A licence to live for small piglets?

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It is not the exception anymore if you wean 28 piglets per sow per year or more. Quite a few herds realise that target these days. Given the enormous economic weight of fertility in the entire pork production chain, most breeding programmes put a heavy selection pressure on litter size.

So, we can expect litter size to increase rapidly in the years to come. Sometimes, however, you hear people wonder whether such a high productivity is a blessing or a curse. Large litters have a lower average birth weight, so the litters do contain more small piglets.

Fig. 1 shows the weight distribution of two groups of sows at the same farm. An increase of 0.8 total born piglet more per litter reduced average birth weight by 50g and increased the percentage of piglets below 1kg from 2.0 to 6.2%.

Le Dividich (1999) reports that for each piglet extra born above 13 per litter, 0.7 piglet has a birth weight less than 1kg.

Weight class (g)	Mortality during first four weeks of life (%)
600-700	64.3
700-800	50.0
800-900	36.4
900-1000	18.5
1000-1100	16.0
1100-1200	10.2
1200-1300	9.0
1300-1400	8.9
1400-1500	5.7
>1500	3.9

Table 1. Mortality in small piglets is higher (Van der Aar, 1985).

Risks of mortality are higher with small piglets than with heavy piglets (Table 1).

Le Dividich (1999), however, concludes that there is no absolute threshold for birth weight below which the piglets have an increased probability of dying.

The within litter variation between piglets appears more relevant than the absolute weight. Vitality appears related to the occurrence of asphyxia during birth and the smaller litter mates are more prone to asphyxia than the larger ones.

Low birth weight piglets in a large litter have problems to compete with larger litter mates for scarce milk resources, which leads to a lower milk intake, weakness, higher mortality and lower performance of the small litter mates. They have demonstrated, however, that adequate cross fostering, creating litters with equivalent birth weights and ensuring that small piglets are put under milk rich sows, reduces mortality substantially.

Their work showed a mortality of small piglets of 32% in large heterogeneous litters compared to 7.5% in small uniform litters, supporting the observations in several other studies.

A recent French analysis yielded similar mortality data and concluded that the majority of the difference in mortality between heavy and light piglets occurs during the first few days due to general weakness and to crushing by the sow.

However, small piglets at birth appeared to be more at risk also after weaning and during the grow-out period and showed a higher mortality rate between weaning and slaughter under high mortality (9.3%) conditions.

A target of weaning 28 piglets per sow per year means weaning almost 12 piglets per litter. That implicates that everything should just be right. In practice, however, it also means that farm staff are pretty busy in the farrowing units to cross foster piglets.

The biggest challenge of such large litters, with, on average a smaller birth weight as well, is to wean the piglets at an acceptable weight and to deliver uniform groups to the nursery.

Birth weight (g)	500-1000	1000-2000	2000-2500
Lifetime daily gain (g)	550	602	626

Table 2. Effect of birth weight on daily growth rate (Kloosterman and Huiskes, 1992).

Foster sows, split weaning, feeding additional milk, and many more options have been created and are being developed to provide the farmer with the tools to help the small piglets survive and to

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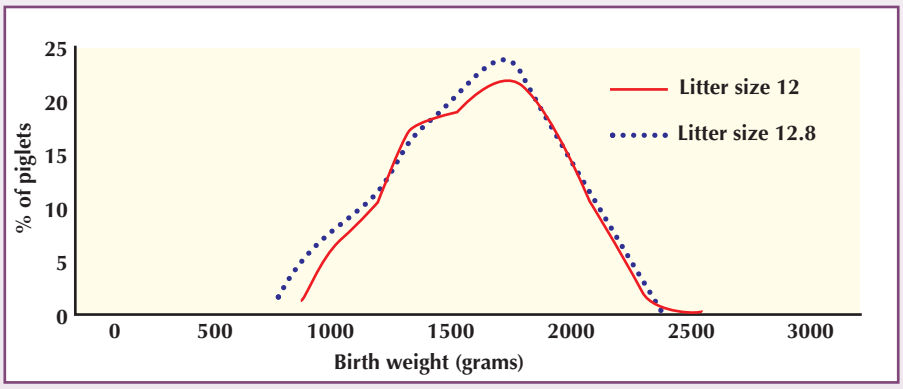
Fig. 1. Large litters have more small piglets (Nutreco, 2002).



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create as much uniformity as possible in his production groups.

But, does this all pay off? Foxcroft and Town (2004) tell us that the quality of piglets is determined in the uterus.

Intra-uterine growth retardation because of crowding in early foetal stages will turn a piglet into a lifetime runt. But even in less extreme situations, muscle fibre development might be hampered by uterine conditions, resulting in low pig performance in the grow-finish unit.

Does this mean that poorly developed piglets at birth stay behind all of their lives and are not worth surviving?

Age category (days)	59-63	64-68	69-73
Number of pigs	31	23	42
Initial weight (kg)	23.1	23.8	24.1
Average daily gain (g)	762	809	831
Daily feed intake (kg)	2.3	2.4	2.4
Feed conversion ratio	3.0	3.0	2.9
Back fat thickness (mm)	13.2	12.8	13.1
L. dorsi diameter (mm)	50.8	51.3	52.2

Table 3. The effect of weaner age on growing finishing performance (Nutreco 2004).

Practical research data seem to confirm this. Kloosterman and Huiskes (1992) processed the individual life performance data of thousands of pigs at the Dutch Proefstation voor de Varkenshouderij. Piglets with a low birth weight (<1kg) did grow significantly less than piglets with a birth weight higher than 1kg. Extremely high birth weights (>2kg) result in better daily gains (Table 2).

More recent data show that also weaning weights and entry weights in the finishing barn correlate with growing finishing performance.

Deen (North Carolina State University, 2004) calculated a linear relationship between exit weight at day 136 and entry weight (around 1kg) in a commercial unit:

Exit weight = 34 + 3.6 x entry weight
(r^2 = 0.31)

Is this a reason to sacrifice small piglets, or to stop breeding for large litters?

The question is, what is really different between low birth weight piglets and high birth weight piglets? Is it their intrinsic capacity to grow? And what is really the disadvantage for the farmer, the lower birth weight as such or the lack of uniformity of the production group?

The statement of Foxcroft and Town (2004) that meat quality and fattening performance of pigs are predetermined in the early foetal stages seem to be confirmed by French research comparing small (1kg birth weight) and large (1.9kg birth weight) piglets.

The small piglets had significantly lower pre-weaning and post-weaning growth rates compared to their heavy litter mates.

Although growing-finishing performance (at a restricted weight-based feeding scale) was similar, at the same slaughter weight the originally small piglets had significantly lower number of muscle fibres, with a higher fibre diameter.

The lower number of fibres had been compensated by hyperplasia, but unlike other studies, this did not have major effects on meat quality parameters like post-mortem pH and drip losses.

Beaulieu et al. (2004) have grouped the piglets by weaning weight in four classes, ranging from 4.9kg to 7.8kg

average weaning weight. In the nursery stage (30-35kg BW), the heavy pigs gained about 14% faster, but feed intake was 20% higher, showing that the main causative difference between heavy and small piglets is their daily feed intake. Feed efficiency differed less than 5% to the advantage of the small piglets.

Also French calculations on institute databases confirm that extreme differences in birth weight (for example less than 1kg or more than 1.8kg) lead to no more than a non-significant 5% reduced or improved daily gain compared to the average birth weight, if and when the growth period is standardised between 30 and 115kg rather than by age.

This appears to be valid in ad libitum feeding systems as well as with restricted feeding.

Although in this dataset the feed efficiency appeared better for the heavy birth weight piglets, even in the finishing period, it was concluded that the major causative factor was the level of feed intake. Apparently heavy piglets at birth are heavier at weaning and compete more successfully for feed. They eat more, but are slaughtered at a younger age and thus require less maintenance feed.

The lean meat percentage in all classes of birth weight were the same, but the heavy birth weights were killed at a heavier carcase weight. This implicates that there may be a small carcase quality disadvantage of low birth weight piglets when judged at the same slaughter weight.

Kloosterman and Huiskes (1992) analysed the database of their institute further and discovered that classifying individual lifetime pig performance according to age at 23kg bodyweight only showed minor differences of growing-finishing performance between classes.

That means that if comparisons between growth rates are being made on the basis of the same initial weight, rather than on the same initial age, differences in birth weight do not matter that much anymore.

Nutreco data obtained with group housed growing pigs, individually fed by an electronic feeding station, confirm this. Pigs with a similar initial bodyweight but different initial age, do not show statistically significant differences in growth rate and carcase quality.

Data obtained in one trial are presented in Table 3.

These pigs were killed at a live weight of 108kg and back fat thickness and diameter of longissimus dorsi was measured ultrasonically.

These and other Nutreco data show that piglets that take longer to reach a body weight of 23kg do not necessarily perform less in the growing-finishing barn.

The above leads to the conclusion that small piglets at birth differ mainly from their larger litter mates in terms of risk of mortality, time required to grow to 20kg body weight and consequently the uniformity of the weaner groups.

Most likely a major part of the (slightly) reduced individual performance of small at birth piglets can be explained by competitive disadvantages in less uniform groups and may disappear with adequate sorting.

Once the piglets are 20kg, there may be some differences in muscle fibre structure, but it remains to be confirmed as to what extent that has on practical effects on carcass and meat quality.

Uniformity problems

The coefficient of variation (variation expressed as % of the mean) of birth weights typically ranges between 18 and 25%.

Variation of birth weights can be attributed to between litter variation and within litter variation, the latter contributing two thirds of total variation of birth weight.

Of course, between litter variation of birth weight (and weaning weight) is larger if herds become more prolific.

Not all sows produce large litters with low birth weights and the between litter variation of birth weight will increase. According to Le Dividich (1999) within litter variation is larger in small litters (<8 piglets, variation coefficient 26%) and in large litters (>15 piglets, CV = 22%), but especially the coefficients of variation of the larger litters are not really dramatically different from the mean.

So, let us not exaggerate the isolated effect of litter size and birth weight on later uniformity.

The correlation coefficients of the databases published show significant, but low correlations between entry weight and exit weight (see the regression equation of Deen mentioned earlier with r^2 just being 31%!).

That means that many other factors influence the growth curve of piglets and many other things may increase variation.

Variation of initial bodyweight does not necessarily have an impact on pig performance. Kloosterman and Huiskes (1992) did not find in their institute database any difference at all of fattening performance between groups of pigs with low versus high initial variation.

This does not change the fact that uniformity in a pig herd is a great asset since a high variability in weight development creates problems:

- All in, all out becomes problematic with lower throughput of farrowing unit, nursery or finishing barn. If they are put in the next production group, potential transfer of diseases is the pay back.
- Less accurate feeding, since it is more difficult to time properly the transition from high spec starter feeds to lower spec finisher feeds and restricted feeding programmes will be less adequate and perhaps more expensive if the uncertainty is translated into margins of safety in the feeding programme.

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● More frequent selection and more frequent deliveries to the slaughterhouse are required to ensure that a maximum number of pigs are in the right weight class. Also this is a cost factor of substantial importance.

There are arguments in favour of uniform groups, but there are also voices that advocate a natural variation to allow a stable, natural social hierarchy to establish and thus prevent social unrest.

Apparently it depends on the specific farm situation (for example feeding and watering system, floor space, group size) as to what the impact of group variability is on the technical performance of pigs. It also depends on the specific farm situation what the possibilities are to manage group variability.

Economy

Assuming that the long term contribution of an extra piglet weaned is €22 per sow per year, an extra piglet born would bring €16.50 per sow per year (0.75 extra piglet weaned). That is a substantial contribution to the bottom line.

ITP (2004) produced a more sophisticated economic model, and presented several scenarios by adjusting farm layout and standard operating procedures in different ways to the increased output of hyper prolific sows.

A typical 169 sow herd that increases litter size from 12.2 to 13.9 would make an extra net margin of €6,000-12,000 per year at current market prices (pork €1.40 per kg, 25kg weaner piglet €46.90) depending on the management strategy.

All differences between light birth weight piglets and heavy birth weight piglets reported above were taken into account when they made this economic calculation.

In the scenario where 30% more small piglets could be saved, the economic benefit of hyperprolificity would even rise to €21,000 for this 169 sow herd.

Conclusions

The above leads only to one conclusion – do not kill the small piglet, but save it.

Once it has survived the first weeks of life, it will perform only slightly less than its heavy litter mate. Of course it will contribute to the group variability and make management more complex.

However, with smaller litter sizes the farmer also needs to manage uniformity and the French economic modelling demonstrated that any extra labour input by the farmer will be rewarded, as the small piglet will finally contribute substantially to the bottom line of the farm.

A clear conclusion is that it makes economic sense to continue to strive for better fertility and larger litters of the sow herd. The industry should continue to improve the husbandry and nutrition during the early pre-weaning and post-weaning stages to improve the chances of small piglets surviving and developing into healthy profitable growers.

These investments will ultimately pay off and determine the future profitability of the sow herd. ■