UK observations on lost genetic potential and future possibilities for improved sow performance

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The first limiting factor in pig production is genetic potential. Breeding Companies are proud of their achievements in continuing to maintain high levels of genetic progress with very little evidence of any 'plateau' effect. A review of literature estimates from the last ten years indicates the following annual changes in selection programmes in key measured traits:

	Mean annual change %
Litter size	+ 1.4
Growth rate	+ 1.7
Lean growth	+ 1.9
Feed conversion	- 1.3
Backfat	- 2.1
Feed intake	- 0.2

There are indications that progress in litter size may be increasing as programmes put more emphasis on reproduction traits and the use of BLUP with minimal inbreeding becomes more widespread. While growth rate, lean growth and feed conversion continue to show significant progress there is some evidence that selection against backfat is decreasing as programmes switch emphasis towards reproduction and 'meat' traits. At the same time, various techniques such as selection index manipulation and selection on components traits should be halting the long-term decline in feed intake.

Despite these genetic advances, progress in some traits at commercial level has been disappointing. As an example, consider the data from the UK Meat and Livestock Commission (MLC) recording scheme over the last fifteen years:

	MLC Yearbook			
	1984	**1989**	**1994**	**1999**
Sow Performance:				
Born Alive	10.33	10.69	10.80	11.01
Weaned	9.13	9.50	9.53	9.78
Mortality %	11.6	11.1	11.8	11.2
Litters/Sow/Year	2.24	2.27	2.24	2.25
Pigs/Sow/Year	20.45	21.57	21.34	22.01
Weaning to Effective Service (days)	22	21	23	22
Sow Feed/Year (tonnes)	1.14	1.20	1.30	1.34
Finisher Performance:				
Growth Period	19-78	20-79	20-82	19-89
Mortality	2.9	2.8	3.6	3.5
Gain	568	602	586	603
Fcr	2.9	2.7	2.6	2.6
Carcase:				
Weight	66.1	63.9	66.7	70.1
Fat (P^2)	14.5	11.9	10.8	11.2

The conclusions from these data are, as follows:

- There has been a small improvement in piglet numbers per litter of some 0.04 to 0.05 per annum.
- Piglet mortality, weaning to effective service interval and litters per sow per year are static.
- Sow feed consumption has increased.
- Mortality during finishing has increased.
- Growth rate and feed conversion have shown small improvements.
- Average carcase weights have fluctuated but are now heavier.
- Backfat has reduced rapidly but the rate of reduction is now slowing.

Over the period covered by these data the percentage annual change by trait was, as follows:

Litter size	+0.46
Growth rate	+0.41
Lean growth	+0.79
Feed conversion	-0.69
Backfat	-1.66
Feed intake	-0.32

Comparison with the previous literature estimates gives an estimate of the lost potential at commercial level. There is a significant shortfall in all the traits except feed intake, where the decline is even greater than expected. The percentage shortfall in the other five traits are shown below:

Litter size	67
Growth rate	76
Lean growth	58
Feed conversion	47
Backfat	21

The conclusion from these data is that significant levels of genetic potential are not being realised or exploited at commercial level. The main reasons are likely to be a combination of various factors:

- Less than optimal health
- Housing and environmental constraints
- Non-optimal management and nutrition
- Incomplete knowledge or application of the needs of modern genotypes

However, the pig industry has solutions to many of the causes of the technical inefficiencies. This is demonstrated by comparing the results for the best herds with those of the average and poorest herds. The data below are from the 1999 MLC recording database:

	Bottom 33%	**Average**	**Top 10%**
Born alive	10.54	11.01	11.77
Weaned	9.26	9.78	10.64
Mortality %	11.2	11.2	9.6
Litters/Sow/year	2.12	2.25	2.41
Pigs/sow/year	19.63	22.01	25.64
Weaning to service	31	22	11
Growth period	17-18	19-89	31-92
Mortality	4.4	3.5	2.9
Gain	571	603	669
Fcr	2.71	2.61	2.46

These typical variances in the national herd have resulted in a major thrust of UK research to pinpoint specific areas causing lost potential and to offer practical solutions at the commercial level.

One of the largest priority programmes is a six-year MLC project (the 'gilt rearing' trial) to focus on the problem of premature disposal of sows. The aim is to reduce these losses by evaluating the relationship between nutritional management of the gilt in early growth and pregnancy on subsequent lifetime reproductive performance and longevity. This is particularly important as it is now recognised that modern lean genotypes are very sensitive to nutritional mismanagement when compared with 'older' genotypes which had ample fat reserves at the start of their breeding life to buffer against shortfalls between nutrient requirement and supply. As a result premature culling is one of the most serious problems facing commercial producers.

Latest MLC data suggest that the average sow lifespan in the USA is only 22 months while in the UK it is just 30 months:

	Britain	**USA**
Productive life span (years)	2.4	1.8
Litters per sow lifetime	5.4	4.2
Piglets weaned per sow lifetime	52.8	36.8
Annual replacement rate (%)	42	56

Closer inspection of the UK data across parity indicates that more than one in four of all animals are culled for failure to show oestrus or failure to conceive:

	%
Reproductive failure	
Failure to conceive	19.8
No oestrus	5.9
Abortion	2.5
Low productivity	
Small litters	7.9
Mothering ability	5.6
Physical	
Lameness/leg weakness	6.5
Health/Trauma	7.7
Age	25.4
Death	10.7
Miscellaneous	8.0

Detailed analysis of within-parity culling patterns indicate that 40 to 50 percent of first and second litter culls are for reproductive failure and some 15% are for leg weakness.

This wastage is further highlighted by various commercial surveys showing that first litter animals accounted for an average of 21% of culled females whilst maiden gilts made up to 19% of all culls.

These high levels often cause producers to blame genetics or nutrition for the failure. However, many other factors are involved in premature culling including environmental components such as lighting, hygiene, temperature control, water supply and feeding method. Perhaps of most importance is the level of stockmanship. For example, field studies of anoestrus gilts at slaughter have indicated that only a third are not cycling - the remaining animals are either pregnant or are cycling successfully!

In the UK, the typical commercial minimum recommendations for gilts at mating are, as follows:

Age	220 days
Weight	130kg
P_2 fat	18 mm

However, modern lean genotypes grow at levels that make the age and fat targets hard to achieve. As the recommendation for achieving adequate fat stores at mating is based on research showing that there is a conflict between reproductive performance and intensive selection for reduced fatness this is a major concern to the breeding industry. Although commercial feed companies have nutritional strategies that aim to encourage fat deposition in high-lean genotypes the results for these strategies are largely unresearched. For example, it is possible that there are significant genotype-nutrition interactions making comparisons between different genotypes impossible. It is for this reason that the MLC has set up the 'gilt rearing' trial, details of which are given in the Appendix together with preliminary results on the first parity data.

These show both advantages and disadvantages for different nutritional treatments up to the first parity with litter size benefits to high lysine-fed gilts. Later parity data are awaited with interest.

As part of the protocol for the MLC trial, an extensive literature review was conducted on nutritional influences affecting 'lifetime sow performance'. Some of the conclusions are outline below:

- Uterine nutritional influences may affect the reproductive potential of the offspring but are currently poorly researched and understood.

- The nutrition of gilt piglets during suckling can influence their reproductive performance with higher weaning weights associated with increased litter size, particularly in the first litter.

- Rearer diets can readily manipulate lean and fat growth in the young pig. Thus, it is possible to promote fat deposition in lean genotypes prior to mating and during the first pregnancy. However, the MLC data indicates that such a strategy results in delayed first oestrus, a delay in mating and reduced first parity litter size. The important conclusion, to date, is that high growth potential is

linked with optimum early reproductive performance. At the same time there is evidence that gilts with excessive weight gains before first service may be more likely to be culled early for lameness/leg weakness.

- The attainment of puberty, which is a measure of physiological maturity, is largely time dependent. As such, many different factors are involved including nutrient supply in the growth stage up to about 50kg. Beyond this point nutrition has only very limited influence.

- Ovulation rate tends to increase in relation to feed supply prior to ovulation. However, higher ovulation rates tend to be associated with higher embryo mortality and stillbirths.

- The evidence on gilt flushing is inconclusive. The reason may be that normal reproductive function is compromised by under-nutrition rather than enhanced by high feed levels.

- Both over- and under-feeding of pregnant sows have an adverse effect on reproductive performance. Over-supply may lead to a range of problems including excessive weight gain, increased risk of lameness, reduced intake and increased weight loss in pregnancy and extended weaning to rebreeding interval.

- Nutrition during lactation is pivotal to successful rebreeding and lifetime performance. The challenge of increasing nutrient intake during lactation will become greater with the increasing demands of the prolific high-lean genotypes. The MLC are investigating liquid feeding, which allows sows to feed on demand without the problem of rejected feed turning stale and suppressing appetite.

- The mature weight of sows has increased as a direct response to selection for increased lean in slaughter pigs. The result is high potential for maternal lean gain in the parities until mature weight is achieved and a concomitant increase in the amount of feed required over time.

For the future it is hoped that the detailed MLC final results, together with other insights into the complexity of the reproductive process will match genetic potential across a range of genotypes. The result should be that greater genetic potential is realised in a range of reproductive traits to coincide with increasing selection emphasis on these traits.

Acknowledgement

Thanks to Dr.P.Gill of the MLC for his valuable inputs to this paper.

References

A detailed list of references may be obtained from the author.

Appendix

NUTRITIONAL MODULATION OF BODY COMPOSITION OF REPLACEMENT GILTS AND EFFECTS ON LIFETIME PERFORMANCE

- The Meat and Livestock Commission are conducting the trial at the Stotfold research facility.

- The trial is designed to compare different nutritional strategies, from 30 kg to completion of the first litter, which could have an impact on mature body composition and, in turn, lifetime reproductive performance.

- Commercial gilts (Large White and Landrace) from four genotypes (JSR, NPD, PIC, UPB) were used. Gilts were reared from 30kg to mating on high lysine (1.2 from 30 - 50; 1.0 from 50 to mating) or low lysine (0.6 from 30 - 50 ; 0.5 from 50 to mating) diets. After mating they were then 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.

- As expected, feeding the low lysine diets resulted in slower growth, lighter weight and more fat at mating. However, by the time of farrowing the weight and fatness was similar across treatments, although the low lysine females were more likely to produce a viable litter at weaning.

- The effect of feeding the low lysine diet in pregnancy was to significantly reduce litter size (born alive, 9.3 v 10.2).

- Feeding the low lysine diet during lactation reduced piglet weaning weight.

- The use of low protein diets during rearing, gestation and lactation appears to have the following advantages and disadvantages:

  Advantages:
  - Reduced gilt wastage
  - Potentially smaller gilts at the end of the first parity with reduced maintenance requirements.

  Disadvantages:
  - Delayed puberty
  - Poorer feed conversion due to increased fat deposition
  - Reduced litter size
  - Reduced weaning weights

- The trial is on-going with the nutritional effects being evaluated beyond the first parity. Currently most animals are in their fourth or fifth parity and the trial is set to finish at the end of 2000. A final report is expected in 2001.

- A second main genotype (25%) Meishan is also being investigated.