Porcine reproduction – from research to practice

Recently The Netherlands Foundation for The Study of Animal Reproduction (Stichting Dierlijke Voortplanting) held a symposium entitled Porcine Reproduction: From Research to Practice that was held in Kerkrade, The Netherlands. The symposium was supported by Janssen Animal Health. This review will summarise the main presentations at the symposium.

The management of breeding gilts

George Foxcroft of The Swine Reproduction Development Programme at The Swine Research & Technology Centre, University of Alberta, Edmonton in Canada reflected on the management of breeding gilts.

There is an urgent need to develop efficient management practices across the swine industry that capture the existing value of contemporary dam lines.

Based on sound estimates of heritability of all the components of litter size in the sow and the continued improvements in the genetic merit of our nucleus sow populations, we should question why repeated predictions that an increase in litter size of 0.5 pigs per year was achievable, but has never actually been realised at the production level.

There are two explanations. Firstly, there is the lack of good, disciplined management.

North American systems have focused a least cost of production mentality in which throughput is used to offset a relatively lower efficiency of production at the biological level.

For many of these integrated systems the risk of becoming less profitable is paramount and, as such, this places high emphasis on the ability to maintain maximal flows through the processing plant, albeit at the expense of quality.

Wrong priorities?

This seems to result in a general malaise on the farm that leads breeding herd managers to believe that improvements in efficiency are not a high priority.

This tends to lead to an attitude that it is the pig (dam line) and not the inefficient management that is responsible for the lower efficiency.

There appears to be a lack of information on the key physical and reproductive characteristics of the dam lines in current use and this leads to the adoption of production practices that are not in tune with the changing biology of breeding sows and gilts.

This shortage of production expertise must be addressed.

A second important failure in current management systems is the failure to adequately recognise increased genetic merit for lean growth potential and associated changes in the overall tissue metabolism of contemporary dam line sows.

Inadequate attention is paid to these changes in the management of these animals.

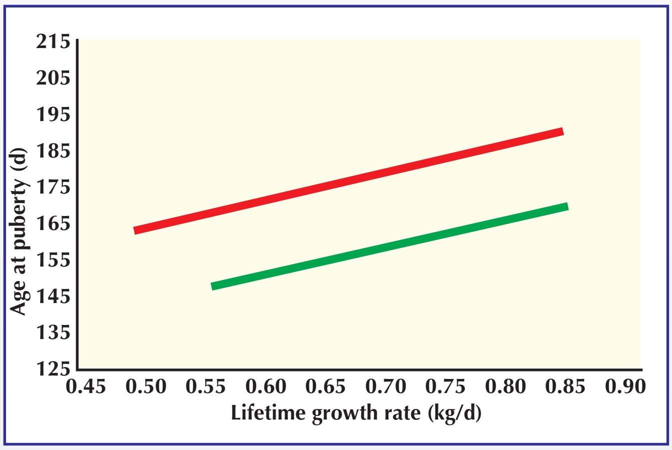

Fig. 1. Effect of puberty stimulation commencing either at 160 days or 135 days of age (Patterson, 2001).

Traditional management practices that were established even 20 years ago need to be re-evaluated if we are to capture the full economic potential of the modern breeding sow and her progeny in terms of better nutrient utilisation.

It was suggested in the early 1990s that it was only when growth rate was below 550g per day from birth to onset of boar stimulation at 160 days that there was any delay in onset of puberty.

Recent studies at the University of Alberta with Genex GP females and their F1, terminal line, progeny support these conclusions.

With unrestricted feeding during the growth/finish phase it is unlikely that growth rate in commercial dam line gilts will limit the age of onset of first oestrus.

The evidence is very much that age of first oestrus is very largely dependent on the age at which effective stimulation with boar pheromones and direct boar contact occurs.

There is little substance to

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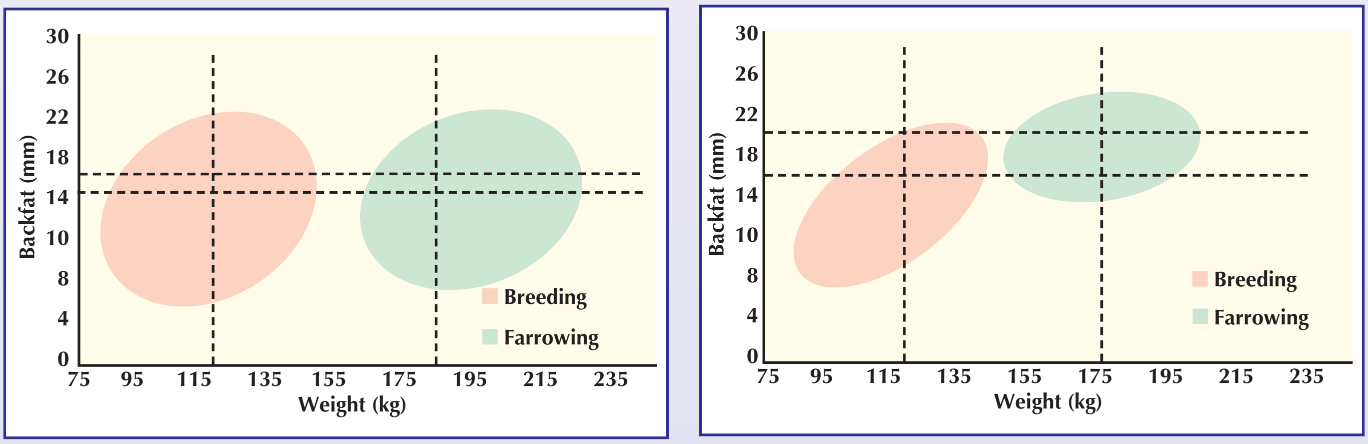
Fig. 2. Associated changes in sow body weight and back fat in, right, Camborough 22 and, left, Genex gilts between breeding and farrowing. Dashed lines indicate average weight and backfat at each time (Unpublished data, SRTC, University of Alberta, 2005).



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claims that first oestrus is occurring at older ages in today's dam lines unless, of course, boar stimulation is delayed (see Fig 1).

There may be a problem in that late maturing and fast growing gilts may become overweight by the time they are bred as this is one of the risk factors for poor retention of sows in the breeding herd.

Therefore, even in terms of physical maturity, it is dangerous to assume that some arbitrary age will succeed in defining the physical development of gilts at stimulation or breeding.

Growth rate variations

Gilt pool managers frequently ignore the enormous variation in growth rate among groups of gilts and the rather uncertain relationship between weight and back fat.

The extremes of sexual maturity and growth rate (boar induced first oestrus at around 130 days of age and a growth rate of 640g per day versus puberty at 189 days and a growth rate of 800g per day) can result in first oestrus gilts differing in body weight by as much as 73kg.

Ideally for physical fitness and longevity in the breeding herd the goal should be 135kg and at least 18mm of back fat at point of breeding.

The lack of any reliable association between age and onset of sexual maturity or body weight implies that these three essential benchmarks should be assessed independently in any well managed operation and then used to allocate gilts to appropriate breeding groups.

Another question that is frequently asked is, are there differences between different dam lines? Studies suggest that the phenotype of gilt and first parity sows clearly reflects the extent to which selection for increased lean tissue gain is reflected in these terminal dam lines.

Lifetime productivity

P2 back fat levels during gilt development are different and a maternal weight gain of 50kg from breeding to farrowing results in a very different response in back fat gain with the Camborough 22 gilts holding their back fat depths and Genex gilts incurring a noticeable increase (see Fig. 2).

This then begs the question, to what extent is this relative leanness of the terminal dam line likely to affect the lifetime productivity of the sow?

The performance of contemporary dam lines can be truly astounding!

Their ability to tolerate major loss of body tissues as a result of experimentally imposed feed restriction at peak lactation, with relatively little effect on many of the measures of post weaning fertility, needs to be recognised.

Equally, the reality that sows can deposit and mobilise lean tissue, requires us to accept a new biological paradigm and to manage these sows accordingly.

Parallel selection for improved lean growth performance and sow fertility seems to have resulted in a fairly characteristic response to lactational catabolism in contemporary dam lines.

The tendency for only a marginal delay in the return to oestrus results in inadequate follicular development at weaning, yet there tends to be a very robust LH response to weaning the litter and, thus, a relatively short interval to the time when ovulation is triggered.

Management strategies for the sow herd need to increasingly recognise the metabolic consequences of increased lean growth performance in contemporary dam line sows.

Furthermore, traditional hormone therapies that would historically be expected to improve weaned sow fertility need to be re-examined.

We probably need to reflect on the view that from a fertility and prolificacy perspective, fatness is simply not the key risk factor!

We need to consider the beneficial effects of achieving necessary thresholds of lean tissue mass as this may well be an increasingly important component of good gilt management in the future. ■

Possibilities and limits of embryo transfer

Embryo transfer in pigs is becoming an interesting tool for the exchange of porcine genetics all over the world and workers from Wageningen University in Holland reviewed this topic.

The major advantages of embryo transfer are the minimal risk of disease transfer, reduced welfare problems when embryos rather than pigs are shipped long distances and the fact that the new stock has no adaptation problems on the recipient farm.

The practical use of embryo transfer has come further under the spotlight by the recent development on non-surgical transfer procedures that remove the need for surgery. For a widespread use of embryo transfer, storage and transport of frozen embryos is a necessity. Recently, successful protocols for embryo freezing have been developed. However, the quality of thawed frozen embryos appears to be poorer than that of fresh embryos.

Successful transfers of frozen embryos have only been reported in combination with surgical transfers and non-surgical transfers in Meishan gilts. The combination of non-surgical transfer and Western breeds has not yet been successful. ■

Rethink on stress

In intensive pig production, female pigs are often subjected to prolonged, acute or repeated stress. It is, therefore, very important that we understand the impact of stress on reproduction. This subject was reviewed by Anne I. Turner and Alan J. Tilbrook from Australia.

Prolonged exposure to stress can impair the female reproductive processes. Even so, even under conditions of prolonged stress, it appears that reproduction in some females is quite robust and is unaffected by prolonged stress.

Similarly, while the elevation of plasma concentrations of cortisol in a sustained manner for a prolonged period can disrupt reproductive processes in female pigs, there may be some individuals in which this is not the case.

When it comes to acute or repeated stress or elevation of cortisol, it appears that reproduction in female pigs is highly resistant to stress.

However, it is possible that exposure to acute or repeated stress after ovulation and/or during early pregnancy may impair reproduction.

Nutritional effects on reproduction

H. van den Brand and B. Kemp from Wageningen University reflected on the nutritional needs of modern breeds which are expected to produce large litters and sufficient milk to nurse all the piglets.

This means that at least 10kg of milk a day is needed.

In sows, especially primiparous sows, feed intake is limited and so body reserves are used to maintain milk production.

Sows which lose excessive amounts of body reserves then tend to have depressed reproductive performance, which is manifested as a prolonged weaning to oestrus interval or reduced subsequent litter size.

A low feed intake during lactation is associated with suppressed follicle development during lactation, impaired oocyte maturation, a lower ovulation rate, lower plasma progesterone levels in the subsequent pregnancy and higher embryonic mortality. ■

Intermittent suckling – the piglets

In modern pig production piglets are usually weaned before four weeks of age and at weaning they experience an abrupt change from a diet of highly digestible milk to one of a relatively poorly digestible starter diet.

As a result of this change and other stressors associated with weaning, feed intake and growth are reduced after weaning and piglets are more vulnerable to develop diarrhoea and oedema disease.

The intake of a sufficient amount of creep feed during lactation creates a more gradual transition to weaning.

However, the consumption of creep feed during lactation is usually low and is highly variable between piglets and between litters.

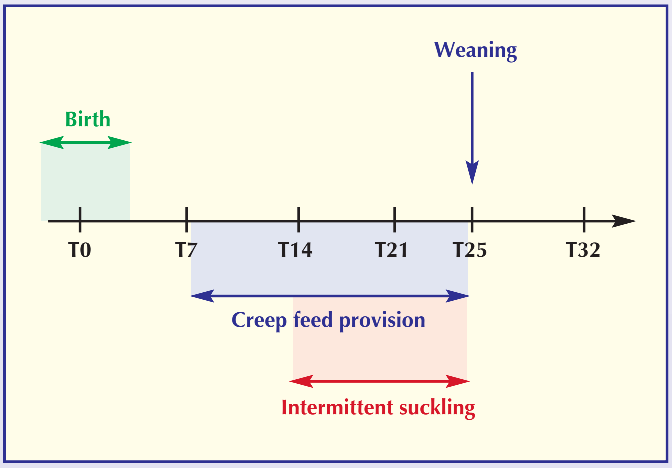
A way to increase creep feed intake during the third and fourth weeks of lactation could be intermittent suckling. Intermittent suckling is a management technique in which piglets are removed from their mother for a number of hours each day in the third and fourth weeks of lactation (see Fig. 1).

Intermittent suckling could also improve the reproductive performance of the sows by reducing the negative energy balance of them during lactation and lessening the suckling stimulus.

Work by W. I. Kuller and colleagues at Wageningen University in Holland showed that intermittent suckling increased feed intake during lactation and especially improved creep feed intake in litters that would otherwise have had a low creep feed intake.

They also found that the higher creep feed intake associated with intermittent suckling was reflected in a higher average daily

Fig. 1. The intermittent suckling model.



weight gain after weaning. This higher average daily gain after weaning compensated for the negative effects of intermittent suckling on average daily gain during lactation, which lead to lower weaning weights of litters.

These lower weights did not negatively affect weight gain after weaning and so weight gain shortly after weaning seems to depend on adaptation of the piglet to solid food rather than on weaning weight. Weight gain and feed intake in litters after weaning were positively correlated to creep feed intake during lactation.

In addition, after weaning tended to be higher in intermittently suckled litters than control litters with comparable creep feed intakes.

It could be that intermittently suckled litters experience weaning as a less stressful event. ■

Intermittent suckling – the sows

A longer lactation period will most probably improve piglet health and welfare but is economically undesirable because the number of piglets per sow per year will be reduced.

This is because the sow is usually anoestrus during lactation as luteinising hormone (LH) secretion is inhibited by the suckling stimulus.

After weaning, LH secretion increases, follicles develop and oestrus behaviour is shown within about five days.

Previous studies have shown that intermittent suckling can induce lactational oestrus.

The recovery of LH pulsatility is necessary to induce oestrus after weaning. It was shown that when piglets were removed for 12 hours from a commercial sow line (Topigs 40) the low LH pulsatility seen during lactation immediately rises. When sow and piglets are reunited the LH pulsatility decreases again.

In another study multiparous sows of the same type were used and three groups were studied.

These groups were the control group, which was weaned at three weeks, and two intermittently suckled groups in which the piglets were removed for 12 consecutive hours (IS12) or for two periods of six consecutive hours (IS6) per day.

The intermittent suckling started on the 14th day. The results are shown in Table 1.

In other words, by applying intermittent suckling it was possible to induce lactational oestrus in almost 100% of the sows but ovulation did not always proceed normally. So, what about periovulatory hormone profiles?

Sows subjected to intermittent suckling did not differ in their profiles of oestradiol from control sows, but their LH surges tended to be lower. In addition, levels of progesterone were also lower from 21 hours onwards.

One possible explanation for this is that the intermittent suckling sows received more feed (6.5kg per day compared to 2.5kg per day).

A higher feeding level appears to be responsible for greater liver activity and consequently a faster clearance rate of progesterone from the blood.

However, it is also possible that the intermittently suckling sows actually produce less progesterone.

At day 23 after service neither ovulation rates nor early embryonic survival differed between the three groups, but placental and embryonic parameters appeared to be adversely affected by the IS6 regime.

For example, the embryos were lighter. This could have consequences later in pregnancy. ■

Table 1. Oestrus, ovulation and pregnancy with intermittent suckling.

	Control	IS12	IS6
No. of sows	23	14	13
Lactational oestrus (%)	26	100	92
Post weaning oestrus (%)	74	-	-
Ovulation (%)	100	93	83
Cystic follicles	0	1	4
Pregnant day 23 after ovulation (%)	94	77	78