Piglet survival and sow efficiency

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Introduction

Piglet mortality is high. In the USA nearly 20% of the piglets do not survive between late gestation and weaning; 7% of the piglets die during farrowing and some 13% are lost during lactation. These statistics from the USA are no exception to the norm. In Western Europe mortality is similar, although the average litter size is somewhat higher.

Both the sow and piglet have an influence on mortality. Mockingly one could argue that a piglet should be fast (to get away) and a sow slow in laying down (to let the piglets escape). Interest in piglet survival has increased over the past years. We will try to summarize this work, with particular focus on our own results, and to go one step beyond this in terms of efficiency of piglet production.

Breeding goal

The breeding goal for pig producers is to reduce the costprice of good quality pork within environmentally, socially and community accepted constraints. Costprice of a piglet is an important factor in the costprice of pork, increasing survival is therefore relevant.

Socially accepted constraints add to the economic value of survival. Low mortality is considered a sign of good health and with that a sign of well being of the animals on the farm. Survival is possibly better defined as vitality, the potential of a piglet to adapt to the environment offered. This environment can be a straw bedded farrowing barn in a labour intensive moderate climate or it can be a concrete, low labour, hot and humid climate. If intrinsic vitality can be increased, piglets should do better in very different environments.

Biological modelling

Birth weight in pigs is mainly a maternal trait (Roehe, 1999). This knowledge is undervalued since it has some consequences. A piglet in utero tries to express its genes for growth. However, it is limited through the nutrient supply of the sow. This nutrient supply is more limiting if litter size is larger. Only in the situation of litter sizes of 4 or 5 there is a chance that piglets reach their full growth capacity and with that their maximum birth weight. Similarly, during lactation piglets grow as fast as the milk production of the sow allows them (Verstegen et al, 1998). Birth weight and weaning weight *per se* are not so important, much more the relative position of a piglet in a litter. Piglets of some Chinese breeds are known to be very small, but at the same time very vigorous.

Stillbirths can occur because of the genes of the sow, if birth channel is too small, or it can be blamed on the piglet if the birth weight of the piglet is too high. It can also be blamed on the piglet since it is not strong enough to live through this very stressful phase of being born. Similarly, during lactation, survival of a piglet depends on the behaviour and milking abilities of the sow nursing it, on the piglet itself and on its litter mates.

The key factor for the differences in piglet survival is the preparation for the birth process. Highly significant differences were found in cortisol level in piglets, two days before farrowing. Cortisol plays an important role in the maturation of the lungs and in the synthesis of glycogen, two important factors for the transition of the piglet from the uterus to real life (Leenhouwers et al., 2002).

Genetic modelling

The previous reasoning results in three sets of genes important for survival: the genes of the piglet; of its natural mother and of the sow nursing the piglet. This model was tested and described for farrowing survival, pre-weaning survival and total survival (Knol et al. 2001).

Consequently, the analysis was based on individual binary records of piglets (classed as alive or dead at weaning) fitting three animal genetic effects (direct, maternal and nurse sow). The model is effectively a direct/maternal model with nurse sow added to it. This type of model is computationally very demanding. We run them on 900,000 animals in an iterative procedure. Data collected on 15 farms in different climate zones and health situations over a period of 12 years. A disadvantage of the procedure could be, that it favours light surviving piglets, since correction for birth weight is part of the model. If all piglets in a litter survive, the smallest one will have the highest breeding value. In the longer term this might result in reduced birth weights. An alternative model would be to replace additive effect (piglets genes) by sire and dam components and add maternal effect to the dam effect and still use individual records of piglets. This model better accounts for dominance effects, potential imprinting effects and does not differentiate between individuals within a litter. However, it is still unclear which of the two is the better approach.

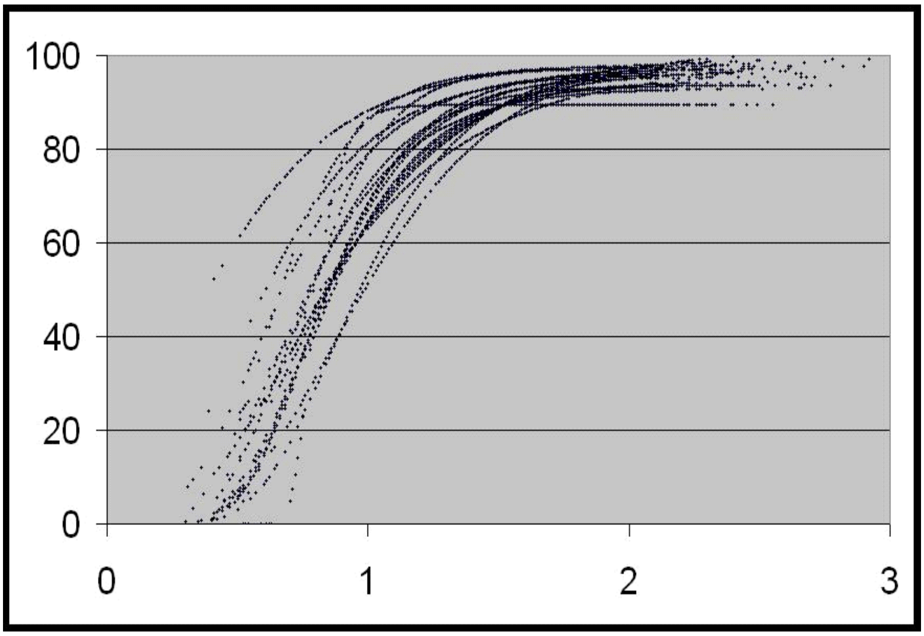

Figure 1. Survival curves for piglets for different sires. Birth weight (kg) on the X-axis by pre-weaning survival (%) on the Y-axis.

Selection for birth weight or survival

This can be seen from the piglets point of view or from the sow side. Selection for increased 'piglet weight' genes will be challenging (see before) since the majority of the genetic variation stems from the sow. Increased birthweight from the sow side is genetically correlated with increased gain and decreased backfat (Knol, 2001). Consequently, selection for lean tissue daily gain over the past decades has increased birth weight. Survival, on the other hand, has a clear piglet component and some extra maternal effect, not mentioning the nurse sow effect on preweaning survival. In Figure 2 three approaches to possible increase in survival are given.

In 2003 at the EAAP meeting in Rome a session was dedicated to the specific question; should we select for birth weight or direct survival selection (Knol, 2003; Roehe, 2003)? Agreement was on the fact that survival has a heritable component and selection is possible. No definitive answer on how to get there most efficiently was obtained.

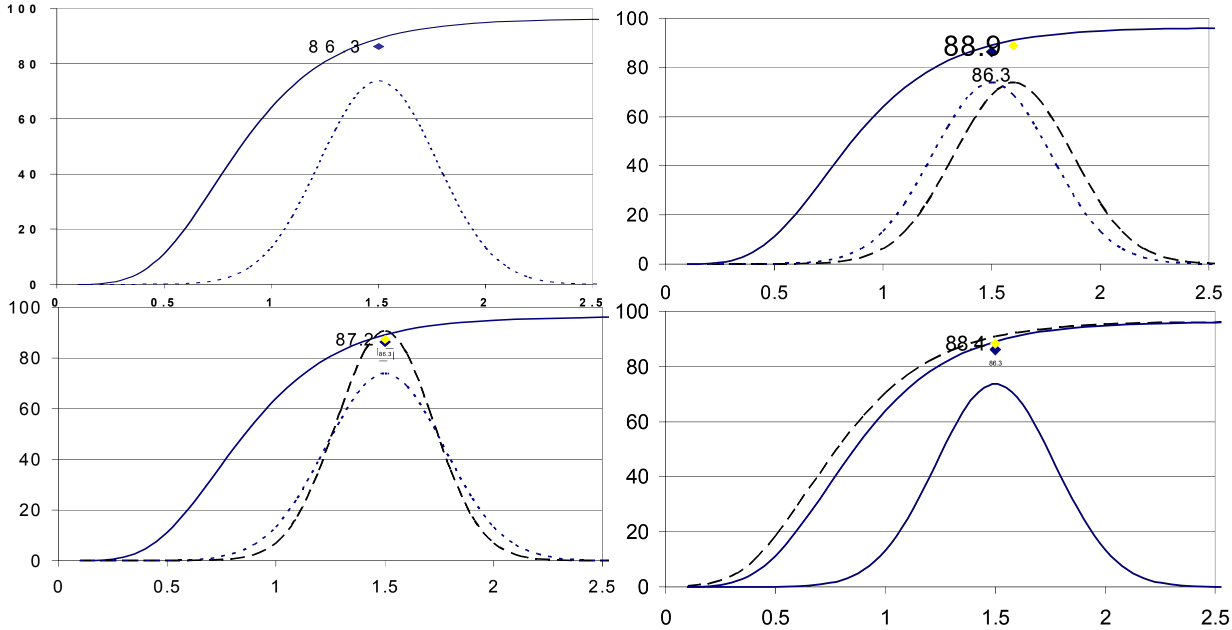

Figure 2a (upper left): The dotted line is the normal distribution for birth weight of piglets, the solid line the survival curve. Multiplication of the two gives the average farm survival (86.3 %).
Figure 2b (upper right): Shifting the normal distribution, that is, increasing birth weight, should theoretically improve survival (88.9 %).
Figure 2c (lower left): Increasing uniformity will increase total survival through a decrease in the percentage of small piglets (87.2 %).
Figure 2d (lower right): Lifting of the survival curve, that is, increase the chance of survival at a given birth weight, will increase total survival (88.4 %).

Selection for mothering ability

The other component is mothering ability, that is, the nurse sow component from the model. Heritability and genetic variation are at least as large as for the piglet component and quite promising for selection.
Firstly, we found that EBVs for mothering ability had predictive value (as they should!). Secondly, we could not find a difference in the udder and/or nipples of animals with high EBVs. Thirdly, we found that glucose clearance prepartum was different between high and low EBVs. Sows with good genes for mothering ability had lower clearance and therefore more and a longer circulation of glucose. For the fourth result we checked piglet sow interaction. Piglets from sows with high EBVs took a significantly shorter time to drink colostrum (Table 1). The possible explanations for this could be the behaviour of the sow and/or scent or temperature of the udder (Knol et al., 2002).

Table 1. Relationships between the average duration per litter (min) of various intervals between birth and colostrum uptake by the piglets and the EBV_{ma} of their mothers.

Time intervals	**Mean ± sd**	**Regression coefficient ± sd**
Birth – first standing	7.53 ± 2.10	0.07 ± 0.33
Birth – first udder contact	15.94 ± 6.52	-0.96 ± 1.02
Birth – first teat in mouth	37.70 ± 14.58	-3.67 ± 2.31
Birth – first colostrum	51.43 ± 19.16	-8.94 ± 3.02**
First standing – first udder contact	8.31 ± 4.64	-0.61 ± 0.73
First standing – first teat in mouth	23.72 ± 12.12	-3.95 ± 1.91*
First standing – first colostrum	39.21 ± 17.27	-8.68 ± 2.72**
First udder contact – first teat in mouth	27.43 ± 16.83	-0.86 ± 1.71
First udder contact – first colostrum	35.70 ± 14.67	-3.67 ± 2.31
First teat in mouth – first colostrum	17.60 ± 13.01	-4.46 ± 2.05*

No significant relationships were found between time from birth until first standing, first udder contact, and first teat in mouth and EBV_{ma}.

Selection for sow efficiency

In the end pork production is about making money and reducing costs. Important cost factors are feed and labour. Feed is tricky, on one side we don't like animals to over eat, since it is a cost factor, on the other side they need the energy and protein to grow (Eissen, 2000). During lactation we like the sows to eat as much as possible. But the flip side of the coin is that high appetite sows tend to transfer appetite genes to their finishers, where feed intake is much more of an optimum. Increasing litter size and/or increasing gain of piglets tends to increase the need for feed intake in a non linear way.
Our current line of research looks at differences in efficiency between sows. Would it be possible to maintain current input and increase piglet output. First results are encouraging (Bergsma and Knol, 2003). In Figure 3 input is given on the x-axis. Input defined as (energy from feed + energy from condition loss – energy necessary for maintenance). On the Y-axis the output in terms of energy gain of piglets from birth to weaning.

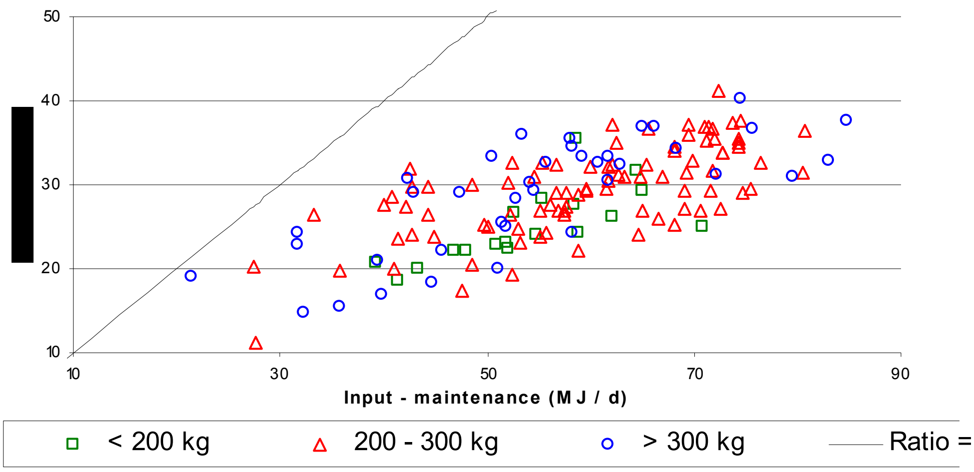

Figure 3: Output related to input (see text for explanation). Legend is sow weight.

Summary

Selection for high gain and low backfat will increase birth weight as a correlated response. Birth weight is mainly a trait of the sow and not so much of the piglet. A genetic increase in birth weight does not lead to an increase in survival. Selection for increased survival in the phase from late gestation to weaning will favour piglets who are better able to make the transition from uterus to real life. Correlated responses are a better developed gastro-intestinal tract and higher appetite during finishing.

The other half of survival is mothering ability. Genetic variation exists and this probably has to do with behaviour and efficiency of transmitting nutrients from the sow to the piglets.

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