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Nutrition during pregnancy: management and consequences

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Take home messages

1) Pregnancy nutrition is the foundation influencing the profitability of grass-based systems of prime-lamb production because it impacts lamb mortality, lamb birth weight ewe colostrum production and body condition at lambing and subsequent lamb performance
2) Shearing ewes at housing results in an increase in lamb body weight of 1.9 kg at weaning, which is equivalent to the response from feeding 19 kg of concentrate per lamb from birth to weaning
3) Each 5% unit increase in the DMD of silage offered to ewes that are housed from mid-December until lambing in March increases ewe body weight at lambing, lamb birth weight and weaning weight by 6 kg, 0.3 kg and 1 kg, respectively
4) Response to concentrate supplementation in late pregnancy depends on silage feed value. Excess concentrate supplementation will not yield an economic response
5) Develop a late pregnancy nutrition plan to provide the required amount of concentrate
6) Purchase concentrate based on ingredient compostion and not solely on price
7) Use a concentrate with 19% protein formulated using good quality ingredients
8) Concentrate supplementation should be stepped up weekly immediately prior to lambing to meet ewe requirements
9) Plan now to produce high feed value silage for next year

Introduction

What happens within 24 hours of lambing has a major impact on the number of lambs reared per ewe joined, the most important variable influencing profitability on sheep farms, because:

1) 58% of lamb mortality occurs within 24 hours of birth. Dystocia is the second main cause of lamb mortality, accounting for 20% of deaths. Under-weight lambs have a higher mortality due to their greater surface area relative to body weight.
2) Birth weight influences lamb growth rate, and thus weight at weaning. Previous studies at Athenry have shown that each 0.5 kg increase in lamb birth weight increases weight at weaning by 1.6 kg, which reduces age at slaughter by approximately 10 days.
3) Colostrum intake within hours of birth influences lamb survivability and subsequent ability to develop immunity to infection.
4) Ewe body condition score influences how the ewe partitions nutrients during lactation. If a ewe has a low body condition score at lambing she will tend to prioritise restoring her body reserves. If she has a high body condition she will prioritise milk production and also has greater ability to mobilise body reserves to produce milk, i.e., milk off her back.

The four points above are impacted by the nutrition plan implemented during pregnancy. The correct nutrition plan increases ewe colostrum production, ensures a good body condition score at lambing, increases lamb birth weight and subsequent lamb performance, all of which improve the financial margin from a sheep enterprise. A poor nutrition plan, on the other hand, results in inadequate colostrum production and light lambs, which have a higher incidence of mortality and are older when drafted for slaughter.

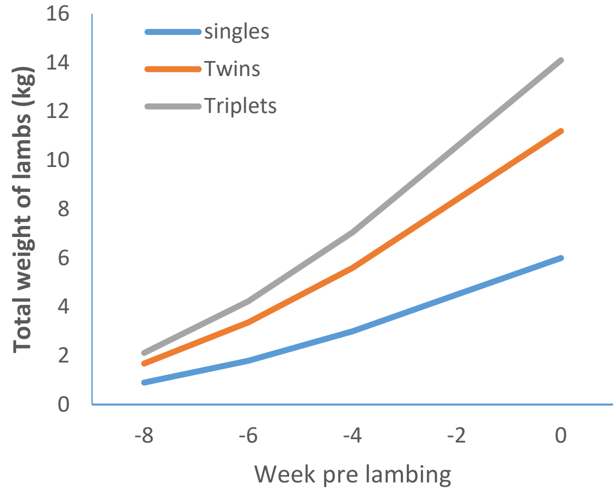
The objective in this paper is to summarise results from many studies undertaken at Athenry on the effects of nutrition during pregnancy on the performance of lambs from birth to slaughter in grass-based systems of prime-lamb production. In all the studies cited the only lambs that received concentrate supplementation pre-weaning were those that were reared as triplets (maximum of 300 g concentrate/lamb daily). Lambs did not receive any concentrate supplementation between weaning and slaughter.

Foetal and placental development

The mean gestation length in sheep is 147 days. Embryo attachment to the uterus is completed by 28 to 35 days after conception. The placenta grows at a rapid rate during early pregnancy reaching its maximum weight at about 90 days of gestation. For a twin-bearing ewe the placenta weighs approximately 1 kg at day 90 of gestation.

The foetus only weighs approximately 0.3 and 1.5% of their birth weight at weeks 4 and 8 of gestation. Most of the growth of the foetus occurs during the last 8 weeks of gestation (see Figure 1). For example, the foetus weighs approximately 15%, 30%, 50% and 75% of its birth weight at weeks 8, 6, 4 and 2 prior to parturition, respectively. Consequently, the weight of the foetus increases by 85%, 70%, 50% and 25% during the final 8, 6, 4 and 2 weeks of gestation, respectively. Therefore, the nutrient requirements of the foetus increase rapidly during late gestation.

Figure 1. Total weight of foetuses, by litter size, during the final 8 weeks of pregnancy



Shearing pregnant ewes at housing

Three studies were undertaken at Athenry on the effects of shearing March-lambing ewes, at housing in December, on their subsequent performance and that of their lambs. In each study, ewes were housed, either unshorn or shorn, and offered grass silage *ad libitum.* For the 6 weeks prior to lambing ewes carrying singles, twins and triplets received a total of 12, 20 and 25 kg concentrate, respectively.

Ewes shorn at housing are easier to monitor during late pregnancy and post lambing. Shearing at housing did not alter ewe condition score at lambing. The effects of shearing ewes at housing on subsequent lamb performance are presented in Table 1. Lambs born from ewes that had been shorn at housing were 0.6 kg heavier at birth and 1.9 kg heavier at weaning. Whilst shearing at housing increased lamb birth weight, it did not affect the incidence of lambing difficulty or lamb mortality.

The increased birth weight of the lambs from ewes shorn at housing was attributable to increased silage dry matter intake by the ewe, which was partly a reflection of cold stress immediately post shearing and, more importantly, a reflection of reduced heat stress in late pregnancy plus an extended gestation period. The difference in silage intake between the shorn and unshorn ewes was similar from housing until lambing.

The increase in lamb weight at birth (0.6 kg) was trebled (1.9 kg) at weaning at 14 weeks of age. The increase in lamb weight at weaning obtained due to shearing ewes at housing is the same response as would be expected from providing 19 kg of creep concentrate to each lamb prior to weaning, which would cost approximately €8/lamb. Shearing at housing (cost €3/ewe) is equivalent to a saving in creep concentrate of approximately €14/ewe for ewes rearing 1.7 lambs. Previous studies at Athenry have shown that an increase in lamb weaning weight of 2 kg reduces the age at slaughter by approximately 2 weeks.

Table 1. Effect of shearing ewes at housing on subsequent lamb performance

	Shearing date	
	May	Mid December
Ewe condition score at lambing	3.5	3.4
Lamb birth weight (kg)	4.1	4.7
Lamb weaning weight (kg)	31.5	33.4

(Keady and Hanrahan 2008, 2009a; Keady et al. 2007)

Ewe nutrient requirements

Pregnancy has little impact on nutrient requirements during early and mid-gestation as the foetus/es are growing at a slow rate. However, as foetal growth accelerates during the final 8 weeks of gestation nutrient requirements increase rapidly. The total requirements for nutrients are influenced by the stage of gestation, the number of foetuses and ewe body weight.

Energy requirements

The effects of stage of gestation, litter size and body weight on the energy requirements of pregnant ewes are presented in Table 2. An increase in ewe body weight of 10 kg increases daily metabolisable energy (ME) requirements for maintenance by approximately 1 MJ/day. Increasing litter size has the greatest impact on ME requirements during late pregnancy and the impact increases as parturition approaches. For example, relative to single bearing ewes (70 kg), ewes that are carrying triplets require an extra 3.4 and 8.3 MJ daily during weeks 6 and 1 prior to lambing, respectively. Ewes in late pregnancy can meet some of their energy requirement by mobilising body reserves (condition). For example, a daily weight loss of 100 g yields about 2 MJ of ME. Therefore having ewes in good condition is an advantage as they have body reserves that can be mobilised during late pregnancy to meet requirements, at a time when the ewe may not be physically able to consume sufficient food to meet those requirements.

Table 2. The effects of ewe body weight, litter size on ME requirements during the final 6 weeks of pregnancy.

Ewe weight (kg)	Litter size	Litter weight (kg)	Week Prior to lambing					
			6	5	4	3	2	1
70	1	5.5	10.6	11.2	11.9	12.7	13.6	14.6
	2	9.8	12.7	13.8	15.0	16.5	18.1	19.9
	3	12	13.8	15.1	16.6	18.4	20.4	22.6
80	1	6	11.7	12.3	13.1	14.0	15.0	16.1
	2	10.8	14.0	15.2	16.6	18.2	20.0	22.0
	3	13.5	15.3	16.8	18.6	20.6	22.8	25.3

(AFRC 1993)

Protein requirements

Protein requirements are also influenced by litter size, stage of gestation and ewe weight (Table 3). Crude protein in a feedstuff is calculated as nitrogen x 6.25. However, the type of protein in the diet is important: some types are readily soluble in the rumen leading to a lower supply of amino acids for absorption in the intestine, whereas other types can bypass degradation in the rumen, and so are available for digestion in the intestine and thus have a higher feed value. Hence, when formulating rations, proteins are divided into two main types: effective rumen degradable protein (ERDP) and digestible undegradable protein (DUP). The ERDP is readily broken down in the rumen and is available to the rumen microbes while DUP is the protein fraction that passes through the rumen and is digested in the intestine. The Metabolisable Protein (MP) concentration of a diet is determined by the concentrations of the ERDP and DUP fractions. The MP requirements, increase with ewe body weight, litter size and stage of pregnancy (Table 3).

Table 3. The effects of ewe body weight, litter size on MP requirements during the final 6 weeks of pregnancy.

Ewe weight (kg)	Litter size	Litter weight (kg)	Week Prior to lambing					
			6	5	4	3	2	1
70	1	5.5	89	93	96	101	106	111
	2	9.8	102	107	114	122	131	140
	3	12	108	115	123	133	144	155
80	1	6	96	100	104	109	114	120
	2	10.8	110	117	124	133	142	153
	3	13.5	118	126	135	146	158	171

(AFRC 1993)

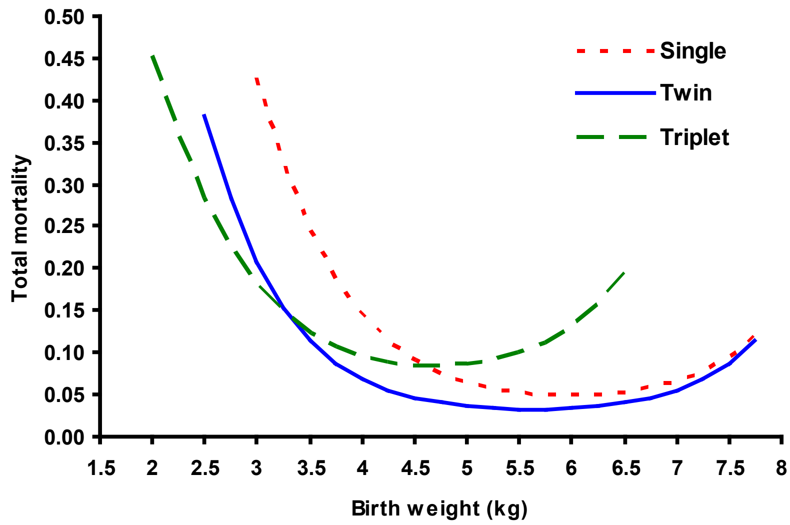
Effects of lamb birth weight

The weight of a lamb at birth influences both the risk of mortality and subsequent growth rate.

Lamb mortality to weaning

Birth weight is a major factor influencing lamb viability. The effect of lamb birth weight on total mortality to weaning of lambs born as singles, twins and triplets is shown in Figure 2. The data were collected from 2905 lambs born at Athenry in a flock that had a mean litter size of 2.0 and total lamb mortality (to weaning) of 10.1%. While optimum birth weight is influenced by litter size, lambs that have a low birth weight have a high incidence of mortality (as high as 40%), regardless of litter size. As birth weight increases mortality declines initially but reaches a plateau, the optimum birth weight, which varies by litter size. At the bottom of the plateau mortality was 5, 4 and 9% for singles, twins and triplets, respectively. Subsequently, as birth weight increases above the optimum, lamb mortality increases again, increasing more rapidly for triplets, followed by twins and then singles. The increase in lamb mortality as lamb birth weight increases above the optimum probably reflects difficulties immediately prior to, and during, delivery. The optimum birth weight, based on lamb mortality, for singles, twins and triplets is 6.0, 5.6 (0.93 that of a single) and 4.7 (0.78 that of a single) kg, respectively.

Figure 2. Relationship between lamb birth weight and total mortality for lambs born as singles, twins and triplets (Hanrahan and Keady 2013)



Lamb mortality is also influenced by litter size and increases as litter size increases. For lambs born as singles, twins and triplets mean lamb mortality (total to weaning) is 6, 7 and 21% respectively. Consequently, as flock prolificacy increases lamb mortality will increase. Data from the National Farm Survey indicate that lamb mortality in lowland flocks is 8.5% while the mean litter size is approximately 1.5.

Lamb performance

Data from a number of studies at Athenry show that each 1 kg increase in lamb birth weight results, on average, in an increase of 3.2 kg in weight at weaning (14 weeks of age). The increased weight at weaning reflects the increase in weight at birth plus a higher daily live weight gain to weaning. Thus, the objective should be to produce lambs which have a high birth weight around the optimum.

Effects of silage feed value

Ewes housed during pregnancy are normally offered grass silage as the basal forage, and are supplemented with concentrates during late pregnancy. The main factor influencing the feed value of grass silage is digestibility (DMD) since it affects both intake characteristics and ME concentration. A number of studies on the effect of silage feed value on the performance of ewes during mid and late pregnancy have been undertaken at Athenry and the results of one of these are presented in Tables 4 and 5, and Figure 3. In these studies ewes were housed in early December, shorn within a few days of housing, and lambed in early March.

Increasing silage feed value increased silage dry matter intake by 41% during weeks -10 to -6 prior to lambing. When concentrate supplementation was initiated the intake of medium feed-value silage (70% DMD) remained relatively unchanged up to lambing whilst that of the high feed-value silage (79% DMD) declined as concentrate feed level increased (Figure 3) - reflecting differences in substitution rate. The substitution rate, reduction in silage dry matter intake per 1 kg of concentrate consumed, was 0.18 kg for the medium feed-value silage compared with 0.75 kg for the high feed-value silage. This clearly shows that concentrate was displacing high feed-value silage in the diet.

The effects of silage feed value on food intake during the final 6 weeks of the study, the time of peak energy demand, are presented in Table 4. The intake of ME increased by 53% for the ewes on the silage with a high feed-value. This increase in ME intake was due to a combination of increased silage DM intake and the higher ME concentration of the high feed-value silage. The ewes offered the high-feed value silage in the current study met their ME requirement until the final week prior to lambing. This is demonstrated by the fact that ewes offered the high-feed value silage gained 0.15 units of body condition (BCS) during the final 6 weeks pre-lambing whilst those offered the medium feed-value silage lost 0.35 BCS units, a difference of 0.5 units, in 7 weeks due to silage feed-value alone (Table 4). Between housing in mid-December and lambing, the ewes offered the MFV silage actually lost 0.8 units of BCS, whilst those offered the HFV silage gained 0.3 units, a difference of 1.1 BCS units due to silage feed value when offered during mid and late pregnancy. This difference is reflected in a difference in body weight of 10.2 kg post lambing.

Figure 2: Effect of silage feed value and stage of gestation on silage and total food DM intake (kg/day) during the final 7 weeks of pregnancy

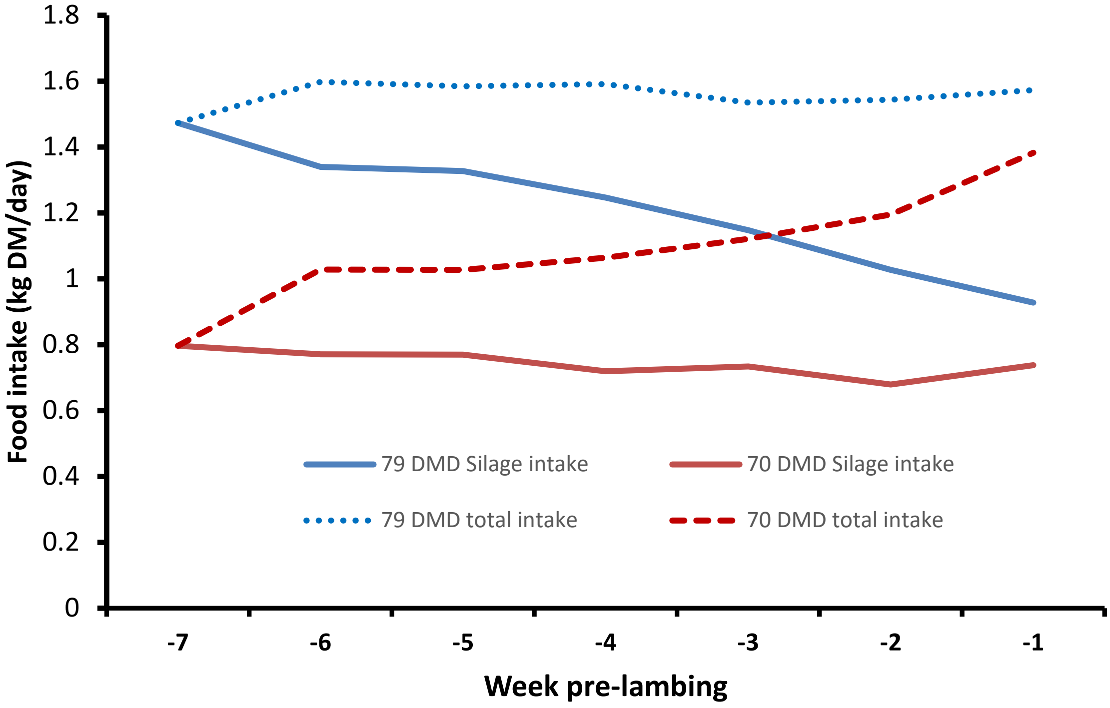


Table 4. The effects of the feed value of grass silage and concentrate feed level in late pregnancy on ewe performance

		Silage feed value (DMD %)			
		High (79%)		Medium (70%)	
Concentrate per ewe in late pregnancy (kg)		15	25	15	25
ME intake (MJ/day)		18.7	19.4	11.5	13.5
Ewe weight immediately post lambing (kg)		71.7	73.6	61.8	63.0
Ewe BCS*	-week 6 pre lambing	3.8	3.9	3.2	3.2
	-lambing	4.0	4.0	2.8	3.0
	-weaning	3.4	3.5	3.1	3.1

*BCS = body condition score (Keady and Hanrahan 2021)

Between lambing and weaning, the ewes that had been offered the high and medium feed-value grass silages indoors partitioned energy intake differently. The ewes that were offered the high feed-value silage lost 0.5 BCS units whilst BCS increased for those ewes offered the medium feed-value silage. These changes in BCS indicate that the ewes on the medium feed-value silage partitioned energy intake to replenish their own body reserves whilst those offered the high feed-value silage sacrificed body reserves in favour of milk production, and thus better lamb performance. The fact that ewes offered the high feed-value silage indoors still had a higher BCS at weaning than those on the medium feed-value silage could impact ewe longevity. On a farm with low feed-value silage and the management decisions implemented between weaning and the following mating season would have to ensure an adequate recovery of ewe BCS prior to joining.

The effects of the feed value of silage offered to ewes, whilst housed, on the performance of their lambs at pasture are presented in Table 5. The lambs from the ewes offered the high feed-value silage were: 0.5 kg heavier at birth, 1.9 kg heavier at weaning and 17 days younger when drafted for slaughter. Based on data from previous studies at Athenry, this reduction of 17 days at slaughter is equivalent to the response that would be expected from feeding ~19 kg concentrate per lamb from birth to slaughter. As each ewe in the current study reared 1.75 lambs, this would equate to 33 kg concentrate per ewe: costing approximately €14/ewe.

Table 5. The effects of the feed value of grass silage and concentrate feed level in late pregnancy on ewe and lamb performance

	Silage feed value			
	High		Medium	
Concentrate per ewe in late pregnancy (kg)	15	25	15	25
Lamb - birth weight (kg)	5.1	5.1	4.6	4.6
- weaning weight (kg)	33.9	33.4	32.5	31.1
Age at slaughter (days)	156	164	171	182

(Keady and Hanrahan 2021)

Results from a previous study undertaken at Athenry on the effects of grass silage feed value on the the performance of 2-tooth ewes are presented in Table 6. This was part of a large study, replicated over 3 years using a total of 287 ewes, concerning the effects of plane on nutrition at different phases during the rearing of replacements, which lambed for the first time at 2 years of age. In that study ewes were housed in early December, shorn within a few days of housing and lambed in mid-March. Ewes scanned as carrying singles, twins, triplets or quadruplets received a total concentrate supplement of 13, 20, 28 and 31 kg, respectively, during late pregnancy. Grass silage with the higher feed value increased ewe BCS at mid pregnancy and at lambing by 0.5 and 0.8 units, respectively. Increasing silage feed value reduced the number of ewes that failed to lamb and increased lamb birth weight. Whilst increasing grass silage feed value tended to increase the proportion of ewes requiring assistance at lambing, lamb mortality was lower for ewes offered the high feed-value silage (6.5% compared with10.6% for lambs from ewes offered the low feed-value grass silage). Increasing grass silage feed value increased lamb weight at birth and at weaning.

Table 6. The effects of the feed value of grass silage on the performance of 2-tooth ewes

		Silage feed value (DMD %)	
		75	69
Ewe body condition	- mid pregnancy	3.5	3.0
	-lambing	3.4	2.6
Failed to lamb (%)		1.0	6.6
Lamb birth weight (kg)		4.4	4.0
Lamb weaning weight (kg)		29.3	28.1

(Keady and Hanrahan 2018)

In summary, from a review of the literature, each 5% unit increase in the DMD of silage offered to ewes that are housed from mid-December until lambing in March increases ewe body weight at lambing, lamb birth weight and weaning weight by 6 kg, 0.3 kg and 1 kg respectively.

Producing high feed value silage

Silage production is one of the most important tasks undertaken on-farm annually. On many farms silage, which was ensiled in one day, is fed for up to 5 months. Consequently, one day's work can have long-term consequences for animal performance. As farmers see their silage each day during the feeding period, this is a good opportunity to assess its feed value, their silage making practices, and to form a plan for the coming season that will produce silage with a DMD that is 5% units higher. More information on the factors influencing silage feed value and the production of high feed-value silage is available in the publication of Keady et al. (2013).

Digestibility

Digestibility (DMD) is the main factor influencing silage feed value. For high feed-value silage, the DMD needs to be at least 75%. Increasing silage DMD presents the producer with 2 options for next winter: maintain concentrate feed level and increase animal performance or maintain animal performance and reduce the level of concentrate supplementation.

Factors affecting digestibility

Most factors that affect silage DMD are within the control of the producer. These factors are:

1) Harvest Date: Silage DMD declines by 3.3 units, on average, for each 1 week delay in the date of harvest, and is similar for first and second harvests. A delay of 1 week requires extra concentrate to maintain performance which means: an additional 1.8 kg/day for lactating dairy cows, +1.2 kg/day for finishing beef cattle, and up to 8 kg extra during late pregnancy for ewes.

The decline in DMD is due to stem elongation and the accumulation of dead material at the base of the sward canopy. In deciding when to harvest: walk the swards, look at the top of the canopy for plant maturity (seed head development) and at the base for accumulation of dead leaf. Note that mowing too close to the ground will result in ensiling low-digestibility stem and risks soil contamination, both of which reduce DMD. In broken weather do not delay harvesting for a protracted period of time in the hope of getting a wilt – it may not happen!

2) Crop Lodging: Lodging of the grass accelerates the rate of decline in herbage DMD as harvest date is delayed. This accelerated decline is due to the accumulation of dead leaf and stem at the base of the sward. In severely lodged crops DMD may decline by as much as 6 to 9 units per week delay in harvest.

3) Sward type: Old permanent pastures, that contain a reasonable proportion of perennial ryegrass and are harvested at the correct stage of growth, can consistently produce silage that has a high feed value, similar to that from perennial ryegrass swards.

4) Heading date: Comparisons of intermediate- and late-heading varieties have shown that to produce silage with the same DMD, herbage from late-heading varieties (heading date 12 June) must be ensiled no more than 8 days later than intermediate-heading (heading date 19 May) varieties despite the difference of 24 days in heading date.

If both intermediate- and late-heading varieties are harvested at 50% ear emergence the DMD of the silage from the late-heading varieties will be 7 units lower.

Wilting

Wilting herbage pre ensiling reduces effluent production, improves ensilability, reduces weight of material for transport during ensiling and feed out, and reduces straw requirements for bedding.

A rapid wilt is desirable. The rate of water loss during wilting is primarily related to solar radiation and swath density. Herbage in auto-swaths (two swaths placed into one) has a much higher density than herbage that is tedded out. Studies have shown that to increase herbage DM from 16% to 25% requires 65, 30 and 14 hours wilting, respectively, for herbage in auto-swaths, single swaths, or tedded out (to cover the total ground area) immediately post mowing.

Prolonged wilting reduces DMD by up to 2 percentage units per 24-hour wilting period in extreme cases. Tedders and rakes must be set correctly to avoid causing soil contamination as this reduces DMD.

Animal performance effects

From the mean of 11 comparisons it was concluded that rapid wilting prior to ensiling increased milk yield and the concentrations of fat and protein, resulting in an increase of 6% in fat + protein yield, but at the cost of increasing silage intake by 16%.

Ensiling in showery weather

Often ground conditions are good but occasional showers are not conducive to wilting. In these conditions some producers fear that herbage will be difficult to ensile and are tempted to delay harvest, thus reducing DMD, in the expectation of better weather. Results from a study where grass was ensiled at 19.0% or 13.7% dry matter (following water application) showed that dry matter percentage had no effect on silage fermentation or on the silage intake or performance of lactating dairy cows. Therefore if the grass is ready to ensile when dry, it is also ready when wet.

Chop length

Whilst chop length has no effect on the performance of beef cattle or dairy cows, chop length affects the intake characteristics of silage when offered to pregnant sheep. Studies have shown that silage that is precision chopped increases lamb birth weight and ewe weight at lambing compared silage that is not precision chopped due to differences in silage intake.

Silage additives

Animal performance is the most important measure of the efficacy of a silage additive since producers are paid for animal product, and not for the measured preservation quality of the silage. It is important to apply additives at the correct rate. For example, if the dry matter concentration of the ensiled herbage is increased from 18 to 25% by wilting, the weight of fresh grass will be reduced by 40%. This must be reflected in the rate of additive application.

There have been many comparisons of additives with respect to animal performance. A review of the published studies shows that:

1) effective inoculants, used under a wide range of ensiling conditions, increased the performance of dairy cows and finishing beef cattle.
2) effective inoculants can substantially improve animal performance without necessarily altering fermentation quality.
3) formic acid applied under difficult ensiling conditions improves animal performance
4) molasses, sulphuric acid and enzyme-based additives improved silage fermentation, but have no significant effect on animal performance.

Concentrate supplementation

Ewes are normally supplemented with concentrate during late pregnancy because they cannot obtain their nutrient requirements from silage as the sole diet. The quantity of concentrate supplementation required depends on silage feed value, expected litter size and stage of pregnancy. In a recent study at Athenry, increasing the amount of concentrate offered to the ewes on a high feed-value silage had little effect on total food intake (Figure 3) because of a high substitution rate. For ewes offered medium feed-value silage increasing concentrate level increased ME intake by only 2 MJ/day and yielded a small improvement in BCS at lambing (Table 4), but had no positive impact on lamb performance (Table 5). These results clearly illustrate that feeding excess concentrate does not necessarily improve animal performance and, thus, there can be a negative return on concentrate expenditure.

Whilst the data are not presented in this paper, a group of ewes were offered a high feed-value silage supplemented with only 5 kg concentrate (5 kg mineralised soya). They produced lambs that were 0.5 and 1.8 kg heavier at birth and weaning than lambs from ewes that received a medium feed-value silage supplemented with 25 kg concentrate, which clearly demonstrates the benefit of high feed-value silage.

The effects of silage feed value on the concentrate requirement of twin-bearing ewes in late pregnancy are presented in Table 7. It is assumed that the silage is being offered using good feeding management, i.e., ewes have access to fresh silage 24 hours per day and that any silage residue is removed twice weekly. Concentrate requirement is influenced primarily by silage DMD, but also by chop length (harvest system). For example, for silages at 75 and 65% DMD an additional 4 and 6 kg concentrate, respectively, are required for long-chop silage, compared to precision-chop silage, respectively. The concentrate requirements per ewe presented in Table 7 can be reduced by 5 kg in the case of single-bearing ewes, whilst concentrate supplementation should be increased by 8 kg for ewes carrying triplets.

Table 7. Effects of silage quality on total concentrate requirements (kg) of twin-bearing ewes during late pregnancy

	Silage DMD (%)		
	75	70	65
Precision chop	12	20	27
Big bale/Single chop	16	25	33

As the quantity of concentrate required per ewe during late pregnancy varies with silage feed value, expected litter size and stage of pregnancy, suggested daily concentrate supplementation rates are presented in Table 8 for different values of total concentrate input per ewe during late pregnancy.

Table 8. Daily concentrate allowance (kg) per ewe required for different total concentrate inputs per ewe during late pregnancy

Week prior to lambing	Target total concentrate input per ewe prior to lambing (kg)						
	5	10	15	20	25	35	45
8							0.4
7						0.4	0.6
6			0.2	0.3	0.4	0.5	0.6
5			0.2	0.3	0.4	0.6	0.8
4	0.1	0.2	0.2	0.4	0.6	0.7	0.9
3	0.1	0.2	0.3	0.5	0.6	0.8	1.0
2	0.2	0.4	0.5	0.6	0.7	1.0	1.0
1	0.3	0.6	0.75	0.8	0.9	1.0	1.1

Protein concentration of concentrate

For prolific flocks the concentrate should be formulated to contain 19% crude protein (i.e., 190 g of crude protein per kilogram as fed) because the grass silage on many sheep farms has a low protein concentration. The low protein concentration of silages on many farms is due to delayed harvest (low DMD) and low application of nitrogen fertiliser. As low levels of concentrate supplement are offered during weeks 6 to 4 prior to lambing there is no financial benefit from formulating low and high protein concentrates for most flocks in Ireland.

Concentrate ingredients

Concentrates are formulated using many different straights. Ingredient composition of concentrate was examined in a study at Athenry (Table 9). Two concentrates were formulated to have the same ME (12.4 MJ/kg DM) and crude protein concentrations (18.5 % as offered) but differing in the concentrations of digestible undegradable protein (DUP). The protein sources used were either soyabean meal or a mixture of by-products (rapeseed, maize distillers and maize gluten). Lambs born to ewes that had been offered the soyabean-based concentrate were 0.3 kg and 0.9 kg heavier at birth and weaning, respectively, than lambs born to ewes offered concentrate containing by-products as the protein source. The increase in weaning weight of lambs from ewes offered the soyabean-based concentrate (extra cost ~€0.60/ewe) is similar to the response obtained from offering each lamb 6 kg of creep concentrate until weaning (cost ~ €5/ewe per set of twins).

Table 9. The effects of concentrate protein source offered to ewe in late pregnancy on subsequent lamb performance

	Protein source	
	Soyabean meal	By-products
Lamb – birth weight (kg)	4.0	3.7
- weaning weight (kg)	30.9	30.0

(Keady and Hanrahan 2012)

Another interesting finding from that study was that lambs from ewes offered 16 kg of the soya-based concentrate were the same weight at weaning as lambs from ewes offered 28 kg of the concentrate containing the by-products. Thus, offering concentrates formulated using good ingredients can reduce the quantity of concentrate required in late pregnancy.

As ewes receive relatively small quantities of concentrate, and it is normally only offered in late pregnancy, the offered concentrate should consist of high feed-value ingredients. Maize and barley are good sources of energy, soya and rapeseed are good sources of protein and soya hulls and beet pulp are good sources of fibre. Relative to the prices of barley and soybean meal: rapeseed, distillers and maize meal are currently good value for money. Some ingredients need to be limited in ewe rations, e.g., distillers, because of potential copper toxicity. The ingredient composition of the concentrate that I have formulated for the ewes during late pregnancy at Athenry this year is presented in Table 10. The concentrate was formulated to contain 19% protein using good protein (soya, rapeseed), energy (maize, barley) and fibre (soya hulls, beet pulp) sources. When purchasing concentrate it is important to be aware of its ingredient composition rather than basing the purchasing decision based solely on price. A reduction in concentrate price of €20/t equates to a saving equivalent to only 45 cents per ewe, therefore focus on concentrate ingredient composition.

Table 10. Ingredient composition of the concentrate that will be offered to ewes at Athenry this year.

Ingedient	kg/t
Maize meal	300
Soyabean meal	180
Soya hulls	175
Rapeseed meal	100
Barley	80
Maize distillers	60
Sugar beet pulp	50
Molasses	30
Minerals and vitamins	25

Managing pregnant ewe lambs

Many producers are lambing replacements at one year of age. Replacements lambing at one year of age need to gain weight during pregnancy to enable them progress in a timely manner towards mature body size. Thus, relative to a mature ewe of similar weight, a ewe lamb requires an additional 2.5 megajoules (MJ) of ME (equivalent to 225 g of barley) daily during pregnancy to enable her to gain 50 g daily in live weight.

Management during pregnancy

Unlike mature ewes, ewe lambs during mid and late-pregnancy require a plane of nutrition that sustains a gain in body weight (excluding weight of the conceptus) of approximately 80 g/day in order to enable ewe lambs progress towards their normal mature body size. Energy is normally the first limiting component in the diet of pregnant ewe lambs. When formulating a ration for ewe lambs it is essential

to make allowances for requirements for maintenance, live-weight gain, wool growth, stage of pregnancy and expected litter size (as determined by ultrasound scanning). As a general rule, a pregnant ewe lamb requires an extra 2.5 MJ of ME relative to adult ewes of similar live weight at the same stage of pregnancy, and carrying the same litter size. Consequently, ewe lambs require high feed-value silage supplemented with concentrate after housing. The level of concentrate supplementation depends on silage feed value and expected litter size.

Management at Athenry

At Athenry pregnant ewe lambs were housed in mid-December, penned according to expected lambing date, shorn post housing and offered high feed value grass silage (75 % DMD) as the sole diet. In mid-January they received 250 g of concentrate daily. Following pregnancy scanning the ewe lambs were penned according to expected litter size and lambing date. Ewe lambs carrying triplets had their concentrate allowance increased to 300 g/day in mid-February. During the last 6 weeks of pregnancy (mean lambing date late March) ewes carrying singles, twins and triplets received a total of 18, 26 and 33 kg concentrate per head, respectively. The feeding schedule required to deliver different concentrate feed levels is presented in Table 8.

If the quality of the silage available is poorer than that used at Athenry then increased concentrate supplementation would be required over the period from housing to lambing.

Management post lambing

Ewe lambs rearing twins should treated the same as mature ewes rearing triplets, i.e., managed in a separate flock and have access to 0.5 kg concentrate daily for 5 weeks post lambing, whilst their lambs have access to up to 300 g concentrate daily until weaning. Ewe lambs rearing singles, and their lambs, do not require concentrate supplementation. Concentrate supplementation ceased at weaning.

Pregnancy nutrition plan

To optimise concentrate use a pregnancy nutrition plan should be prepared. For this the following is required:

a) laboratory analysis for the silage feed value
b) ewes should be grouped according to predicted litter size (based on ultrasonic scanning) and expected lambing date (mating date determined by information on raddle colour)
c) supplementation should be stepped up weekly over the weeks immediately prior to lambing to follow the known changes in ewe requirements.

The feed schedules required to deliver different concentrate feed levels, varying from 10 to 45 kg per ewe in late pregnancy are given in Table 8. During the week prior to lambing ewes receive up to 1 kg daily, clearly illustrating the benefits of penning ewes according to expected lambing date as well as expected litter size. For example, for each extra week on the high level of concentrate supplementation a flock of 100 ewes would consume ~700 kg concentrate - thus dramatically increasing concentrate usage and expenditure (by approximately €300).

References

Agriculture and Food Research Council, (1993). Energy and protein requirements of ruminants. An advisory manual prepared by the AFRC Technical Committee on Responses to Nutrients. Cab International, Wallingford, UK.

Hanrahan JP and Keady TWJ (2013). Lamb mortality in a prolific flock managed in an intensive grassland system: effect of lamb factors. Advances in Animal Biosciences 4:7.

Keady TWJ and Hanrahan JP (2009). Effects of shearing at housing, grass silage feed value and extended grazing herbage allowance on ewe and subsequent lamb performance. Animal 3, 143–151.

TWJ Keady and JP Hanrahan (2012). Effect of concentrate feed level and protein source on the performance of ewes in late pregnancy and the performance of their progeny. Advances in Animal Biosciences 3: 77.

Keady TWJ and Hanrahan JP (2018). Plane of nutrition during the rearing phase for replacement ewes of four genotypes: II - effects on performance during first pregnancy and to weaning, and of their progeny. Animal 12, 722–732.

Keady TWJ and Hanrahan JP (2021). Effects of grass and maize silage feed value, offering soybean meal with maize silage, and concentrate feed level in late pregnancy, on ewe and lamb performance. Animal 100068.

Keady TWJ, Hanrahan JP and Flanagan S (2007). The effects of extended grazing during mid, late and throughout pregnancy, and winter shearing indoors, on ewe performance and subsequent lamb growth rate. Irish Journal of Agricultural and Food Research 46, 169–180.

Keady TWJ, Hanrahan JP, Marley CL and Scollan ND (2013). Silage production – factors affecting the utilization of ensiled forages by beef cattle, dairy cows, pregnant ewes and finishing lambs. A review. Agricultural and Food Science 22, 70–92.