How do we manage gilts for good lifetime performance?

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Introduction

Replacement rates in the sow herd are too high! For example, in a comparison between the British and US industries based on national data, Gill [1] presented the following data (Table 1):

Table 1. Comparisons between the British and US industries sow performance data.

	Britain	**US**
Average sow life (years)	2.4	1.8
Litters/lifetime	5.4	4.2
Pigs weaned/lifetime	52.8	36.8
Replacement rate %	42	56

These suggest that the life span of most sows is disappointingly short and that culling is taking place far earlier than the industry mantra of 6 litters. This is further shown from a recent review of the literature gathered over the last decade [2] which indicated that the average parity at culling across Australia, Denmark, Norway and Sweden averaged only 3.92.

So, what are the reasons for the observed high levels of premature culling? Gill [1] again compared data from Britain and the US (Table 2):

Table 2. Comparisons between the British and US industries sow premature culling data.

	Britain	**US**
Reproductive failure		
Failure to conceive	19.8	-
No oestrus	5.9	-
Total	25.7	29.6
Low Productivity		
Old age	25.4	-
Small litters	7.9	9.4
Abortion	2.5	5.0
Mothering ability	5.6	8.8
Lameness/Leg weakness	6.5	11.0
Health/Physical damage	7.7	18.7
Death	10.7	10.7
Miscellaneous	8.0	6.6

Note that more than one in four animals were culled for failure to show oestrus or failure to conceive. Several authors have looked at within-parity culling patterns [3,4] and here the proportion of animals culled for poor reproductive performance is as high as 50% in the first litter (defined as an animal that has

not achieved a second farrowing, thus including maidens and animals that have farrowed one litter). The wastage of young females is further highlighted [1,2,3,4] by parity profiles from the culled population from commercial herds showing that first litter animals accounted for an average of 21% of culled females whilst maiden gilts made up 16 to 19% of culls.

Poor nutritional management of the breeding sow, and in particular the primiparous gilt, is often blamed for the high culling rate [2]. It has been conjectured that this may be partly due to the conflict caused by increasing the selection pressure for leaner animals and the requirement for the breeding female to have adequate body fat reserves to promote and maintain reproductive function [1].

UK Meat and Livestock Commission Gilt Trial

In order to study the effect that early nutritional management of the breeding sow has on lifetime productivity and longevity in the herd a major trial was set up by the British Meat and Livestock Commission (MLC) in 1995 at their Pig Development Unit at Stotfold [5] – this is outlined below:

The study sought to nutritionally manipulate the proportion of fat to lean in the maternal body prior to 1st service and during the 1st pregnancy. It also aimed to evaluate the influence of nutrition during the different phases of the gilt reproduction cycle on the subsequent reproductive performance and longevity (over 6 consecutive parities) of the gilt in the herd.

Commercial Large White x Landrace gilts from four Breeding Companies entered the trial at 25kg liveweight and were allocated to one of eight dietary treatments (see Appendix). The dietary treatments were applied between 30kg and the end of the first parity. Diets were classified as either high or low in dietary ideal protein during rearing, during gestation and during lactation. The nutritional treatments were only imposed until the gilt weaned her first litter. After this point, all sows received the same standard diets for the remainder of their productive lifetime.

In addition to standard measures of production such as number of piglets born and weaned, the sow's bodyweight and P2 backfat levels were measured at regular intervals. Reasons for culling sows from the herd were also recorded. A cohort of gilts was serially slaughtered at key points throughout the first parity to allow further analysis of the effect of dietary treatment on body composition.

Preliminary results have been published [1,6] and final results are in press. The main conclusions, based on MLC reports [7,8] are:

- As anticipated it was found that gilts that were offered a diet high in dietary ideal protein during the rearing phase were heavier and had lower back fat levels during parity one (Table 3). They also reached first oestrus at an earlier age and consequently were mated at an earlier age:

Table 3. Differences in reproductive traits between gilts offered high and low lysine diets.

	High Lysine	Low Lysine	P
Age at first oestrus	153	163	<0.001
Age at first mating	206	212	0.03
Weight at first mating	137	124	<0.001
P2 at first mating	15.8	16.1	0.39

- Rearing diet had no effect on litter traits in the first parity (Table 4):

Table 4. Differences in litter traits between first parity gilts fed high and low lysine diets.

	High Lysine	Low Lysine	P
Numbers born alive	9.99	9.76	0.55
Total birth weight	14.79	14.28	0.30
Number weaned	10.11	10.19	0.74
Total weaning weight	58.84	61.18	0.22
Weaning to service interval	8.7	8.2	0.71

- Gilts offered the high lysine gestation diet produced first litters with higher numbers of piglets born alive (Table 5):

Table 5. Comparisons between first litter traits of gilts fed high and low lysine diets.

	High Lysine	Low Lysine	P
Numbers born alive	10.26	9.47	0.04
Total birth weight	14.93	14.15	0.12
Number weaned	10.25	10.05	0.37
Total weaning weight	60.87	59.21	0.42

- There was a residual effect of gilt gestation diet on the weaning to service interval following parity one weaning in favour of the sows on the high protein gestation diet (Table 6):

Table 6. Comparisons between gilt weaning to service interval between two different diets.

	High Lysine	Low Lysine	P
Weaning to service interval	7.1	9.9	0.04

- There was no effect on total lifetime performance for either rearing or gestation diet treatments (Table 7):

Table 7. Comparisons of total lifetime performance between diet treatments.

	High Lysine	Low Lysine	P
Total piglets born	40.5	43.5	0.56
Total piglets born alive	38.0	39.9	0.61
Lifetime birth weight	57.8	59.9	0.56

- There were no significant effects of lactation diet on sow performance, indicating that nutrient intake per day may be more important than dietary composition *per se*.

- There was a significant effect of gilt rearing diet on the number of sows not completing six parities. Those sows offered the high protein rearer diet were significantly less likely to successfully complete all six parities. However, it should be noted that the strict criteria laid out in the Stotfold trial were designed to ensure that all treatment groups received equal inputs. This meant that gilts/sows that lost body condition could not be given extra feed to allow them to recover, as should happen in practice, during the subsequent gestation period. Instead these sows were removed from the trial on welfare grounds. Whilst this may have penalised the 'high protein' gilts, which were bigger on entry to the breeding herd, it does highlight the importance of increasing feed levels to take account of the larger body size of modern gilts if problems are to be avoided (Figure 1):

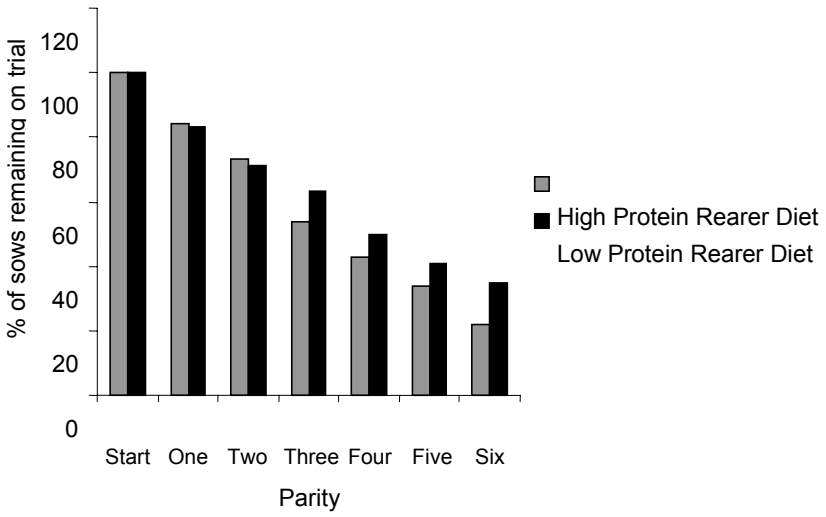

Figure 1. Effect of gilt rearing diet on the proportion of sows remaining in the trial for six parities.

- There was no significant effect of gestation or lactation diet on the number of sows completing six parities.

- There was no significant effect of dietary treatment on the reason for culling sows from the herd, although there was a trend (P<0.1) towards those sows on the low protein rearing diet being culled less frequently for leg problems. This is believed to be because these gilts will have a lighter bodyweight and grow more slowly, allowing bone strength and joint development to develop more adequately (Figure 2):

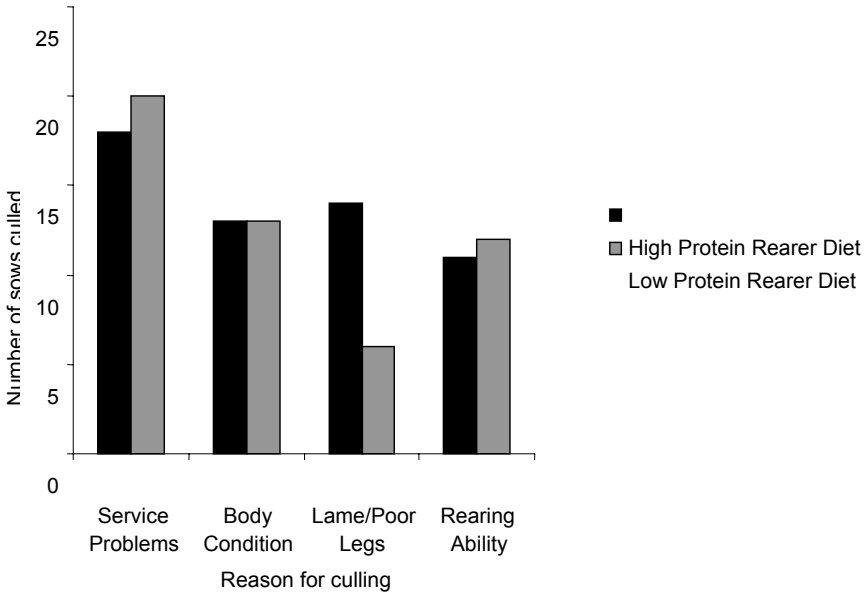

Figure 2. Number of sows culled for each gilt diet treatment.

- In terms of manipulating the proportion of fat:lean in the maternal body, carcass dissection data showed that those gilts offered the low protein diet had a significantly higher lipid:protein ratio.

- This study appears to suggest that in the case of the eight nutritional regimes offered in this trial the early nutritional management of the breeding gilt does not have significant long lasting effects on lifetime productivity. Protein growth is important in getting gilts to breed earlier and also to re-breed faster, but these benefits may be offset by reduced longevity.

- Gilts, after weaning the first litter, are quite resilient so that body fat acts as a 'buffer' against inadequate feeding.

These results are similar to those reported in other recent reports. For example, the reviews of Rozeboom [9] and Stalder et al. [2] have confirmed that gilt development nutritional trials have had a mixture of positive and negative impacts on sow longevity when measured through to the sixth parity. Kirkwood [10] postulates that data showing a relationship between body composition at mating and longevity may be "merely reflecting the consequences of subjecting improved pigs to conventional management." He further states "when modern

gilts are subjected to good management that minimises weight and condition loss during lactation, there is no association between live weight or backfat depth at first successful breeding and subsequent reproductive performance."

Practical considerations

Typical international industry targets for the gilt at mating are [1,11,12]:

220-240 days

120-140 kg

18-20 P2 backfat

Some research has indicated that backfat levels of 18 P2 or more are particularly important for a successful breeding life. For example, Challinor et al. [13] reported that gilts that had 18 to 22 mm of backfat at an average weight of 150 kg averaged 7.2 more piglets over five parities than did gilts with 14 to 16 mm backfat. However, other research has suggested that the relationships are complex. For example, Kerr and Cameron [14], in a long-term selection study, found that selection for lean growth over five generations did not adversely affect reproductive performance, although backfat was reduced.

Notwithstanding the variable results from the scientific literature, most commercial feeding companies and most producers are aiming for the 18 P2 backfat minimum. However, in the Stotfold gilt rearing study the increase in backfat through nutritional manipulation was quite small with the low protein rearer diet resulting in gilts with an average P2 backfat depth of 16.1mm at first service, compared with 15.8mm for the high protein rearer diet. This shows that, despite using a low protein diet strategy, the levels of back fat achieved were still a long way off the 18-20mm previously recommended for gilts entering their first pregnancy. It demonstrates the difficulty that exists in getting back fat cover on gilts of modern genotypes. As a result the MLC has issued simple national guidelines [8] on the nutritional management of the gilt. Key areas are summarised in the next section.

Guidelines for the nutritional management of the gilt

1. Feeding the gilt during rearing

During the rearing stage, the gilt is still a young, rapidly growing animal. This provides an opportunity to influence growth rate and the amount of fat and lean tissue deposited in the body of the gilt, and her subsequent reproductive performance, through nutrition and feed management.

- Gilts should be *ad lib* fed a finishing type diet to promote good rates of body weight gain during rearing.

- It is important to avoid excessive weight gains that may lead to an increased risk of gilts suffering from leg and lameness problems. Using a lower density

diet can help to slow growth on *ad lib* feeding. Ensure that recommended levels [15] of minerals and trace elements are provided.

- It is important to get the dietary protein provision correct - feeding a high protein rearer diet may improve gilt performance, but this benefit is likely to be offset by reduced longevity. However, whilst a low protein diet may promote longevity in the herd, this will increase days to first oestrus and mating, and possibly increase subsequent rearing to service intervals. Changing onto a higher protein diet just before puberty may be a compromise solution.

- Gilts, after weaning their first litter, are pretty resilient. Aim to get it right early on in the gilts life to help them build for later life and to avoid any negative effects on longevity and reproductive performance.

2. Feeding the gilt before mating

Mating is normally delayed until either the second or third heat after puberty. Nutrition and feeding during the oestrus cycle preceding mating can influence ovulation rate and in turn the number of live piglets the gilt produces in her first litter. Flush gilts by *ad lib* feeding a high nutrient density diet, such as that fed to lactating sows, during the oestrus cycle preceding first mating.

3. Feeding the gilt during pregnancy

Gilts fed concentrated cereal-based diets are normally fed restricted levels of feed during pregnancy. However adjustments to feeding level at different stages of pregnancy and overall feeding allowances for gilts will differ from farm to farm according to different conditions of production. There are three stages of pregnancy that influence the nutritional requirements of the gilt - early, mid and late pregnancy.

- **Early pregnancy (first 3 weeks after mating)**

Current advice is to reduce feed intake during early pregnancy to limit embryonic mortality.

- **Mid-pregnancy (interval between early and late pregnancy)**

During mid-pregnancy, gilts should be fed to achieve a target body condition score of around 3 to 3.5 at farrowing on a 1-5 scale.

- **Late-pregnancy (last 3 weeks before farrowing)**

In late pregnancy, feed allowances should be further increased to meet the demands of the rapidly growing litter carried by the gilt and avoid loss of gilt body condition.

Body condition score of individual gilts must be taken into account - when the gilt enters the farrowing house, around 5 days before farrowing, the feed level

should be reduced because maintaining a higher feed level may lead to udder problems or farrowing difficulties.

When setting the daily feed allowances of individual gilts it is important to take into account individual pig differences. These include the following:

1. Body weight- the bigger the gilt, the higher is her maintenance feed requirement and so she needs a higher daily feed allowance.

2. Body weight gain - the young breeding gilt will continue to gain body weight after mating during her first pregnancy and this may range between 50 and 60kg. This is in addition to the weight of the growing litter she is carrying during pregnancy. Gain in the second pregnancy should be around 25kg.

3. Condition score - feeding level throughout pregnancy should be adjusted according to the body condition score of individual gilts. The aim is to achieve a body condition score of around 3.5 by the end of pregnancy.

4. Environmental temperature - under low temperatures, feed requirements must be increased to counter cold stress and loss of body condition. For example, a gilt weighing 150 kg in good body condition (score 3 to 3.5) will require about 50 g of extra feed per day for every one degree drop in temperature from 20°C. In very high temperatures it is important to maintain feed intake targets.

4. Feeding the gilt during lactation

Every provision must be made to prevent gilts from losing too much body condition during lactation and being too thin at weaning. Thin gilts, and sows, at weaning take longer to come into heat, have poorer conception rates, more non-productive days and lower subsequent litter size. Factors that will help both gilts and sows to have a healthy appetite and prevent excessive weight loss include:

- Good hygiene – clean out any leftovers from the trough before adding fresh feed.

- A high quality, palatable diet.

- Frequent feeding - daily feed intake, or more specifically nutrient intake, is more important than the concentration of nutrients in the diet.

- An *ad lib* water supply - target flow rate from nipple drinkers should be 2 litres per minute to ensure good water intake.

- Cool conditions – as near to 18^{o}C in the farrowing house as possible.

- Efficient fostering practice.

Summary

Replacement and culling rates are too high. Often poor nutritional management is blamed as the modern lean breeding female may have inadequate body fat reserves to maintain sound reproductive function for longevity.

A major trial in the UK attempted to nutritionally manipulate body fat prior to first service and during the first pregnancy. Gilts reared on a high lysine diet were heavier and younger at mating than contemporary gilts reared on a low lysine fat-promoting diet. The high lysine animals produced more pigs in the first parity but there was a tendency to higher culling levels. Lifetime performance was not affected by nutritional regime. Diet had little effect on body fat and it was not possible to achieve typical industry targets for fatness at first mating. However, it appeared that gilts, after weaning their first litter, are pretty resilient. Thus, body fat acts as a 'buffer' when feeding is inadequate, but is not an issue per se when feeding is consistently adequate.

The results from the trial have been used to produce national guidelines for the development of nutritional strategies for gilt rearing.

Acknowledgements

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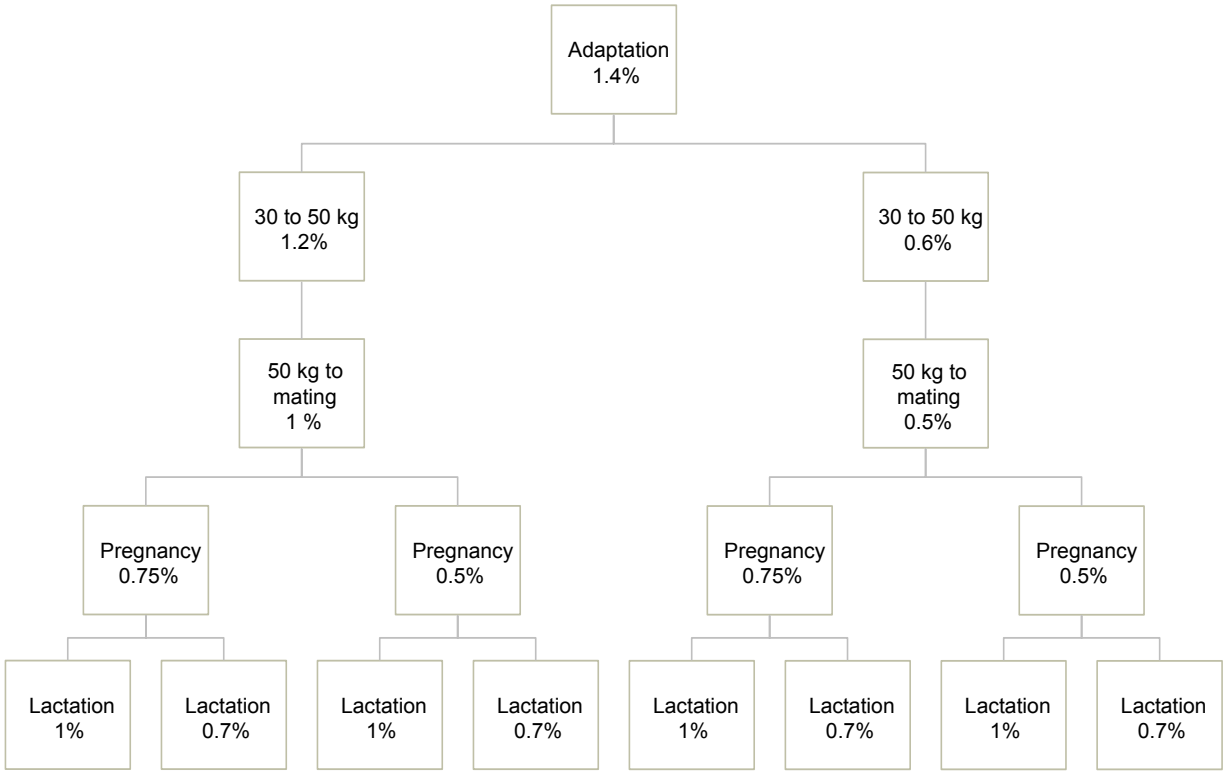
Appendix. Nutritional pathways for gilts during rearing and first parity



Diets differed in ideal protein (% lysine) but were isoenergetic and formulated to provide 14.5, 13.5, 13.5 and 14.5 MJ DE/kg over 30 to 50 kg, 50 kg to mating, pregnancy and lactation respectively.

Gilts were reared from 30kg to mating on high lysine (1.2 from 30-50kg: 1.0 from 50kg to mating) or low lysine (0.6 from 30-50kg: 0.5 from 50kg to mating) diets. After mating they were reallocated to diets containing either 0.75 or 0.55 lysine and then reallocated again at farrowing to diets containing either 1.0 or 0.7 lysine until weaning. Thus there were a total of eight different divergent nutritional pathways from 30kg to the end of the first parity. Post farrowing, diets were offered according to the Stotfold feeding scale for lactating sows – a 'stepped' scale designed to maximise lactation intakes.

After weaning (parities 2-6) sows were returned to the sow service yards and all offered the high protein rearer diet that had previously been offered in the isolation unit. The diet was offered at a starting rate of 4kg per sow per day increasing to 6kg per sow per day until they were mated.

Any sows that did not return to service within seven days after weaning were then offered the low protein rearer diet and their feed allowance reduced to 2.5kg per day. Any sows that had been mated were also offered this diet at the same rate.

Over subsequent parities all sows were offered the low protein gestation diet at a rate of 2.25kg per day increasing to 2.75kg per day in the last three weeks of gestation and the high protein lactation diet during the lactating period offered according to the Stotfold lactation feeding scale.