ACMC Technical Update

Issue 42

Back to the Future

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Every animal breeder knows that to some extent they must be able to accurately predict the future to be able to provide "direction" for their genetic programme. Those that are successful will be able to provide the correct solutions for the market needs, whilst those that are not will have stock poorly adapted to emerging market environments. The need for forward planning is driven by genetic change, especially within-breed, being made in small steps per generation. Even the quickest type of genetic change (changing which breeds are utilised within your breeding programme) can sometimes take years to have effect at commercial level. So breeders must think ahead.

Within-breed genetic selection is usually multi-trait selection, where high indexing animals are those animals which demonstrate favourable characteristics for a number of traits, rather than excelling for just one.

$$SI = (a \times Trait_1) + (b \times Trait_2) + (c \times Trait_3) + (d \times Trait_4)$$

Where

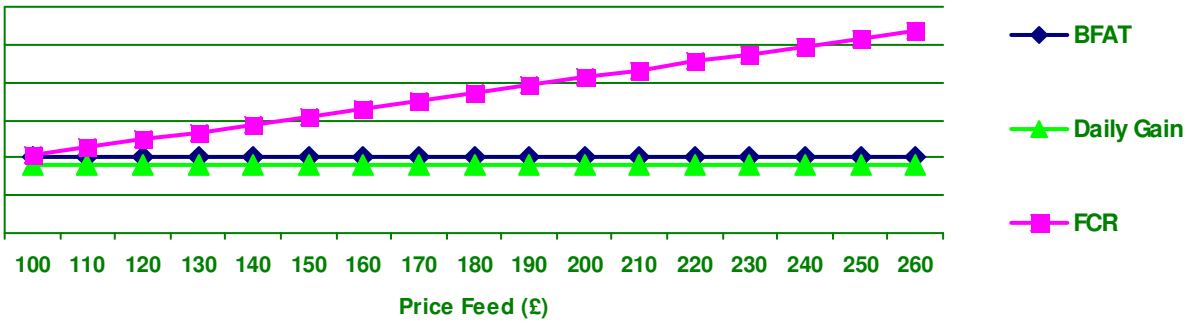
SI	=	*Selection Index*
a	=	*Relative importance of Trait 1*
b	=	*Relative importance of Trait 2*
c	=	*Relative importance of Trait 3*
d	=	*Relative importance of Trait 4*
$Trait_x$	=	*Performance of individual in Trait x*

Geneticists 'predict the future' by arriving at the relative importance of the multiple traits under selection (their weightings in the index) to meet the needs of the future market environment. This can be achieved in different ways. Weightings in the index can be set to achieve a desired rate of improvement in each trait, or a model of the economics of pig production can be used to provide the weightings which optimise the economic rate of improvement of the traits.

So why does all this matter? There are two reasons why this is important. The first most obvious reason is that major production costs can change rapidly, an example of this is the world-wide increase in the price of feed. Feed prices have risen again to prices seen over 10 years ago and have nearly doubled for some people in the UK who have come off favourable contracts at the wrong time. These changing production costs alter the relative weightings for economic traits in index selection as, in this case, much more importance is then applied to feed efficiency than previously.

From Figure 1 it can be seen that as feed prices increase, the importance of FCR increase linearly. However, considering growth rate and back-fat in isolation, i.e. ignoring any correlated effects on FCR, their importance remains unchanged by rising feed costs.

Figure 1. Representation of feed costs *vs.* relative importance of selection traits



The second reason is that socio-economic factors can also focus on the importance of weightings within an index. Whilst the reasons for the changing environment may be contentious with some, nobody can argue that the world's weather patterns are changing. The effects of this are partly the cause of the feed price increase (crop failure and bio-fuel demand), but it may also impact agriculture generally, and pig production specifically, due to the need to reduce global warming potential of food production.

Research within the United Kingdom has shown that pig breeding has a good track record with an estimated 25% reduction in GWP100 (a measure of the global warming potential of outputs) per tonne of carcass over the last 25 years (this compares to roughly 2% reduction with beef production). This has mainly been achieved through improved feed efficiency of the growing pig but is also influenced by the improved productivity of parent gilts. Of course, genes from the UK have been disseminated across the world which will have impacted favourably on the GWP100 of Pig Production in other countries too. However, with the need to reduce emissions further in the future, the importance of improved feed efficiency is only going to increase.

One question this raises is how much can feed efficiency continue to improve in the future? Amazingly, despite feed costs accounting for the majority of costs of producing pigs (even with feed costs at their lower levels), not all breeders record feed intake as it is an expensive trait to measure. Whilst it is true that you can improve feed efficiency without measuring feed intake, to maximise the accuracy of selection and therefore rate of improvement in this trait, it is necessary to record it.

The reason for this is that some traits are genetically correlated; that is to say that the traits share some genetic control. A correlation of ±1.0 means the same genes control both traits and a correlation of 0 means there are no genes in common. In the case of feed efficiency, if we take the example of back fat, then, as it takes approximately four times more energy to produce fat than it does lean (Swine Nutrition. 2001. Lewis A. J. and Southern L. L. - pp67) a pig which lays down less fat (and consequently a higher proportion of lean) will be more feed efficient. However, estimates put this genetic correlation between 0.2 and 0.6. Thus, relying on the measurement of back fat to improve FCR is not by itself an efficient way of improving feed efficiency. Also, as little weighting is now put on back fat due to the lean nature of modern genotypes, trying to improve feed efficiency in this manner will no longer achieve improvements. Likewise, growth rate has a genetic correlation with FCR of -0.5 to -0.6 (i.e. improving growth improves FCR).

By measuring feed intake, the breeder is seeing the net effect of all the genes controlling intake and efficiency under the controlled environment of the performance test. This means that, in effect, the breeder can select on the effect of all the genes related to these traits, rather than just those that are related to fatness or growth.

So returning to the opening theme, the challenge for breeders is to identify those traits that are going to become, or remain, important in the future (this may conversely be seen as not using traits which will become less important in tomorrows world!). These traits are perhaps those previously identified, as due to the changing dynamics of food production over the coming years, there is a renewed opportunity to focus on economic, efficient production. There may be an opportunity to use new defined traits e.g. to describe increased robustness which would bring reduced mortality (waste) to improve efficiency, or we may have to rely on our current portfolio of traits.

As today's pig production 'climate' has shown, efficiency, or should I say specifically, feed utilisation efficiency, should be on everyone's agenda.

ACMC Technical Update

The Longest Day

Dr Mike Varley, SCA NuTec

The events of June 6th 1944 had enormous ramifications for the subsequent course of the Second World War and this story was told in the movie entitled 'The Longest Day'. This single day began for many of those involved at a very early hour and was not over until almost into the next day for many. When we consider the events in a piglets life, most also have a 'longest day' event in their lives and this is the day of weaning itself. On the day of weaning, the events that occur for individual piglets will also have important consequences for success or failure in the lives of these individuals.

Whilst with the sow, the life of a piglet is one of nurture and comfort. There is a ready supply of water and highly palatable nutrients in the form of milk and there is a stable social order within each litter such that the more dominant piglets own the front more productive teats and the more subservient piglets take the rear teats. Temperature and the general environment are highly controlled and the piglet is automatically protected from pathogens by a steady stream of the right IgA antibodies contained in the sow's milk. This must seem like utopia for the four first weeks of life, up until the day of weaning.

At weaning, there is of course a massive change in circumstances for each and every piglet. The comfort and nurture is immediately removed, the temperature control may be a lot worse and more variable, the nutrient supply is also critically changed in form and composition and the automatic gut protection is immediately withdrawn. This is all coupled with a huge change in the social order. All of a sudden, on the day of weaning, there are new individuals to cope with, some of which may be more aggressive or competitive than previously encountered, and hence there are 2 days of mayhem whilst a new social order is established. Expressed in this way it is a wonder any survive at all! It does certainly, even at the best of times, amount to a heap of stress that always needs addressing, day on day, after the event of weaning.

Day 1 post-weaning is undoubtedly '**The Longest Day**'. There is a huge amount of fighting, even with just two litters mixed together, and this stress in itself diverts the piglets away from the more productive tasks of learning where the new, and separate, supplies of food and water are located. If, however, there has been a management focus on this to make the longest day part of a gradual transition phase in the piglet's life, then the passage can be smoothed. This comes down to things such as; an effective creep feeding programme with the right feed, ample drinkers and positioning of the drinkers, good temperature control and high quality pens and equipment. On this longest day, the survivors and thrivers will be those that are quick learners. They have to learn where the new feed comes from, learn where the new water supply is located, learn which pigs to avoid and which pigs they can ignore or dominate. They must also learn where to defecate, where to sleep to get the most comfort and also where they can hide from other more aggressive piglets.

Day 2 is just about as difficult as the first day, but by the end of this day, at least the new dominance order is established and the fighting should stop. Many piglets will now have started to eat and drink again, although the respective intakes will still be far lower than on the day before weaning.

Day 3 should see many, if not most, piglets eating normally and most of the stragglers will have learnt from the more educated piglets that the hopper is where dry food is delivered and the nipples and bowls deliver liquid.

Day 4 is probably a critical day in the life of a post-weaned piglet because at this stage, the success or failure of eating and drinking will begin to have its impact on the inner lining of the gut itself. If feed intake has failed, the villus structures will also be critically reduced in size and functionality. The more the damage here, the longer the period before feed intake and nutrient absorption return to 'normality'.

Day 5 will see a classical 'growth check' setting in, if feed intake has not started in the earlier days and many piglets will have not gained weight at all since the day of weaning itself. Gut damage is also evident and there will now be overt signs of depleted health status. Hairy coats, gaunt body shape and the beginnings of diarrhoea will occur rapidly.

Day 6 is when the piglets may get to rock bottom in terms of gut health status and again, depending on whether they ate or not in the previous days, there could be a significant number of piglets showing scours. Some will become dehydrated and at the extremes, mortalities will be seen.

Day 7 – 10 is the beginning of the recovery phase. The villus structures now begin to recover and feed consumption should rise rapidly coupled with adequate water intake. The active immune system begins to kick in to provide the much needed systemic and enteric protection and the piglet begins to gain weight again. The danger here, with a poorly designed or poor quality feeding programme, is that as dry matter intake rises rapidly, a nutritional scour can result, and more deaths occur.

Figure 1 summarises some of the main events occurring in these eventful days post-weaning. There is also good evidence that on those farms where these days are managed better, then performance in general is a lot better through this phase and performance to slaughter is also significantly improved.

Figure 1. Summary of 'The Longest Days'

Pre Wean	Health and vigour Immune protection
Day 1	Little or no feed intake Social order disrupted
Day 2	Fighting and aggression New dominance order established
Day 3	Learning feed intake initiated Water intake resuming
Day 4	Villus damage and regression Growth check
Day 5	Feed intake still sub-optimal Growth check
Day 6	Villus damage Susceptible to pathogenic attack
Days 7-10	Recovery phase 'do or die' Feed intake 'normal'

Figures 2 and 3 also present some evidence for the waxing and waning of the post-weaned piglet's fortunes. Figure 2 shows data from an experiment carried out at the SCA Green Hill farm unit, it shows that the health scores taken on individual pens of 8 piglets post-weaning start off at 0 (excellent) and rapidly decline to nearly 4.5 (poor), but then, in this group, there was recovery after day 7, but the health score had still not returned to zero, or even close to zero, by day 25 post-weaning. In contrast, another batch from the same trial, displayed in Figure 3 shows the health score again at weaning is 0 (excellent) and then worsens to day 6 but then is rather more successful and shows a good recovery so that by day 19 post-weaning, a health score of zero was observed once again.

Figure 2.

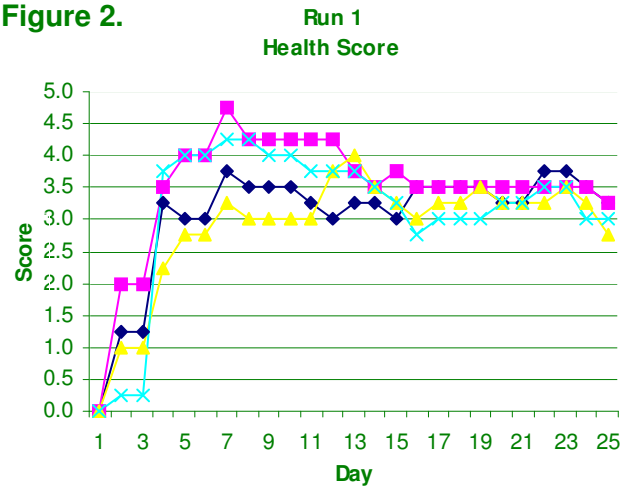


Figure 3.

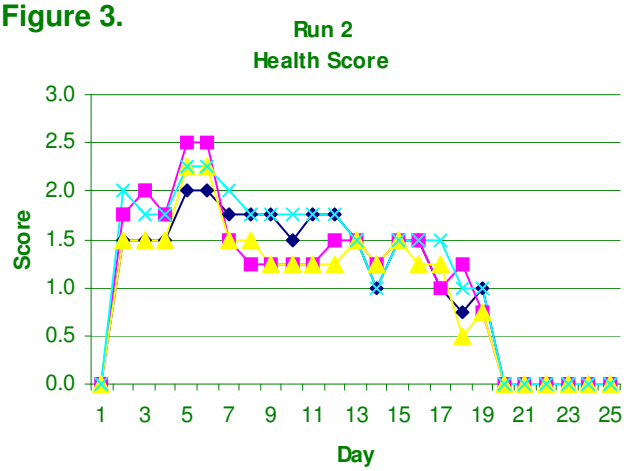
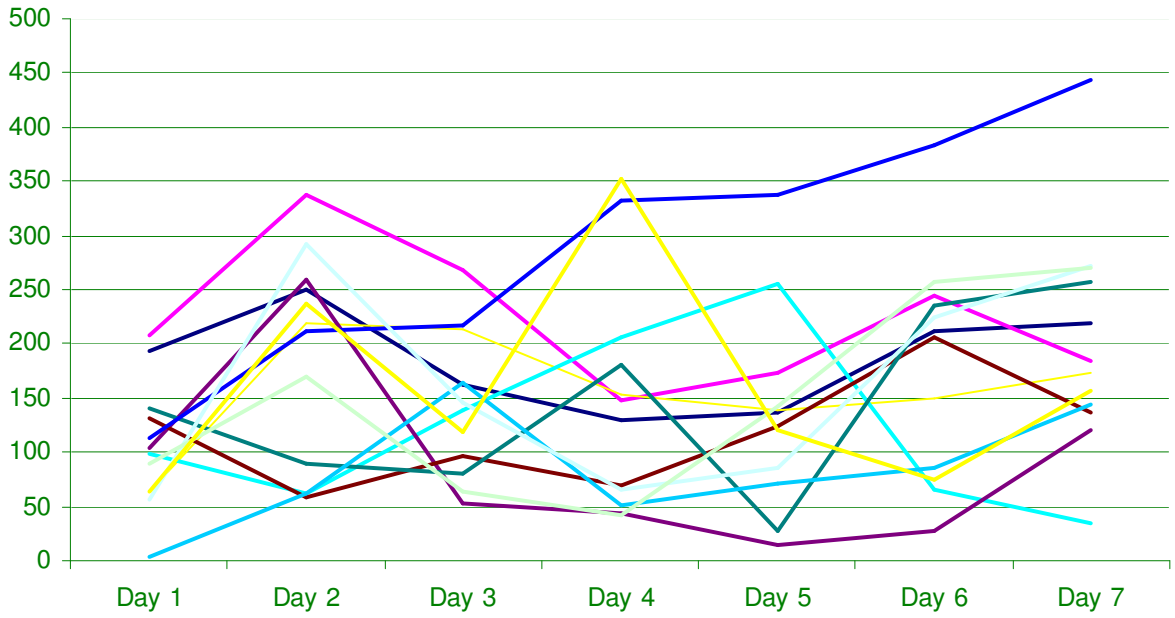


Figure 4 presents a sample of data from some of the work of Dr Bev Miller from Bristol University School of Veterinary Science. If we take into account that on the day prior to weaning the average dry matter intake of most piglets is around 450 g/d then clearly there is a cataclysmic fall on day 1 and much beyond and this is extremely variable even within litters and groups. This is where the downstream damage comes from.

Figure 4.

12 piglets - Week 1
Post-Weaning (daily feed Intake g/d/per piglet)



Conclusions

This whole transition period should therefore be carefully managed and monitored day on day for each batch of weaned piglets. The management and attention starts with the critical nutritional inputs for gut protection and the stimulation of the early bite on day 1. We also have many tools in our kit bag to encourage early intake, such as appetisers and gruels. We have good and effective nutritional aids, such as essential oils, functional fibres and acidulants to provide that extra protection the piglet needs.

At the end of the day, it is the planning and stockmanship that will make it work to perfection.

The effort put in to the 'longest day' in reducing the level of stress, involved is well worth that extra focus of attention.

For those who remember the 1962 movie, we are looking to make all of our post-weaned piglets into John Waynes and Robert Mitchums – who survived and prospered during the longest day in 1944.

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