds, although they remained well within the target weight range of 3.5-4.5kg. Lamb mortality was also similar for each of the ewe breeds.

Table 2.3 Effects of hill ewe breed on lamb performance up to weaning

	Ewe breed				
	Blackface (BF)	*Swaledale X BF*	*Cheviot X BF*	*Lleyn X BF*	*Texel X BF*
Birth weight (kg)	4.0	4.1	4.3	4.1	4.3
Weaning weight (kg)	30.8	31.3	32.5	32.1	32.3
Live weight gain (g/d)	209	212	218	217	216
Mortality rate (%)	17	16	13	14	12

Targeting higher daily weight gains in hill lambs is essential to reduce age at slaughter, whether lambs are finished on-farm or sold as stores. Keeping crossbred ewes on the hill can help to achieve this goal provided suitable breeds are selected. Table 2.3 compares the performance of lambs from several crossbred ewe types. Keeping Cheviot X Blackface, Texel X Blackface and Lleyn X Blackface ewes increased weaning weights of lambs by 1.3-1.7kg compared with those reared on Blackface ewes, due mainly to their higher growth rates. However there was no advantage from using Swaledale X Blackface ewes.

Mature body size and output efficiency

Mature body size has an impact on the nutrient requirements of ewes. As mature weight increases, a greater amount of feed is required just to maintain the ewe, which on a hill farm can limit its stock-carrying capacity especially on the more marginal hill areas. The mature weights of crossbred ewes sired by heavy mature weight sire breeds, such as Cheviot and Texel, were up to 7kg heavier than the pure Blackface ewes, as shown in Table 2.4, which equates to a 10% increase in daily energy requirements just to maintain the ewe.

Table 2.4 Mature weight of ewes and its impact on production efficiency

	Ewe breed				
	Blackface (BF)	*Swaledale X BF*	*Cheviot X BF*	*Lleyn X BF*	*Texel X BF*
Mature body weight (kg)	53	55	60	56	59
Lamb output (kg/ewe)	38.9	42.6	43.7	45.6	44.3
Kg lamb weaned per unit of body weight	0.75	0.79	0.74	0.83	0.76

The impact on mature weight was much less when sire breeds of moderate mature weight were used, such as Lleyn (+3kg) and Swaledale (+2kg).

One of the benefits of raising the mature weight of ewes is the potential to increase the growth rates of their lambs, resulting in higher levels of output. Weaned lamb output of all the crossbred ewe types studied in the AFBI trials was higher than the Blackface ewes (Table 2.4) due to their greater prolificacy and higher lamb growth rates. However the increased lamb output of crossbred ewes must be considered alongside the potential reduction in stocking rate needed to sustain these 'heavy' ewes. This can be examined by comparing ewe efficiency, in terms of lamb output per kilogram of body weight, as shown in Table 2.4. On this basis, the increased lamb output of Cheviot X Blackface and Texel X Blackface ewes was not sufficient to compensate for their heavier body weight relative to the purebred Blackface. By increasing the level of lamb output but maintaining ewe body weight at a similar level,

Swaledale X Blackface and Lleyn X Blackface ewes were more efficient than Blackface.

Lamb performance post-weaning

The benefits of producing crossbred lambs for slaughter were outlined in Chapter 1 and included a significant improvement in growth rate, heavier carcass weights and better carcass conformation. In comparison, the added benefits for lamb growth and carcass quality from using crossbred hill ewes were relatively small whenever the ewes were crossed with a terminal sire breed ram (predominantly Texel and Dorset), as shown in Table 2.5.

Table 2.5 Performance of lambs from Blackface and crossbred ewes finished on a range of concentrate-based diets (slaughtered at fat class 3)

	Ewe breed				
	Blackface (BF)	*Swaledale X BF*	*Cheviot X BF*	*Lleyn X BF*	*Texel X BF*
Initial live weight (kg)	32	33	32	33	34
Live weight gain (g/d)	241	220	247	229	245
Carcass weight gain (g/d)	143	140	147	145	161
Feed conversion ratio[1]	10.1	10.2	10.1	10.7	9.6
Days to finish	59	68	65	66	63
Carcass weight (kg)	20.3	20.1	21.1	21.2	21.5
Kill-out %	45.6	45.1	46.1	46.9	46.5
% EUR grades	91	78	96	94	93
Carcass value (£)[2]	60.92	60.12	63.74	64.07	65.19
Lamb output per 100 ewes tupped (£)	**7,128**	**7,876**	**8,031**	**8,649**	**8,409**

[1] Kg of concentrates needed to produce 1kg of lamb carcass
[2] Base price (R3) £3.00/kg carcass weight

During the finishing period, lamb growth rates were similar for both Blackface and crossbred ewes. Carcass weights of lambs from Cheviot X Blackface, Lleyn X Blackface and Texel X Blackface dams were on average 1.0kg heavier than those from Blackface and Swaledale X Blackface dams, although this was mainly due to their extended finishing period (+6.5 days). Carcass weight gain was increased only when Texel X Blackface dams were used.

Lambs from Texel X Blackface ewes achieved the highest proportion of U grades for conformation (39%), followed by Lleyn X Blackface (28%), Cheviot X Blackface (25%), Swaledale X Blackface (13%) and Blackface ewes (10%). However the differences in carcass value between breeds was mainly due to differences in carcass weight rather than conformation grade. Overall, with the exception the Swaledale X Blackface, more than 90% lambs from all the ewe breeds examined achieved the target U and R grades for conformation.

Lambs from Swaledale X ewes had poorer conformation compared with those from the other ewe breeds

Chapter 3: Do crossbred ewes survive on the hill?

Summary

- Crossbreeding has no adverse effects on longevity in hill ewes
- Crossing two hill breed types (Swaledale X Blackface, Cheviot X Blackface) produced a longer lasting ewe than the pure Blackface
- Swaledale X Blackface had the lowest culling rate
- Lifetime output of ewes was increased by up to 23% through crossbreeding
- Over 5 years, crossbred ewes generated additional returns of more than £68/ewe.

Introduction

Longevity of the ewe is a key factor affecting the economics of hill sheep production. Typically, more than 20% hill ewes are replaced annually and the cost of producing or purchasing replacement ewes can account for almost 40% costs on a hill flock, second only to purchased concentrates. Crossbreeding provides hill sheep farmers with an opportunity to introduce hybrid vigour into the flock, which can benefit the health and fitness of ewes and potentially improve their longevity. On the other hand, the extra lamb output achieved from crossbred ewes outlined in Chapter 2 may put them under greater biological stress, resulting in even higher replacement rates. This chapter examines the effect of crossbreeding on ewe longevity and lifetime output, and explores the underlying reasons for these differences.

Why do ewes 'disappear' off the hill?

Ewes disappear from hill flocks primarily due to mortality and culling. Mortality rate is an important factor to consider because of the high cost of disposing dead ewes combined with their zero income generation. Overall, crossbreeding had no effect on mortality levels in hill ewes (Table 3.1), although the level of mortality in Cheviot X Blackface ewes tended to be lower than the Blackface.

Table 3.1 Mortality and culling rates of Blackface and crossbred ewes over 5 breeding seasons (up to 6½ years old)

	Ewe breed				
	Blackface (BF)	*Swaledale X BF*	*Cheviot X BF*	*Lleyn X BF*	*Texel X BF*
Total mortality (% ewes)	37	36	29	32	35
Culling rate (% ewes)	27.8	15.9	28.2	30.9	25.3
Reason:					
Infertility	12.6	8.4	13.6	10.1	8.1
Udder problems	5.2	3.6	5.4	8.3	7.0
Poor teeth condition	7.0	1.6	5.4	5.2	4.5
Prolapse	0.4	0.0	1.5	4.3	3.3
Thin	1.2	2.1	1.4	0.5	0.0
Feet problems	1.1	0.5	0.0	1.6	0.9
Abortion	0.7	0.0	0.9	1.0	1.5
Difficult lambing	0.0	0.0	0.0	0.0	0.5
Bad mothers	0.4	0.0	0.0	0.0	0.0

Culling is the second most important reason for ewes disappearing off the hills. Culling can occur for several reasons, as shown in Table 3.1, although this list is by no means exclusive. On the hill flocks participating in the AFBI trials, 41% ewes were culled due to infertility, followed by udder problems (23%), bad teeth condition (19%) and prolapse (7%). Crossbreeding had no negative effects on the culling rate in hill flocks. In fact, Swaledale X Blackface had the lowest culling rate of all the ewe breeds investigated, with fewer ewes being culled as barren or with functional problems. Lleyn X Blackface tended to be more prone to udder problems and prolapses than the Blackface ewes which could be linked to their larger litter sizes. However their higher fertility resulted in fewer barren ewes being culled so that the overall culling rate of Lleyn X Blackface ewes was similar to the other breeds, with the exception of the Swaledale X Blackface.

Teeth condition

Teeth condition is an important culling criterion for hill flocks. Tooth loss, excessive wear or separation of incisors from the horny pad (overshoot) can make it more difficult for ewes to graze hill vegetation, resulting in the loss of body condition and reduced performance. Age is an important factor influencing teeth condition. Teeth condition in young ewes is generally very good; however the incidence of tooth loss and the degree of overshoot increase significantly when ewes are aged 4 years old and above. Ewe breed is also important, as shown in Table 3.2.

Table 3.2 Teeth condition in 5½ year old hill ewes

	Ewe breed				
	Blackface (BF)	*Swaledale X BF*	*Cheviot X BF*	*Lleyn X BF*	*Texel X BF*
Bite score[1]	3.4	3.7	3.3	3.3	3.2
Ewes with missing teeth (%)	26	42	7	18	12
Ewes with loose or worn teeth (%)	17	28	10	12	11

[1]Scores above 2.5 indicate overshoot

Teeth condition in Swaledale X Blackface ewes was consistently poorer than the other breeds examined in this study, with 42% ewes aged 5½ years old having a lest one tooth missing (broken-mouthed) and 28% ewes having loose or worn teeth. However it is worth noting that, despite their inferior teeth condition, lamb output from the Swaledale X Blackface ewes was higher than most other breeds (see Chapter 2 *Crossbreeding on the hills for more productive ewes*). In comparison, fewer than 12% Cheviot X Blackface and Texel X Blackface ewes were broken-mouthed at a similar age, and less than 11% of these ewes had loose or worn teeth. With the notable exception of the Swaledale X Blackface ewes, overall teeth condition tended to be better in crossbred ewes than the Blackface.

Replacement rate and lifetime performance of crossbred ewes

Replacement rate is a good indicator of longevity in sheep flocks. When the combined effects of culling and mortality are considered together, crossbreeding had no detrimental effects on longevity of hill ewes, despite the greater lamb output of crossbred ewes. In fact, replacement rates of Swaledale X Blackface and Cheviot X Blackface ewes were 3.0% and 2.1% lower than Blackface respectively, as shown in Table 3.3, indicating better longevity in these ewes.

Crossbreeding has no detrimental effects on hill ewe longevity. Swaledale X and Cheviot X ewes remained in the flock longer than pure Blackface

Table 3.3 Effect of crossbreeding on the replacement rate and lamb output of hill ewes over 5 years

	Ewe breed				
	Blackface (BF)	*Swaledale X BF*	*Cheviot X BF*	*Lleyn X BF*	*Texel X BF*
Average annual replacement rate (% ewes)	26.8	23.8	24.7	26.0	25.5
Total lambs reared	4.2	5.0	4.6	5.0	4.7
Total weaned lamb output (kg)	125	152	147	154	149
Lamb output minus replacement cost (£ per 100 ewes over 5 years)[1]	**17,423**	**+5,473**	**+4,686**	**+6,831**	**+5,723**

[1] Assumes all lambs are sold for slaughter

Replacement rates of Lleyn X Blackface and Texel X Blackface ewes were similar to the Blackface. Thus, if the objective of a crossbreeding programme is to develop longer-lasting hill ewes, crossing two hill breed types is recommended.

Considering that crossbred ewes produce more lambs and can survive longer, it is inevitable that their lifetime output will be higher than that of Blackface ewes. Table 3.3 outlines the benefits of crossbreeding for lamb output over 5 successive years.

Compared with using Blackface ewes, crossbreds reared up to 80 more lambs and weaned an extra 2.9 tons of lamb for every 100 hoggets that joined the flock. The greatest advantage came from using Lleyn X Blackface and Swaledale X Blackface ewes due to their greater prolificacy.

When the impacts on ewe longevity and lamb output are considered, over 5 years, crossbred ewes increased flock returns by up to £6,831 per 100 ewes when compared with Blackface.

Chapter 4: Ram selection for easier-care systems

Summary
When compared with using terminal sire breed rams (e.g. Suffolk):

- Using maternal breed (e.g. Lleyn) rams reduces lambing intervention by up to one-third and lamb mortality by 3-4% but the lambs are slower growing.
- Crossing with NZ terminal sires has a small benefit for lambing ease and no significant effects on lamb performance.
- Easier-care sire breeds tend to reduce carcass conformation but the financial penalty is small (10-25p per lamb)

Introduction
Sheep flocks in the UK and Ireland require relatively high labour inputs. A survey carried out in the Republic of Ireland in 2001 reported that lowland flocks require between 5 and 10 man hours per ewe per annum, which is equivalent to one full time labour unit managing a flock of 193 to 385 ewes. In recent years, declining margins and rising labour costs have increased interest in developing more natural 'easier-care' systems that require less human intervention. In New Zealand, where these systems have been used for some time, average flock size is around 750 ewes and flocks of 1,500 to 2,500 ewes per labour unit are common. Choice of ram is a key factor affecting labour inputs particularly around lambing time. This chapter highlights some options for easier-lambing sire breeds, based on trials carried out on 6 lowland flocks around Northern Ireland.

Which breeds were evaluated?
Three ram breeds were investigated in this study:

1. *Suffolk:* a popular terminal sire breed in the UK and Ireland, producing fast-growing lambs with good carcass conformation. Typically 30-40% ewes will need assistance at lambing.
2. *NZxUK Suffolk:* developed by crossing Suffolk strains from the UK and New Zealand, where flocks are managed within extensive, easier-care systems and selection for lambing ease is a priority. The aim was to develop an easier-care terminal sire that retained the growth and carcass attributes of UK strains but with improved lambing ease.
3. *Lleyn:* once a minority breed, native to the Lleyn Penninsula in North Wales, has grown in popularity in the past 10 years . A prolific maternal breed with limited selection for carcass traits.

These rams were crossed with a wide range of ewe breeds representative of the main crossbred ewe types found on lowland flocks in Northern Ireland, including Mules, Suffolk x Cheviot, Texel X Mule and Lleyn X Mule. Ewes lambing to NZxUK Suffolk and Lleyn rams were equally divided between indoor and outdoor lambing systems so that ram performance could be compared in a range of environments. All ewes lambing to Suffolk rams were lambed indoors due to their greater prevalence of lambing problems.

Ease of lambing
The lambing period accounts for around 20% of total labour inputs on lowland sheep flocks so reducing the need to assist ewes at lambing is critical for easier-care

systems. Furthermore, assisting ewes at lambing has been proven to prolong the birth process and impair ewe-lamb bonding so improving lambing ease is likely to benefit the welfare of both ewe and lamb. Ease of lambing is determined mainly by compatibility of the lamb with the ewe's pelvis so lamb birth weight is a major contributing factor. Birth weight is determined mainly by litter size, nutrient intake of the ewe during pregnancy, and by the breed of both sire and dam.

Table 4.1 Birth weight and lambing ease of lambs sired by easier-care ram breeds in both indoor and outdoor lambing systems

	Indoor lambing			Outdoor lambing	
	Suffolk	NZxUK Suffolk	Lleyn	NZxUK Suffolk	Lleyn
Birth weight (kg)	5.6	5.5	5.3	5.8	5.3
Mortality at birth (%)	4	3	1	4	5
Viability at birth[1]	1.05	1.06	1.04	1.04	1.03
Lambing ease:					
No assistance (%)	68	72	79	76	91
Voluntary assistance (%)	19	17	13	15	6
Moderate assistance (%)	8	7	5	5	2
Major assistance (%)	5	5	3	4	1

[1] High scores indicate less viable lambs

Table 4.1 outlines the benefits for lambing ease from using 'easier-care' sire breeds. Easier-care Suffolks, developed by crossing UK and NZ Suffolk strains, successfully reduced the level of lambing intervention when compared with UK Suffolk strains although the benefit was relatively small (28 vs. 32% respectively). A more targeted approach based on recording sire performance and identifying individual rams which are easy-lambing is needed to develop terminal sires for easier-care systems. The use of maternal breed (Lleyn) rams had the greatest benefits for lambing ease with just 21% indoor lambing ewes requiring assistance, one-third less intervention than Suffolk rams. It is interesting to note that then ewes lambed down outdoors to Lleyn rams, the level of intervention dropped to just 9% without any change in lamb birth weight. This would suggest that much of the help given to ewes in lambing sheds is unnecessary and that most will eventually lamb themselves, given time.

Ram effects on lambing ease and mortality are closely related to lamb birth weight, which in turn is influenced by the mature weight of the ram. Maternal sheep breeds in general have lower mature weights than terminal sire breeds and produce lambs with lower birth weights. Lleyn X lambs were on average 0.3kg lighter at birth than the Suffolk X lambs which helped improve their lambing ease. For both breeds, the average birth weight of lambs was in excess of 5kg so poor lamb viability was not an issue.

Lambing intervention with NZ x UK Suffolk rams was just **4% lower** than traditional UK Suffolks

Lamb performance up to weaning

Maximising lamb performance off grass while ensuring that lamb mortality levels remain low are key drivers towards profitability and also play an important role in reducing the carbon footprint of lamb production. Whereas using heavy mature weight ram breeds is associated with heavier birth weights and increased lambing difficulties, using sire breeds with a low mature weight can impact on the growth rate of their lambs. This was evident by the lower growth rate of Lleyn X lambs compared with Suffolk X lambs, resulting in a 2kg differential in weaning weight (Table 4.2).

Table 4.2 Effects of using easier-lambing sire breeds on lamb performance up to weaning

	Indoor lambing			Outdoor lambing	
	Suffolk	NZxUK Suffolk	Lleyn	NZxUK Suffolk	Lleyn
Mortality to weaning (%)	11	11	7	9	11
Weaning weight (kg)	33.3	33.0	31.3	34.4	32.6
Pre-weaning live weight gain (g/d)	263	262	248	272	259

However, total lamb output at weaning was similar for both ram breeds due to the lower mortality rates of Lleyn X lambs. Introducing NZ Suffolk strains into the UK Suffolk breed had no effect on the growth rate or mortality levels of Suffolk X lambs. Growth rates of lambs born outdoors were 4% higher than those born in the shed, reflecting the higher milk output of ewes lambing down at grass.

Lamb carcass characteristics

While achieving improvements in lambing ease and lamb growth rates is essential to reduce production costs on-farm, the impact of using easier-care sire breeds on lamb carcass quality must also be considered.

Sire breed effects on the growth rates of lambs from birth to slaughter were similar to those observed during the pre-weaning period (see Table 4.3), with Suffolk X lambs slaughtered on average 11 days earlier than Lleyn X lambs at the same fat class.

Table 4.3 Comparison of the carcass characteristics of lambs sired by conventional and easier-lambing ram breeds (slaughtered at fat class 3)

	Indoor lambing			Outdoor lambing	
	Suffolk	NZxUK Suffolk	Lleyn	NZxUK Suffolk	Lleyn
Age at slaughter (days)	179	184	190	177	192
Slaughter weight (kg)	45.7	45.5	44.8	45.4	45.2
Carcass weight (kg)	19.7	19.9	19.8	19.8	20.0
Kill-out %	43.0	43.5	44.3	43.5	44.3
Conformation grade (%):					
U	24	15	11	18	15
R	70	74	75	73	74
O	6	10	14	9	11
Carcass value (£)[1]	**59.45**	**59.20**	**59.34**	**59.58**	**60.08**

[1] Base price (R3) £3.00/kg carcass weight

However the impact of using maternal breed sires on age at slaughter was smaller than might be expected from their slower growth rates because the killing-out percentage of Lleyn X lambs was 1.3% higher than Suffolk X lambs. This would indicate that Lleyn X lambs produce less waste than Suffolk X lambs, which could emanate from a smaller head weight, finer bone development in the legs, a lower weight of intestines, reduced gut fill, or a combination of these.

Maternal breeds are less heavily selected for carcass conformation than terminal sire breeds and therefore tend to have less pronounced bone development in the legs and shoulder, which contributes to their greater ease of lambing. However this also has an impact on the grading of lambs at the abattoir. Usng Lleyn sires resulted in 13% fewer U grade carcasses and 8% more O grade carcasses compared with using Suffolk rams. Use of NZxUK Suffolk rams also impacted on carcass conformation but to a lesser degree, with 9% fewer U grades and 4% more O grades than Suffolk X lambs. Assuming U grade carcasses attract and 10p/kg bonus and O grade carcasses a 10p/kg penalty, Suffolk X lambs were worth 1.3p/kg and 2.1p/kg more than NZxUK Suffolk X and Lleyn X lambs respectively.

Lleyn rams presented the fewest lambing difficulties but Lleyn-cross lambs achieved **8% more O grade carcasses** than Suffolk crosses

Chapter 5: Is there a role for New Zealand sheep breeds in Northern Ireland?

Summary

- Experience to-date indicates that lambs born to maternal breed sires from New Zealand (Romney, Highlander) perform well on the ground but struggle with carcass conformation.
- Terminal sire breeds (Primera) are easy-lambed and produce fast-growing lambs with reasonable carcass conformation. These breeds may have a role to play in the future.
- Crossbred ewes are currently being evaluated on both hill and lowland flocks.

Introduction

The previous chapter highlighted the issue of high labour requirements on sheep flocks in the UK and Ireland. The situation is very different in New Zealand where flock sizes of 1,500 to 2,500 ewes per labour unit are common, and intervention rates at lambing are often below 1%. Unlike the UK sheep industry, which has some 90 recorded breeds (excluding crossbreds), the New Zealand industry has fewer than 30 recorded breeds plus some composite types, with the NZ Romney accounting for more than half of the ewe population. This chapter examines the potential role for New Zealand sheep breeds within NI farming systems.

Which breeds are being assessed?

Three sheep breeds are currently being investigated within AFBI trials:

1. NZ Romney
2. Highlander
3. Primera

NZ Romney

The Romney is the most common breed of sheep in New Zealand for a number of reasons. Firstly it is well adapted to grazing in both hill and lowland environments. Also, it is regarded as a dual purpose breeding suitable for both meat and wool production, which provides a degree of flexibility. However the Romney is noted most for its excellent mothering ability, and a number of Romney-cross ewes are currently being investigated by AFBI for their maternal ability.

The performance of 1st cross Romney lambs is outlined in Tables 5.1 and 5.2.

Table 5.1 Performance of Texel and NZ Romney sires on 6 lowland flocks

	Texel	NZ Romney
% lambs born unassisted	77	77
Birth weight (kg)	5.4	5.9
Mortality at birth (%)	6	5
Weaning weight (kg)	33.6	33.9
Birth to weaning LWG (g/d)	263	265

Table 5.2 Comparison of the carcass characteristics of lambs sired by Texel and NZ Romney rams (slaughtered at fat class 3)

	Texel	NZ Romney
Age at slaughter (days)	200	174
Slaughter weight (kg)	45.2	45.5
Carcass weight (kg)	20.3	19.7
Kill-out %	44.7	43.2
Conformation grades (%):		
U	22	11
R	72	65
O	6	24
Carcass value (£)[1]	61.22	58.84

[1] Base price (R3) £3.00/kg carcass weight

Ease of lambing was very similar to the Texel X lambs despite the Romney crosses being 0.5kg heavier at birth. However, with 23% ewes requiring assistance, it is difficult to see a role for Romney sires within easier-care sheep systems. Growth rate and weaning weight were also very similar in these breeds. Being an earlier maturing breed, the Romney X lambs reached finished condition on average 26 days earlier than Texel X lambs, albeit with a small penalty on carcass weight (Table 5.2). Killing-out percentage was 1.5% lower for the Romney crosses, which is probably due to their heavier weight of fleece. However the Romney X lambs struggled to reach a suitable carcass conformation, with 24% lambs failing to meet the target EUR grades for conformation compared with just 6% of Texel X lambs.

Highlander

The Highlander is a maternal composite breed developed within a large-scale breeding programme by Rissington Breedline Ltd., a sheep breeding company based on New Zealand's north island. This breeding programme aims to develop a long lasting ewe of moderate mature weight with good fertility and high lamb output off grass. Emphasis is also now being placed on improving muscling and the degree of resilience to worm infestations. Highlander-cross ewes are currently being examined by AFBI on 12 hill and lowland flocks around Northern Ireland.

The performance of Highlander rams as a crossing sire for Cheviot X Blackface, Lleyn X Blackface and Texel X Blackface ewes on hill flocks is outlined in Table 5.3.

Table 5.3 Performance in 2010 of Highlander, Lleyn and Texel cross lambs within a rotational breeding programme on 6 hill flocks

	Highlander	Lleyn	Texel
% lambs born unassisted	85	80	87
Birth weight (kg)	3.9	3.9	3.8
Mortality at birth (%)	5	4	7
Weaning weight (kg)	29.8	29.9	29.2
Birth to weaning LWG (g/d)	201	202	197

While this study is currently ongoing, results to-date would indicate that Highlander X lambs are easily lambed with just 15% births requiring assistance. Growth rates and weaning weights of Highlander X lambs recorded so far have been comparable with the Lleyn and Texel cross lambs. Early indications from a small sample of lambs slaughtered in 2010/11 are that carcass conformation in Highlander X hill lambs is also comparable with Lleyn X lambs, with around 70% lambs achieving EUR grades.

Within lowland flocks, the relative merits of using Highlander rams are similar to those observed in hill flocks, as shown in Table 5.4.

Table 5.4 Performance in 2010 of Texel, Primera and Highlander cross lambs on 6 lowland flocks

	Texel	Primera	Highlander
% lambs born unassisted	83	91	87
Birth weight (kg)	4.7	4.7	4.6
Mortality at birth (%)	6	6	4
Weaning weight (kg)	30.4	31.3	30.7
Birth to weaning LWG (g/d)	252	261	255

To-date, Highlander X lambs have achieved similar growth rates and weaning weights to Texel X lambs but with fewer lambing difficulties. However, there is some indication that Highlander X lambs struggle to achieve a high proportion of EUR grades for conformation.

Primera

Like the Highlander, the Primera is a composite breed developed within a large-scale breeding programme by Rissington Breedline Ltd. As the terminal sire breed, the target breeding objectives of Primera are to produce lambs with good viability which are born without assistance, achieve high growth rates off grass with efficient food conversion and produce carcasses with good muscling and excellent eating quality.

Primera sires are currently being evaluated on 6 lowland flocks around Northern Ireland. Provisional results on lamb performance up to weaning in 2010 are presented in Table 5.4. To-date, Primera sires have presented few lambing difficulties with less than 10% lambs requiring assistance at birth, which is excellent for a terminal sire breed. In keeping with their breeding objectives, Primera X lambs have achieved high growth rates off grass (comparable with Suffolk X lambs) which has continued through to slaughter. Early indications are that carcass conformation of Primera X lambs is acceptable, with around 75% lambs achieving EUR grades.

Section 2: Feeding for performance

Chapter 6: Managing ewe lamb replacements from tupping to lambing to maximise output

Summary
- Select replacement ewes as soon as possible after weaning
- Aim for at least 60% mature weight at tupping
- Feed to achieve a moderate weight gain (0.5kg/week) during the first 95 days after tupping
- Plan feeding strategies in late pregnancy according to silage quality and litter size.

Introduction

The decision whether or not to breed replacement ewes as ewe lambs is one that every sheep producer faces annually, whether grazing the high hills or along the coast. Delaying breeding until the second year has obvious advantages - it is much easier to ensure ewes are heavy enough for tupping; ewe fertility is generally better and management at lambing easier. However, delayed breeding brings additional feed costs without generating any additional income to offset these costs. Breeding replacements as ewe lambs can be equally as successful as breeding from adult ewes but the approach to feeding management during pregnancy can mean the difference between success and failure. This chapter outlines how ewe lambs should be fed during pregnancy to maximise lamb output.

Early pregnancy (1-40 days post-tupping)

The primary objective of feeding in early pregnancy is to promote fertilization and minimise embryo losses. Fertility in ewe lambs is highly sensitive to the level of feed intake during the first 6 weeks after tupping, as shown in Table 6.1.

Table 6.1 Effect of feeding level during the first 40 days of pregnancy on ewe lamb fertility

	Feeding level in early pregnancy		
	High	Moderate	Low
Daily energy intake (MJ)	12.6	6.1	3.7
Live weight at mating (kg)	45	43	44
Condition score at mating	3.7	3.7	3.7
Live weight at day 40 (kg)	50	46	43
Condition score at day 40	3.8	3.8	3.7
Conception rate to 1st service (%)	38	51	61
Lambs born per ewe to a single service	0.44	0.71	0.80

Maintaining ewe lambs on a high plane of nutrition to increase body size and condition leads to a higher incidence of ewes repeating to the ram and leaves it more difficult to maintain a compact lambing pattern without carrying a high proportion of barren ewes. Excessive feeding, even at this early stage of pregnancy, can also lead oversized lambs that require extra assistance at lambing, as shown in Table 6.2.

Overfeeding replacements during early and mid pregnancy impacts on ewe fertility and lamb vigour at birth

Table 6.2 Effect of feeding level during the first 40 days of pregnancy on lamb output of ewe lambs

	Feeding level in early pregnancy		
	High	Moderate	Low
Live weight at lambing (kg)	60	56	54
Lamb birth weight (kg)	5.3	4.6	4.5
% ewes assisted at lambing	87	52	48
Lamb mortality at birth (%)	6	7	14
Lambs weaned per ewe put to ram	0.25	0.38	0.35
Lamb weaning weight (kg)	34	33	33

Allowing ewe lambs to lose a small amount of body weight and condition in early pregnancy maximizes their fertility (Table 6.1) but there are consequences for lamb output. When body reserves are depleted post-tupping, ewe lambs can struggle to compensate later in pregnancy. This can affect their ability to suckle their lambs successfully, leading to increased mortality levels around birth (Table 6.2). Thus to achieve a suitable compromise between ewe fertility and lamb viability, it is best to target a small increase in body weight (0.5kg per week) in ewe lambs during the first 6 weeks after tupping. This can be achieved by grazing short (4-6cm) swards and monitoring body weight accordingly. Where grass supplies are inadequate, feeding a

medium quality grass silage should be sufficient to maintain this level of weight gain without the need for additional concentrates.

Mid-pregnancy (40-95 days post-tupping)

In sheep, implantation begins around day 30 and is normally completed by day 50. Following implantation, the developing foetus becomes dependent on the placenta to meet its nutritional demands. Thus the primary objective in rationing ewes during mid-pregnancy is to promote development of a fully functional placenta with a high nutrient transfer capacity, capable of sustaining foetal growth later in pregnancy.

When rationing ewe lambs in mid-pregnancy, the level of feeding must be sufficient to support growth of the ewe as well. While it is tempting to feed ewes well to promote rapid body weight gains, overfeeding ewe lambs in mid-pregnancy restricts placenta development and can lead to the birth of smaller lambs. Research at AFBI Hillsborough has found that when the degree of overfeeding is mild (ewes gaining 1kg per week) the impact on lamb birth weight is relatively small (see Table 6.3) but other research would indicate that feeding to achieve even higher weight gains (2kg per week) in mid-pregnancy can result in undersized lambs.

Table 6.3 Effect of feeding level offered to ewe lambs in mid-pregnancy (day 40-95) on performance at lambing

	Feeding level in mid-pregnancy	
	High	Moderate
Daily energy intake (MJ)	13.0	9.1
Live weight at day 40 (kg)	46	47
Condition score at day 40	3.8	3.8
Live weight at day 95 (kg)	54	52
Condition score at day 95	3.8	3.7
Lamb birth weight (kg)	4.7	4.9
% ewes assisted at lambing	68	50
% normal birth presentation	59	74

Lamb viability at birth is also affected by overfeeding in mid-pregnancy. When ewe lambs are well fed, a higher proportion of their lambs were incorrectly presented for birth and needed more help at lambing (Table 6.3). Once on the ground, these lambs were also less active and slower to suckle following delivery (Table 6.4).

Table 6.4 Effect of feeding level in mid-pregnancy (day 40-95) on the behaviour of ewe lambs and their offspring within 30 minutes of lambing

	Feeding level in mid-pregnancy	
	High	Moderate
Frequency of ewe behaviours:		
Grooming	17	27
Sniffing/nosing	9	4
Facilitate suckling	1	8
Frequency of lamb behaviours:		
Approach udder	8	14
Successful suckle	2	4

Behaviour of ewe lambs is also affected by overfeeding in mid-pregnancy, with well-fed ewes spending less time grooming their lambs and less willing to facilitate suckling compared with those maintained on a lower plane of nutrition (Table 6.4).

From 40-95 days post-tupping it is therefore advisable to maintain ewe lambs on the same level of feeding recommended for early pregnancy, targeting a modest rate of weight gain (0.5kg per week).

Note: since the opportunities to gain body weight following tupping are limited, it is essential that ewe lambs reach a suitable live weight at mating. Ewe lambs should be at least 60% of their mature weight when they join the ram (45kg for Mules). This means that preparation for mating should begin as soon as possible after weaning.

Late pregnancy (95-147 days post-tupping)

Late pregnancy is a period of rapidly increasing feed demands. The foetus doubles in size during the final month of pregnancy, while the udder also begins to develop and accumulate colostrum in the final 2-3 weeks before lambing. With the rapidly increasing demands being placed on the ewe, feeding ewe lambs to increase body weight is difficult. However it is possible to manage lamb birth weights provided the level of weight gain has been controlled in mid-pregnancy to promote placenta development. Where ewe lambs have been overfed in mid-pregnancy and begin to lamb down with undersized lambs, feeding additional concentrates is likely to be ineffective if placental development has been compromised.

Typical concentrate feed rates for ewes lambs are shown in Table 6.5.

Table 6.5 Typical concentrate feed rates (kg/day) for Mule ewe lambs offered grass silage-based diets in late pregnancy

	High quality silage (72D)		Medium quality silage (66D)	
Weeks to lambing	Singles	Twins	Singles	Twins
6 to 4	-	0.10	-	0.20
4 to 2	-	0.25	0.20	0.35
2 to lambing	0.20	0.45	0.30	0.60
Concentrate costs (£ per 100 ewes)[1]	67	269	168	386

[1] Assuming concentrates cost £240

Concentrate inputs vary depending on litter size so it is useful to scan ewes to avoid overfeeding or underfeeding. Knowing the quality of your grass silage is also important when rationing ewes. To enquire about getting your silage analysed, contact the Hillsborough Feeding Information Service (HFIS) directly on 028 9268 1589, or alternatively, speak to your local CAFRE Beef and Sheep Advisor.

Chapter 7: Managing ewes post-tupping to maximise performance

Summary
- Monitor ewe body condition from weaning onwards and aim to meet target condition scores
- Maintain body condition in early pregnancy
- Allow for some lose of body condition in mid-pregnancy to maximize lamb viability
- Base late pregnancy feeding regimes on silage quality and litter size

Introduction

Management of nutrition during pregnancy is one of the main factors affecting flock health and performance. Home grown forages and purchased feedstuffs account for approximately 70% of production costs on both hill and lowland farms so making good use of these resources makes sense. Feeding strategies for ewe lamb replacements have already been discussed in Chapter 6. This chapter now examines a range of feeding options for the main breeding flock of adult ewes to maximize their performance.

Early pregnancy (1-40 days post-tupping)

It is estimated that around 20-40% of viable ova shed by ewes during ovulation fail to develop into offspring, resulting in smaller litter sizes, repeats to the ram or even barrenness. Most of these losses occur during the first 12 days post-tupping; therefore the main objective of feeding strategies in early pregnancy is to promote fertilization and minimise embryo losses.

Table 7.1 Effect of feeding level during early pregnancy (day 0-40) on the fertility of adult ewes

	Feeding level in early pregnancy		
	High	Moderate	Low
Daily energy intake (MJ)	18.2	9.3	5.5
Live weight at mating (kg)	80	80	80
Condition score at mating	3.8	3.8	3.8
Live weight at day 40 (kg)	86	79	74
Condition score at day 40	4.0	3.9	3.7
Conception rate to 1st service (%)	91	92	97
Lambs born per ewe put to ram	1.86	1.81	1.86

Table 7.1 outlines a range of nutritional scenarios during the first 6 weeks after tupping and their effects on ewe fertility. Compared with ewe lambs (see Chapter 6), fertility of adult ewes is relatively insensitive to feed intake in early pregnancy whenever ewes are in good body condition at mating (condition score 3 plus). Where forage supplies are limited, ewes can afford to lose up to 1kg body weight per week without impacting on their fertility. In fact, restricting the level of feeding has benefits for foetal development, as shown in Table 7.2.

Table 7.2 Effect of feeding level in early pregnancy on lamb output from adult ewes

	Feeding level in early pregnancy		
	High	Moderate	Low
Gestation length (days)	146	147	147
Lamb birth weight (kg)	5.4	5.2	5.5
Immune status[1]	48	45	57
Lambs weaned per ewe put to the ram	1.38	1.44	1.76
Lamb weaning weight (kg)	43	39	41

[1] Higher scores indicate better immunity in lambs

Lambs born to ewes that lost weight during early pregnancy were found to be heavier at birth, had higher levels of immunity and better survival rates compared with ewes that were well-fed. However there is also evidence that lambs born to restricted ewes produced fatter carcasses with poorer conformation.

Assessing body condition of ewes is a simple but highly effective means of monitoring the nutritional status of ewes and guiding feeding strategies throughout pregnancy. However it takes time to increase body condition so preparation for pregnancy needs to begin at the previous weaning. In practice, there is often significant variation in the body condition of ewes around mating. When ewes have reached their target body condition for mating (condition score 3.5) it is advisable to maintain body weight and condition during the first 6 weeks after tupping by grazing short (4-6cm) swards and monitoring body condition as a check. Fat ewes can be grazed more tightly and allowed to lose some body condition to bring them closer to target, while thin ewes (condition score less than 3) should be put to the better swards (6-8cm) to build up their body reserves in preparation for lambing.

Feeding in early and mid pregnancy should be guided by the level of body condition. Fat ewes can afford to lose up to half a unit of condition score during the first 100 days of pregnancy.

Mid-pregnancy (40-95 days post-tupping)

By day 30 post-tupping, sheep embryos begin to attach to the wall of the uterus. At this stage the embryo weighs around 0.3g so its nutrient demands are almost negligible. By day 50 attachment is complete and the growing embryo becomes dependent on the placenta to supply its nutritional demands. The primary objective in rationing ewes during mid-pregnancy is thus to promote development of a fully functional placenta with a high nutrient transfer capacity. This is particularly important for prolific ewe breeds that produce a high percentage of triplets.

When ewes are in good condition at tupping, allowing ewes to lose some body condition in mid-pregnancy will enhance the nutrient transfer capacity of the placenta leading to heavier lamb birth weights (Table 7.3).

Table 7.3 Effect of feeding level offered to ewes in mid-pregnancy (day 40-95) on performance at lambing

	Feeding level in mid-pregnancy	
	High	Moderate
Daily energy intake (MJ)	12.1	6.9
Live weight at day 40 (kg)	80	79
Condition score at day 40	3.9	3.9
Live weight at day 95 (kg)	88	79
Condition score at day 95	4.0	3.7
Lamb birth weight (kg)	5.3	5.4

Enhancing placental development by avoiding overfeeding ewes in mid-pregnancy also benefits lamb vigour, as shown in Table 7.4.

Table 7.4 Effect of feeding level in mid-pregnancy (day 40-95) on lamb vigour during the first 30 minutes after lambing

	Feeding level in mid-pregnancy	
	High	Moderate
Attempts to stand	39	40
First successful attempt to stand (mins)	11.0	8.4
Suckling attempts	19	27
Number of vocalisation	40	41

When ewes are allowed to lose some body condition, their lambs are more active at birth, get to their feet more quickly, make more efforts to seek out the udder and suckle earlier compared with ewes that are well fed.

Feeding strategies for mid-pregnancy should be guided by the level of body condition of the ewes. Ewes in good condition (condition score 3.5) should be allowed to lose up to 0.25 units of condition score between day 40-95 post-tupping. This can be achieved by grazing tight swards (around 3cm) and monitoring body condition. If ewes are housed at this stage, access to medium and high quality grass silages (10.5-11.5 MJ/kg DM) should be restricted to prevent ewes becoming over fat. For the same reason, grazing ewes on long swards should be avoided when grazing

conditions are good. Fat ewes (condition score 4 and above) can benefit from losing up to 0.5 units of condition score in mid-pregnancy; however thinner ewes (condition score less than 3) should be allowed to gain up to 0.5 units of condition score by grazing longer grass swards (5-7cm) or feeding grass silage ad libitum.

Overfeeding in mid-pregnancy can reduce lamb birth weight

Late pregnancy (95-147 days post-tupping)

Late pregnancy is a period of rapidly increasing feed requirements, with 85% of foetal growth occurring in the last 8 weeks before lambing and udder development taking place in the last 2-3 weeks of pregnancy. As the uterus expands it puts pressure on the rumen which can restrict feed intake, putting multiple-bearing ewes under even greater nutritional stress. The ewe's body reserves will act as an energy buffer when diets fail to supply what ewes need, so monitoring body condition is crucial. When ewes are in good condition in mid-pregnancy (condition score 3.0-3.5), they can afford to lose up to 0.5 units of condition score in late pregnancy without impacting on health or performance. The risk of twin lamb disease, prolapse and lambing problems increase significantly when ewes are over fat (condition score 4 and above). On the other hand, thin ewes (condition score below 2.5) may lamb down with little or no milk and can struggle to produce enough milk to sustain their lambs during early lactation. Also it is very difficult to increase the level of body condition in late pregnancy due to the high nutrient demands for foetal growth.

For ewes on grass silage-based diets, the need for additional concentrates is dependent on silage quality, litter size and lambing date. Ultrasound scanning is a

useful tool to help plan feeding strategies in late pregnancy, to avoid overfeeding single-bearing ewes or underfeeding triplets. Grass silage quality on sheep farms is often unknown but this is one of the main factors affecting concentrate inputs. Ewes also tend to eat more silage when it's of good quality which adds to its concentrate-sparing effect. Typical concentrate feed rates for ewes fed good and medium quality grass silages are presented in Table 7.5.

Table 7.5 Typical concentrate feed rates (kg/day) for lowland ewes offered high quality and medium quality grass silage in late pregnancy

	High quality silage (72D)			Medium quality silage (66D)		
Weeks to lambing	Singles	Twins	Triplets	Singles	Twins	Triplets
6 to 4	-	-	0.20	-	0.25	0.40
4 to 2	-	0.30	0.45	0.20	0.45	0.65
2 to lambing	0.20	0.50	0.75	0.35	0.70	1.00
Concentrate costs (£ per 100 ewes)[1]	67	269	470	185	470	689

[1] Assuming concentrates cost £240

To enquire about getting your silage analysed, contact the Hillsborough Feeding Information Service (HFIS) directly on 028 9268 1589, or alternatively, speak to your local CAFRE Beef and Sheep Advisor. Feeding strategies for alternative systems, including outdoor lambing, are discussed in Chapter 8.

Chapter 8: Alternatives to grass silage for ewes approaching lambing

Summary

- Alternatives to grass silage can be equally and potentially more cost effective.
- Early spring grass is the cheapest and most nutritious feed source. Managing sward height is critical to control intake and avoid oversized lambs.
- High quality maize silage is a good substitute for grass silage. Less concentrate supplementation is required but a higher level of protein is needed.
- All-grain diets are a useful option when silage is expensive or stocks are low. Care is needed to avoid digestive upsets.

Introduction

Grass silage is the most common forage fed to ewes during late pregnancy. However a recent comparison of forage costs on NI dairy farms, undertaken by staff from CAFRE and AFBI, found that the cost producing good quality grass silage has increased by around 67% (£34/t DM) in the past 10 years. This increase is largely driven by rising oil prices which force up fertilizer and contracting charges. While the cost of alternatives to grass silage have also risen (see Table 8.1), in most cases the cost increase has been relatively modest in comparison to grass silage.

Table 8.1 Cost of forage production on NI dairy farms

	Yield potential	Cash cost (£/t utilised DM)		
Forage	(t DM/ha)	2002	2008	% change
Grazed grass	10.6	32	57	+78
Zero-grazing	11.4	55	80	+45
3-cut grass silage	13.8	51	85	+67
Maize silage (with plastic)	14.7	56	73	+30
Wholecrop wheat	13.0	49	72	+47
Concentrates	-	163	271	+66

For example, the cost of producing maize silage has risen by just £17/t DM due to its lower fertilizer inputs and single harvesting operation, making it cost competitive relative to grass silage whenever a good crop yield is obtained. This chapter outlines how some of these alternative forages can be utilized in pregnant ewe rations.

Early spring grass

Grazed grass remains the cheapest forage available to sheep producers and potentially has the highest feed value. When managed correctly, early spring grass has a digestibility (or D-value) 5-10 percentage units higher than most grass silages and a nutritional value similar to an 18% protein ewe mix. With good grazing conditions, ewes at grass can also consume up to 50% more dry matter compared with ewes fed a high quality grass silage (see Table 8.2).

Table 8.2 Performance of twin-bearing ewes offered grass or grass silage-based diets in late pregnancy

	Grass (zero grazed)		High quality silage		Medium quality silage
Concentrates (kg/d)	0.0	0.5	0.0	0.5	0.5
Forage DM intake (kg/d)	1.7	1.3	1.2	1.2	0.6
Colostrum yield (kg)	1.62	2.08	1.28	1.75	1.51
Lamb birth weight (kg)	5.2	5.2	4.5	4.9	5.2
Lamb growth rate (g/d)	292	293	301	304	291

With its high nutritive value and high intake characteristics, early spring grass has the potential to meet the nutrient requirements of single and twin bearing ewes without the need for additional concentrate supplementation.

Newborn lambs require at least 160ml colostrum per kilogram of birth weight during the first 18 hours after birth. Thus a typical twin-bearing ewe needs to produce approximately 1.6kg colostrum to help ensure lamb survival is not compromised by an inadequate intake of colostrum. Ewes fed grass in late pregnancy are capable of meeting this target level without the need for additional concentrates, as shown in Table 8.2, whereas ewes fed grass silage require significant concentrate inputs, even when the silage is top quality.

Birth weight of lambs fed grass-based diets can be increased by up to 0.7kg when ewes are fed grass-based diets rather than grass silage in late pregnancy. This is particularly beneficial to ewes under severe nutritional stress (e.g. triplet-bearing ewes, ewe lambs carrying twins) where the risk of undersized lambs is high. Triplet-bearing ewes fed grass-only diets are capable of producing adequately sized lambs and a good supply of colostrum without feeding additional concentrates, provided there is an adequate supply of quality grass available. However there is much variation in colostrum production between individual ewes, regardless of which diet they are fed. To minimize the proportion of ewes lambing down with insufficient colostrum, it is advisable to supplement triplet-bearing ewes at grass with 0.3-0.5 kg/d concentrates.

With single and twin-bearing ewes, controlling grass intake is critical (Table 8.3).

Table 8.3 Effects of grass herbage allowance on ewe performance

	Herbage allowance (kg dry-matter per day)			
	1.30	1.75	2.20	2.60
Lamb birth weight (kg)	5.3	5.5	5.7	5.9
% ewes assisted at lambing	5	9	8	18
Lamb growth rate (g/d)	274	259	257	258

Early spring grass is a highly nutritious feed for pregnant ewes. Grazing short swards (3-5cm) is critical to avoid oversized lambs

As herbage availability increases, herbage intake will increase and there is a real risk that lambs will become oversized and subsequently require more assistance at lambing. When conditions are favourable, turning ewes out to short swards (3-5cm) 3 to 4 weeks before lambing, and stocking at a level sufficient to maintain this sward height, should be sufficient to meet the ewes' nutritional requirements without the need for additional concentrates. The target stocking rate will vary depending on ground conditions and grass growth but is typically around 12 ewes/ha (5 ewes/ac) for a mid-March lambing flock.

Maize silage

Developments in plant breeding combined with improved methods of establishment, such as the use of plastic mulch, has resulted in forage maize becoming a more reliable and cost effective crop to produce. In the past 10 years alone there has been a 60% increase in the area of forage maize grown in the UK. While the production of consistently high yields of high quality maize silage within less favoured areas remains difficult, contract growing of forage maize within arable rotations is leading to an increased availability of maize silage for sheep production.

Intake of maize silage by ewes, whether offered as the sole forage or mixed with grass silage, is typically 15-20% higher than grass silage (see Table 8.4).

This should be taken on board when considering the timing and level of concentrate supplementation as excessive concentrate feeding can result in increased lambing difficulties.

Table 8.4 Alternative feeding strategies for indoor-lambing sheep systems

	Grass silage	50:50 mix of grass + maize silages[1]	Maize silage	Concentrates
Silage DM intake (kg/d)	1.00	1.15	1.20	-
Concentrate intake (kg/d)	0.55	0.55	0.55	1.47
Lamb birth weight (kg)	5.3	5.3	5.1	5.4
% ewes assisted at lambing	35	51	27	7
Lamb growth rate (g/d)	245	252	245	253

[1]Mixed in a 50:50 ratio on a dry-matter basis

The nutritional value of maize silage is largely dependent on starch levels in the cob. High quality maize silage should have a dry-matter content between 30-35% and supply 25-30% starch and 11.0-11.5 MJ ME/kg DM. The main disadvantage with maize silage is its low protein content (typically 8% DM) so most commercially available concentrates, which have been formulated to supplement grass silage-based diets, are unlikely to supply enough protein to meet the ewe's requirements. To balance dietary protein content when feeding maize silage as the sole forage, it is advisable to supplement with soyabean meal due to the low levels of supplement needed. An alternative strategy is to feed a mixture of maize silage and grass silage (ideally 50:50 on a dry-matter basis) to achieve a better protein balance in the forage and supplement with a 20-22% protein concentrate. Typical concentrate feed rates for ewes offered high quality maize silage are outlined in Table 8.5.

Table 8.5 Requirements (kg/d) for soya bean meal (maize silage only) or high protein concentrates (grass/maize silage mix) when ewes are fed maize silage-based diets in late pregnancy

	Maize silage			Mixed grass/maize silages		
Weeks to lambing	Singles	Twins	Triplets	Singles	Twins	Triplets
6 to 4	-	-	0.10	-	-	0.20
4 to 2	-	0.10	0.20	-	0.20	0.40
2 to lambing	0.10	0.25	0.40	0.20	0.40	0.60

It is important to note that maize silage contains less calcium than grass silage so additional calcium supplementation is needed. When feeding soyabean meal at the levels recommended in Table 8.5, ewes should receive 25g/head/day of a high calcium mineral/vitamin supplement (minimum 21% calcium). Ewes fed grass/maize silage mixtures should be fed concentrates containing at least 0.8% calcium.

High quality maize silage is a good substitute for grass silage in ewe rations

All-grain diets

All-grain diets are potentially a cost effective feeding solution for sheep producers. While straights or concentrate blends may be more expensive to purchase compared with home-produced grass silage (see Table 8.1), the level of capital investment in storage facilities, feeding equipment, etc is almost negligible with concentrate feeding and there is potential to reduce labour costs also. Feeding a high dry-matter diet also reduces the need for straw bedding.

The performance of ewes fed all-grain diets is comparable with those offered silage-based diets, as shown in Table 8.4. In fact, fewer lambing difficulties have been found in ewes offered all-grain diets which may reflect an improved ability of lambs to assume their normal birth presentation due to reduced gut fill in the ewe. Typical concentrate feed levels are presented in Table 8.6 for ewes carrying single, twin and triplet lambs.

Table 8.6 Suitable feed rates (kg/d) for ewes fed a concentrate blend in late pregnancy

Weeks to lambing	Singles	Twins	Triplets
6 to 4	1.00	1.20	1.40
4 to 2	1.10	1.40	1.60
2 to lambing	1.25	1.60	1.80

Since concentrates form the complete diet, a crude protein level of 13-14% is more than adequate to meet the ewe's protein requirements. However to minimise the incidence of rumen acidosis and feed refusals, high starch blends (40-50% cereals or

maize meal) should contain at least 30% high fibre ingredients. Research at AFBI Hillsborough has found that sugarbeet pulp or soya hulls are equally effective in this role. A small amount of straw (0.1-0.2kg/ewe/day) should also be offered to provide some long fibre in the diet, aiding contentment of the ewes.

The transition from a forage-based diet to an all-grain diet needs to be done gradually to avoid digestive upsets, especially where concentrates have not previously been fed. When moving from a silage-based diet, start by feeding ewes 0.5kg/d concentrates along with some silage and gradually remove silage from the diet altogether while increasing the level of concentrates by 0.1kg/d, provided ewes consume all the feed offered. Some ewes do not adapt well to all-grain diets, therefore it is advisable to split the daily concentrate allowance into at least 2 meals per day to check that all ewes are eating and to reduce the risk of over-eating, which can lead to digestive upsets. Ewes will generally consume their concentrate allocation within a few minutes so adequate trough space (0.45m or 18 inches per ewe) is essential. A continuous supply of clean drinking water is also essential and drinkers should be checked regularly, especially during cold weather.

Chapter 9: Targeting selenium deficiencies in sheep flocks

Summary
- Low selenium levels are widespread in NI flocks
- Know the selenium status of your flock before considering options for supplementation. Blood sample 4-6 weeks before tupping for best results.
- Selenium supplementation can have benefits for ewe fertility, lamb viability and performance.
- Various options for supplementation are available

Introduction

Selenium is an essential trace mineral for all livestock. In sheep, selenium plays an important role in preventing tissue damage, regulating energy metabolism and maintaining a healthy immune system. Selenium is therefore essential for good health, development and performance. Whereas the symptoms of clinical selenium deficiency (white muscle disease) are relatively rare, selenium inadequacy is widespread. In Northern Ireland, for example, a small survey involving six hill flocks has identified that up to 95% ewes within a flock can have inadequate selenium levels. This chapter outlines how a low selenium status can impact on flock performance.

Assessing the selenium status of your flock

The mineral status of ewes varies widely between flocks. Before an effective mineral supplementation strategy can be developed, it is critical to know the specific needs of your own flock. To accurately assess the mineral status of a flock, animals must be free from stress (e.g. pregnant, suckling, etc) and free from exposure to any form of mineral supplement within the last 8 weeks. For most flocks the ideal time to assess mineral levels is approximately 4-6 weeks before mating. Mineral status is determined from a blood sample obtained by your local vet. Ideally 6-8 randomly selected ewes should be blood sampled to obtain a reliable assessment of mineral status.

68% ewes sampled in AFBI trials had inadequate selenium levels

The best indicator of selenium status in sheep is the level of activity of glutathione peroxidise (GPX), a selenium-containing enzyme. GPX levels above 280 indicate that the flock's selenium status is satisfactory. GPX levels between 127-280 are an indicator that the selenium status of ewes is marginal, whereas levels below 127 indicate selenium deficiency.

Supplementing ewes with selenium improves lamb viability

Selenium is important for good muscle tone so the selenium status of lambs at birth can influence their viability. Because selenium is transferred to the lamb both before (across the placenta) and after birth (via the colostrum), supplementing ewes with selenium is a highly effective means of increasing selenium levels in lambs from the moment they are born.

When ewes have a marginal or low selenium status, research at AFBI Hillsborough has shown that supplementing ewe rations with selenium during early and mid-pregnancy can have significant benefits for lamb viability and performance, as shown in Table 9.1.

Table 9.1 Benefits for lamb viability and performance when ewes are supplemented with selenium during pregnancy

	Control ewes	Se-supplemented ewes
Lamb GPX at birth (U/g Hb)	657	1077
No. attempts to stand	37	42
Time to first successful stand (mins)	19.3	13.2
No. suck attempts	20	26
Immune status (ZST units)	45	55
Growth rate from birth to weaning (g/d)	289	305
Mortality rate at weaning (%)	23	15

Lambs from supplemented ewes got to their feet much more quickly and were keener to suckle compared with those from non-supplemented ewes. As a result, mortality rate was 7% lower for lambs born to selenium supplemented mothers. There was also a small benefit for lamb performance, with lambs born to supplemented ewes achieving 6% higher growth rates. The benefits of selenium for lamb mortality and growth performance are likely to result from increased milk production by the ewe as well as the higher selenium status of their lambs.

Selenium supplementation improves ewe fertility

Selenium supplementation prior to mating can have benefits for ewe fertility, even in flocks where selenium status is satisfactory. AFBI trials carried out on 6 hill flocks around Northern Ireland found that treating ewes with a long-acting selenium supplement (by subcutaneous injection) 4-6 weeks before tupping increased the average conception rate of ewes by 4% and average weaning rate by 9% compared with non-treated ewes (see Table 9.2).

Table 9.2 Effects of selenium supplementation at mating on fertility in hill ewes and performance of their lambs

	Control ewes	Se-supplemented ewes
GPX at mating (U/g Hb)	292	353
GPX pre-lambing (U/g Hb)	561	1351
Conception rate (%)	92	96
Lambs born per ewe mated	1.36	1.49
Lambs reared per ewe mated	1.18	1.29
Lamb growth rate (birth to 6 weeks) (g/d)	276	284

Increasing the selenium status of ewes also had some benefits for lamb performance, with lambs born to treated ewes achieving 3% higher growth rates than non-treated ewes in the first 6 weeks after birth.

Correcting low selenium levels

There are several options available to supplement ewes with selenium, including dietary supplements, free access licks, oral drenches, injections, slow-release boluses and pasture/soil application. Options vary considerably in terms of cost, practicality, labour requirements, stress on the animal and the persistency of the response.

Because ewes are slow to incorporate selenium into their body tissues, a minimum supplementation period of at least 20 days is needed to see any improvement in GPX levels and subsequent animal productivity. For this reason, supplements that provide a continuous and prolonged supply of selenium (e.g. long-term feed supplementation, slow-release boluses, sustained release injectables, etc) are recommended.

Supplementing ewes with selenium can help improve ewe fertility and lamb vigour

Section 3: Flock health

Chapter 10: Sustainable worm control

Summary
- Resistance to anthelmintic drenches in sheep is increasing but there are currently no reliable alternatives
- It is best to use existing anthelmintic drenches more sustainably by using faecal egg counts (FECs) to target dosing regimes

Introduction

Worm infections can cause major economic losses and welfare problems in sheep. For the past 50 years, regular dosing with anthelmintic drugs has been the most commonly used method of worm control in sheep. However there is growing evidence of resistance to some classes of anthelmintic drugs in sheep, in particular the 'white' drenches (benzimidazoles). Recent surveys in the UK and Ireland indicate that up to 95% of sheep flocks now have resistance to at least one of the three main classes of anthelmintic drugs. With the situation becoming worse each year, and with few new drugs currently being developed, there is a very real risk that some areas may have to abandon sheep farming in the future. This chapter examines some of the options to help reduce the chances of resistance becoming a problem on your flock.

Targeting dosing regimes

Faecal egg counting (FEC) is a simple technique that helps identify the level of worm infection in a flock, and consequently the need to dose, based on the number of worm eggs released in sheep faeces. With this technique it is also possible to identify which species of worm are present, which can aid the decision as to which drench to use.

Ideally dung samples should be obtained from a random sample of at least 12 sheep, although a single 'mob' (group) sample collected from approx. 20 dung pats can be used and is more practical. A faecal egg counting service is provided by AFBI's Veterinary Sciences Division at Stormont. Basic on-farm kits (e.g. Fecpak) are also available and can produce very accurate results with appropriate user training and experience. However on-farm trials of these kits carried out by AFBI have found that many farmers find it difficult to differentiate between the eggs produced by different worm species, leading to gross overestimation of the worm burden.

While they are a useful guide to help target dosing regimes, the decision whether or not to dose should not be based on faecal eggs counts alone. Other factors to be considered alongside the faecal egg count include the age of the animal, grazing history, current performance, clinical signs, previous treatments, time interval since the last treatment and the withdrawal periods of the product.

Faecal egg counting helps identify the level of worm infection for more targeted dosing regimes

‘Natural’ wormers

Tannins are naturally-occurring chemicals found in plants. These chemicals give plants a bitter taste, thus providing some degree of protection against grazing animals, insects and certain diseases. Laboratory studies have indicated that tannins can exert a toxic effect on some worm species infecting sheep. AFBI have undertaken field trials to investigate the potential for tannins to be used as an alternative to dosing lambs. Two supplementation strategies have been examined so far, although results-to-date have been disappointing:

1. *Adding tannins to the concentrates*: tannins have been isolated from wild plants and some are available commercially. Table 10.1 outlines the response in lambs when Quebracho was included in lamb creep. Regardless of the level of inclusion, adding tannins to the feed had no effect on faecal egg counts in lambs, although this could be influenced by the low level of worm burden overall. There was however some indication that tannin inclusion improved protein utilization when lambs were fed low protein diets, resulting in higher growth rates.

2. *Grazing plants containing tannins:* a number of herbs and forage crops that contain tannins can be grazed by sheep, including chicory, sainfoin and birdsfoot trefoil. Each of these crops were examined for their ability to reduce the worm burden in lambs that had previously grazed contaminated ‘dirty’ pasture. Lambs were grazed on these forages for 2 weeks and the faecal egg count was examined before and after grazing, as shown in Table 10.2. While egg counts were low prior to grazing, none of these crops were effective at reducing the level of worm infection when compared with lambs that remained on the contaminated pasture. There was some indication that grazing chicory could delay the build up of *Nematodirus* and *Trichostrongylus* infections although the benefits were small.

Table 10.1 Effect on tannin (Quebracho) inclusion in lamb creep on faecal egg counts and growth rate of lambs

	Level of tannin inclusion (%)		
	0	8	10
Strongyle FEC (eggs per gram)	20	38	69
Teladorsagia FEC (eggs per gram)	1950	2188	6918
Trichostrongylus FEC (eggs per gram)	1622	3020	3020
Live weight gain (g/d)	310	315	300

Table 10.2 Faecal egg counts of lambs before and after grazing either 'dirty' pasture or a range of bioactive forages

	Dirty pasture	Chicory	Sainfoin	Birdsfoot trefoil
Strongyle FEC (eggs per gram)				
Pre-grazing	70	111	92	24
Post-grazing	265	230	280	652
Nematodirus (eggs per gram)				
Pre-grazing	1	7	2	7
Post-grazing	1	3	9	4
Trichostrongylus FEC (eggs per gram)				
Pre-grazing	8	2	258	72
Post-grazing	157	20	422	104

Concentrate feeding

Creep feeding with concentrates is common practice on many sheep farms and has been shown to improve lamb performance at pasture where grass is in short supply. In situations where lambs are undernourished (e.g. grass shortage, poor forage quality), creep feeding can also help to reduce worm infections in lambs by 1) reducing dependence on grazed grass, the source of worm infections, and 2) increasing nutrient intake to compensate for nutrient losses due to worm infections.

Grazing chicory and other 'bioactive' forages were not effective at reducing worm burdens in lambs

Studies at Hillsborough have found that when lambs are grazing good quality grass swards, creep feeding has no effect on the level of worm infection, either before or after weaning (Table 10.3).

Table 10.3 Effects of creep feeding on faecal egg counts and growth rate of lambs from birth to slaughter

	No creep	12% protein mix	20% protein mix
Pre-weaning			
Strongyle FEC (eggs per gram)	11	3	5
Teladorsagia FEC (eggs per gram)	3162	1698	1660
Trichostrongylus FEC (eggs per gram)	2344	2188	2818
Live weight gain (g/d)	251	293	308
Post-weaning			
Strongyle FEC (eggs per gram)	-	93	65
Teladorsagia (worms per gram)	-	2291	1862
Trichostrongylus (worms per gram)	-	3388	1738
Live weight gain (g/d)	-	249	249

Providing access to creep feed before weaning resulted in higher growth rates and heavier weaning weights of lambs (+5kg) but this response was unrelated to the level of worm burden.

SHEEP 2011 - Key facts

High output hill flocks

- Crossbred hill lambs achieve heavier carcass weights with better conformation at a younger age
    - worth up to £6.31 more than purebred lambs
- Crossbred hill ewes are capable of rearing up to 18% more lambs per annum compared with pure Blackface
    - generates up to £7,600 additional income per year from a 500 ewe flock
- Crossing 2 hill breeds can reduce the replacement rate of ewes by up to 3%
    - reduces annual replacement costs by £1,000 for a 500 ewe flock.
- Crossbred ewes are up to 7kg heavier than purebred ewes.
- Texel-cross lambs and Texel X ewes exhibit more lambing difficulties

Easier-care sheep systems

- Sire selection is a key factor affecting lambing ease
    - Typically +30% ewes lambing to terminal sires need assistance
    - There are limited benefits from using NZ-cross terminal sires
    - Maternal sire breeds reduce intervention rates by around one third
- Selecting easier-care rams impacts slightly on carcass conformation
    - financial penalty is no more than 25p per lamb
- Indications are that NZ ram breeds perform well in NI flocks but carcass conformation can be poor
    - potential price penalty of £2.38 per lamb
    - work is ongoing to evaluate a range of NZ sire breeds

Feeding for performance

- Set targets for replacement ewes as soon as possible after weaning
    - 60% mature weight (around 45kg) at tupping
    - Growth rates of 0.5 kg/d for 100 days post-tupping to maximize fertility
- Monitor condition score in the main breeding flock from weaning onwards
    - Target a condition score 3.5 at mating
    - Maintain condition for the first month after tupping
    - Target a loss of 0.25 condition score units in the second and third months
- Base concentrate feed levels on forage quality
- Check the mineral status of ewes and supplement where levels are low or marginal

Options when grass silage is scarce

- Early spring grass is cheap and highly nutritious
    - Turnout 3-4 weeks pre-lambing on 3-5cm swards to avoid oversized lambs.
- High quality maize silage can reduce concentrate inputs
    - Supplement with soyabean meal to balance dietary protein
- All-grain diets can be as cost effective as grass silage
    - Increase feed level gradually and provide some straw to avoid digestive upsets
    - Avoid under- or over-feeding

- Ensure ewes have adequate feed space (18 inches per ewe)

Sustainable worm control

- Implement a targeted dosing regime
  - use faecal egg counts to identify when animals need dosing and which product to use
- Ensure anthelmintic drenches are used sustainably since no effective alternatives have been identified to-date.

Useful contacts

For more information on any of the topics discussed in this booklet, please contact the following:

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