Effects of rearing regime of replacements on the lifetime performance of ewes differing in prolificacy

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Introduction

The net cost associated with rearing a replacement to the point of joining with rams, and thus the ewe flock, at 18 months of age is €126. As the mean national replacement rate is 22%, the annual replacement costs of the national sheep flock equates to €55.3 million, which is equivalent to €1.20/kg lamb carcass produced. Two ways of reducing replacement cost are, firstly, to increase longevity and thus the number of crops of lambs produced, and, secondly, to increase litter size and thus the number of lambs weaned per ewe joined. The objective in this article is to present information from an on-going study at Athenry designed to evaluate the effects of plane (level) of nutrition during the rearing phase and first pregnancy, and ewe genotype on longevity and lamb output. The reasons for culling were recorded and are also presented.

Management of replacements to lamb at 2 years of age

The replacement cost in any flock is influenced by the replacement rate and rearing expense. Rearing expense is influenced by the plane (level) of nutrition offered during the first winter and second grazing season. Plane of nutrition offered during the first pregnancy affects total costs up to the point of lambing. A study was initiated at Athenry in mid November 2006 involving a total of 284 ewe lambs of four different ewe genotypes, which differed in prolificacy. For the years 2006 to 2008, inclusive, approximately 95 ewe lambs entered the study annually and remained (remain) on the study until culled for normal husbandry/health reasons or the die. This study is ongoing as nearly 15% of the animals are still in the flock. The study may run until 2017, depending on the culling rate of the remaining animals.

During their first winter the ewe lambs were managed at pasture in an extended grazing system and offered either a low (0.75 kg DM) or high (1.75 kg DM) daily herbage allowance with the intention of varying energy intake and thus growth rate. From early April to 30 August half of the lambs from each winter treatment were divided equally to graze pasture, set stocked to ensure either a low or high herbage allowance. This was achieved by maintaining sward heights at 4 cm (low) and 6 cm (high), respectively. From 30 August until housing (mid December) the 2-tooth ewes (hoggets) were managed as one flock. At first joining the ewes were, on average 77 % of mature body weight.

Effect of dietary treatment on performance until mating as 2-tooth ewes

Lambs that were on the high plane of nutrition during their first winter and subsequent summer were 8.5 kg heavier (61.7 kg) than those on the low level of nutrition (53.3 kg) throughout the rearing phase (Table 1). By early September (18 months), animals that were on the high level of nutrition in winter and had been moved to the summer low level or those which have previously been on the low level in winter and moved to the summer high level of nutrition were of similar weight (56.7 kg) at joining. Consequently, the animals offered the high level of nutrition throughout the study were 16% heavier than those offered the low level of nutrition.

Effect of plane of nutrition on ewe reproductive performance

The effects of plane of nutrition offered during the winter and summer of the rearing phase on ewe prolificacy are presented in Table 1. Whilst plane of nutrition impacted on body size (frame size, weight and condition score) at joining, plane of nutrition during the rearing phase did not affect litter size or weaning rate (number of lambs weaned per ewe joined to rams) of ewes lambing as 2 tooths (2 years of age) or up to 5 years of age.

Plane of nutrition during the first winter

The two planes of nutrition offered during the first winter resulted in metabolisable energy intake equivalent to 73 and 142 % of maintenance requirements. The effects of plane of nutrition offered during the first winter on ewe and progeny performance as 2 year olds and up to 5 years of age are presented in Table 2. Increasing the plane of nutrition offered during the first winter increased lamb birth and weaning weights, improved lamb growth rate from birth to weaning for ewes lambed as 2-tooths, improved total performance up to 5 years of age, and reduced ewe barrenness. The response in lamb weaning weight to increased plane of nutrition of the dam during first winter was consistent (0.6 kg) regardless of ewe age at lambing. Plane of

nutrition offered during the first winter had no effect on the mortality of lambs born to ewes up to 5 years of age.

Table 1. Effect of plane of nutrition during the first winter and second grazing season on animal performance

	Winter nutrition			
	High		Low	
Summer Nutrition	**High**	**Low**	**High**	**Low**
First joining - weight (kg)	61.7	56.6	56.8	53.3
- condition score	3.8	3.5	3.5	3.3
Performance as 2 year olds				
Litter size	2.02	2.14	2.11	2.08
Number weaned per ewe to ram	1.64	1.73	1.62	1.71
Mean performance to 5 years of age				
Litter size	2.11	2.14	2.21	2.21
Number weaned per ewe to ram	1.74	1.71	1.72	1.80

Plane of nutrition during the second grazing season

Altering the plane of nutrition offered during the second grazing season by changing residual sward height resulted in a similar difference in ewe weight at joining as occurred due to altering the winter plane of nutrition. The effects of altering summer plane of nutrition on the performance of ewes (and their progeny) at 2 years of age, and up to 5 years, are presented in Table 2. Plane of nutrition offered during the second grazing season did not alter litter size, number of lambs weaned per ewe let to the ram, or lamb birth or weaning weights from ewes when they lambed at 2 years of age, or up to 5 years of age, or ewe barrenness.

Table 2. Effect of plane of nutrition offered during the first winter and second grazing season on ewe and progeny performance

	Winter nutrition		Summer nutrition	
	High	**Low**	**High**	**Low**
Performance as 2 year olds				
Lamb birth weight (kg)	4.2	4.0	4.1	4.0
Lamb weaning weight (kg)	28.5	27.9	28.1	28.2
Mean performance to 5 years of age				
Lamb birth weight (kg)	4.3	4.2	4.3	4.3
Lamb weaning weight (kg)	31.0	30.5	30.7	30.9
Total number of lambings to 5 years	2.93	2.79	2.88	2.84
Lamb mortality (%)	8.3	7.6	8.6	7.6
Ewe barrenness (%)	3.6	6.1	4.9	4.8

Effect of plane of nutrition during the first pregnancy

Silage feed value is influenced by its digestibility (DMD) and intake characteristics. The mean DMD of silages produced in Ireland for 2010, 2011 and 2013 was 68.7%, 70.3% and 67.3%, respectively. From housing until lambing half of the animals from each group were offered medium (DMD = 69.3%) feed-value grass silage while the other half was offered high (DMD = 75.2%) feed-value grass silage and thus had different levels of nutrition during first pregnancy. Regardless of silage feed value 2-tooth ewes carrying singles, twins, triplets and quads (scan information) received an average of 15, 21, 25 and 31 kg concentrate, respectively.

The effects of plane of nutrition offered during the first pregnancy on ewe (and subsequent lamb) performance when they lambed at 2 years of age, and on their performance up to 5 years of age are presented in Table 3. Increasing the plane of nutrition offered to pregnant ewes prior to lambing at 2 years of age increased lamb birth weight by 0.3 kg and weaning weight by 0.9 kg. The increased weaning weight was due to a combination of increased birth weight and growth rate (8 g/day) from birth to weaning. The low plane of nutrition resulted in higher ewe mortality (4.9%) and ewe barrenness (4.2%) relative to the ewes offered the high plane of nutrition (1.5 and 0.0 % respectively). Therefore, 98.5 and 90.9 % of 2-tooth ewes offered the high and low planes of nutrition during pregnancy weaned lambs. Consequently, increasing the plane of nutrition during the pregnancy of 2-tooth ewes increased the weight of weaned lamb by 9%. Whilst plane of

nutrition offered during the first pregnancy affected the performance of ewes lambing at 2 years of age, and of their lambs, it did not impact on ewe performance between 3 and 5 years of age.

Table 3. Effect of plane of nutrition offered during the first pregnancy on ewe and progeny performance

	First pregnancy nutrition	
	High	**Low**
Performance as 2 year olds		
Litter size	2.10	2.07
Number weaned per ewe to ram	1.72	1.63
Lamb birth weight (kg)	4.23	3.95
Lamb weaning weight (kg)	28.6	27.7
Mean performance to 5 years of age		
Litter size	2.17	2.17
Number weaned per ewe to ram	1.75	1.73
Lamb birth weight (kg)	4.3	4.2
Lamb weaning weight (kg)	30.8	30.7
Total number of lambings to 5 years	2.9	2.8
Ewe barreness (%)	4.1	5.3

Effects of ewe genotype on animal performance

The four ewe genotypes used were Charmoise X Scottish Blackface (SBF), Belclare X SBF, Belclare (carrying a gene with a large effect on ovulation rate- MG) x SBF and Belclare. These genotypes were chosen with the objective of representing a range in prolificacy that covers, and exceeds, that found at farm level. The four genotypes differed in body size, prolificacy (litter size), number of lambs reared and also in the performance of their progeny. As all ewes were mated to Suffolk sires, genetic differences in lamb performance can be attributed to ewe genotype. The effects of genotype on ewe performance when lambing up to 5 years are presented in Table 4. For the Charmoise x SBF ewes the average number of lambs weaned per ewe joined was 1.12, which is lower than the national average of 1.3 lambs. At the other extreme the number of lambs weaned per ewe joined for Belclare x SBF, Belclare and BelclareMG x SBF ewes (regardless of dietary treatment) was equivalent to the top 5%, 2.5% and <0.5%, respectively, of lowland ewe flocks nationally.

The progeny from Belclare, Belclare x SBF and BelclareMG x SBF dams achieved daily live weight gain to weaning (from grazed grass only) that were close to the target for the number of lambs reared per ewe. However, the progeny from the Charmoise x SBF performed poorly pre-weaning, their live weight gain being 33 g/day less than the mean of the progeny of the other breeds. Consequently, they were 3.7 kg lighter at weaning, but representative of the weaning weight achieved on many commercial farms.

Table 4. Effect of genotype on the performance of ewes lambing up to 5 years of age.

	Breed*			
	C x SBF	**Bel x SBF**	**Belclare**	**BelMG x SBF**
Litter size	1.45	2.10	2.25	2.56
Number weaned per ewe to ram	1.12	1.71	1.78	2.06
Lamb weight at birth (kg)	3.9	4.4	4.4	4.0
Lamb weaning weight (kg)	27.8	31.1	32.4	30.9
Lamb growth rate to weaning (g/day)	246	274	287	275
Total number of lambings to 5 years	2.6	2.7	3.3	3.9
Number of lambs reared to 5 years	2.9	5.3	6.5	8.2

* C x SBF = Charmoise x Scottish Blackface; Bel x SBF =Belclare x SBF; BelMG x SBF = Belclare x SBF (BelMG = Belclare carrying major genes for ovulation)

Ewe genotype had a major effect on the number of lambs reared and on the total weight of lamb weaned. For example, relative to the Charmoise x SBF, the Belclare x SBF, Belclare and BelclareMG x SBF genotypes increased the number of lambs weaned to 5 years by 83%, 221 and 283%, respectively. Results to date indicate that the replacement rate for the Charmoise x SBF, Belclare x SBF, Belclare and BelclareMG x SBF genotypes were 23, 26, 26 and 23% respectively. This preliminary analysis shows that whilst ewe prolificacy

impacts on replacement rate, the effect is probably quite small given the fact that, to date, the replacement rate for the highly prolific BelclareMGx SBF ewes is identical to that for the Charmoise x SBF.

Based on the information in Table 4 the replacement costs for ewes with similar prolificacy and productivity as the Charmoise x SBF, Belclare x SBF, Belclare and BelclareMG x SBF genotypes are equivalent to €0.83, €0.64, €0.56 and €0.48 per kg of lamb weaned during their lifetime. Another way to express the replacement cost is as per kilogram of lamb carcass produced. When expressing the cost per kilogram of lamb carcass it needs to be realised that the period of time for the lambs from the different ewe genotypes to achieve a given carcass weight differs, consequently, impacting on cost of production. The replacement costs for ewes with similar prolificacy and productivity as the Charmoise x SBF, Belclare x SBF, Belclare and BelclareMG x SBF genotypes are equivalent to €1.30, €0.96, €0.92 and €0.71 per kilogram of lamb carcass produced during their lifetime. Consequently, increasing weaning rate by 0.2 lambs per ewe joined with rams reduces replacement cost by the equivalent of 13 cent/kg lamb carcass. Even when fixed costs (land charge, building) are omitted replacement costs are still high equating to €0.86, €0.63, €0.61 and €0.47 per kilogram of lamb carcass produced during the lifetime of Charmoise x SBF, Belclare x SBF, Belclare and Belclare x SBFMG genotypes, respectively.

Effect of ewe age on ewe and lamb performance

The effects of ewe age on prolificacy and lamb performance are presented in Table 5. As ewe age increased to 4 years prolificacy, number of lambs weaned and lamb performance, as determined by weaning weight, all increased and lamb mortality declined. Ewes that lambed as 5 year olds had the same lamb output as ewes aged 4 years. Preliminary data (not presented) show that ewe prolificacy, or the performance of their lambs, did not decline when lambed as 6 year olds. Consequently, retaining older ewes in the flock (provided there are no reasons to cull) reduces replacement rate, and consequently, replacement cost, without any adverse effects on the weight of lamb weaned per ewe.

Table 5. Effect of ewe age on progeny performance

	Ewe age (years)			
	2	**3**	**4**	**5**
Litter size	1.96	2.11	2.31	2.29
Number weaned per ewe to ram	1.41	1.76	1.90	1.88
Lamb birth weight (kg)	3.8	4.1	4.4	4.8
Lamb weaning weight (kg)	27.7	30.9	32.3	32.1
Lamb growth rate to weaning (g/d)	247	276	286	279
Total lamb mortality (%)	15.7	6.1	3.5	2.8

Reasons for culling

The reason for culling, and the proportion of ewes culled is influenced by ewe age. The reasons for culling as influenced by ewe age are presented in Table 6. The percentage of ewes that died was similar for each ewe age group. Similarly, with the exception of the 3 year old ewes, the incidence of mastitis was similar regardless of age group. The proportion of ewes culled for mastitis was similar to the number of ewes that died. As ewes got older the percentage of ewes being culled for teeth (mouth), incidence of lameness and poor condition increased. The effects of ewe genotype and dietary treatment on culling will be assessed when all the ewes are culled which may take up to 3 more years.

Table 6. Age and reason at culling (% of ewes joined)

	Age					
	2	**3**	**4**	**5**	**6**	**Average**
No. joined	284	248	223	162	74	
Died	4.9	4.0	3.6	6.8	4.1	**4.7**
Mastitis	6.0	1.6	6.3	4.3	5.4	**4.7**
Condition	0	0.8	1.3	6.2	5.4	
Teeth	0	0.8	13.9	23.5	36.5	
Feet	0.7	0.8	0.4	3.1	4.0	
Other	1.8	1.2	0.4	1.2	0	

Other = Rupture or prolapse

Incidence of barrenness

Increasing the plane of nutrition offered during the first winter decreased the incidence of ewe barrenness by 2.5 percentage points (Table 2). In the current study ewes were not culled for barrenness. A total of 16% of the ewes in the study were barren at least once. On the basis of chance we would expect about 3% of ewes to be barren twice – the observed incidence was 3.5% and of the 10 such cases the second barren event was after a previous lambing that required major assistance in the case of 2 ewes. The evidence suggests that culling young ewes for barrenness increases replacement cost unnecessarily as the likelihood of being barren on a second occasion is low.

Effect of lamb birth type and rearing type on lamb performance

Birth type influenced lamb birth and weaning weights. However, the rearing type (i.e., number of lambs reared per ewe) also influences lamb performance. The effects of birth and rearing type on lamb weaning weight are presented in Table 7. Rearing a twin-born lamb as a single reduces the weight difference between single and twin-born-and-reared lambs by 65% (3.9 kg). Triplet-born lambs reared as twins will be approximately 1 kg lighter than twin-born lambs reared as twins. Triplet-born and quad-born lambs which were reared as triplets using the management system employed in the current study were as heavy at weaning as twin-born lambs reared as twins. The data presented in Table 7 clearly illustrate the need to know the flock weaning rate when determining the target weaning weight of lambs for a given flock and when interpreting the mean performance of a flock.

Table 7. Effect of birth type and rearing type on lamb performance

	Birth type								
	Single	**Twin**		**Triplet**			**Quad**		
Rearing type	1	1	2	1	2	3	1	2	3
Weaning weight (kg)	35.5	33.4	29.5	30.9	28.4	30.0	30.9	27.3	31.0

Conclusions

1. The plane of nutrition offered to replacements during their first winter has a lifetime impact on progeny weight at weaning – thus a high plane of nutrition during the first winter increases lamb weaning weight by 0.6 kg at all lambings up to 5 years of age.
2. Increasing the plane of nutrition offered during the first winter reduced the incidence of ewe barrenness from 6.1 to 3.6%.
3. Plane of nutrition offered to replacements during their second summer had no effect on subsequent ewe prolificacy or on the performance of their progeny.
4. Offering a high plane of nutrition during first pregnancy increased the weight of lambs weaned by 2-year old ewes by 9% due to a combination of lower ewe mortality and barrenness, and increased performance of progeny.
5. Ewe genotype, due to its impact on litter size, and thus number of lambs reared, is the main factor influencing the cost of replacement ewes.
6. Lambs born and reared as triplets, with appropriate management, were as heavy as lambs born and reared as twins.
7. Based on this study to date, and regardless of ewe genotype, replacements should be
    a. managed during their first winter to gain 40 to 50 g daily.
    b. managed during their second summer to gain approximately 90 g daily
    c. offered a high plane of nutrition during their first pregnancy.
8. An increase in weaning rate of 0.2 lambs per ewe joined reduces replacement cost by the equivalent of 13 cent/kg of lamb carcass produced.
9. Final recommendations from this study will not be available until 2017 by which time all ewes are expected to have been culled.