Update on the management of the gilt.

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Introduction

One of the most critical factors driving the reproductive performance of the sow herd is gilt development and management. Large variation exists with respect to the successful introduction and retention of high value replacement gilts into the herd (Culbertson, 2008). On average, approximately 50% of sows are culled and replaced every year and wean only 30 to 40 piglets per lifetime. Furthermore, nearly 20% of premature culling of females from the breeding herd occurs at parity 0, with 65% of these culls attributed to reproductive disorders or failure (Engbom et al., 2008; Gill 2007; PigChamp 2006; Lucia et al. 2000). Developing management practices that produce gilts with the greatest potential lifetime performance is crucial to the productivity of conventional production systems. Even minor improvements in gilt management can lead to major increases in breeding herd efficiency by meeting replacement targets from smaller pools of "select" gilts with improved lifetime performance.

Sow Lifetime Performance

Producers should set high targets with respect to anticipated gilt performance. With the quality of gilts available to production systems, and with high-quality management and good gilt health status, these targets can be undoubtedly met. Realistic performance targets should be >86% farrowing rates (highest in the herd), >12.5+ total born, >70% of gilts served farrowing the 3rd litter, no "2nd parity dip", and >50 pigs weaned lifetime (Sporke, 2006).

Sow productive lifetime can be defined both at the sow and herd level (Holtkamp, 2007). Measures of longevity at the sow level include, parity at removal, days in herd at removal, lifetime pigs born or weaned and percent productivity. Whereas at the herd level, removal rate, culling rate, replacement rate and parity distribution are good measures of longevity. Heritability of sow longevity is low to moderate at best (Stalder et al., 2007). Therefore, improvements to sow longevity must be made by other means and this paper will focus on management practices that improve longevity.

One of the most critical factors driving sow longevity and reproductive performance of the sow herd is gilt development and management (Foxcroft et al., 2006). The successful introduction of select gilts is generally associated with improved retention of high value replacement females in the herd (Culbertson, 2008). Implementation of effective gilt pool management strategies will also:

- Improve utilization of building space
- Improve flow of "eligible" gilts
- Increase efficiency of labor
- Achieve body condition at first service
- Reduce annual replacement rates
- Achieve desired physiological targets at first service
- Improve long term sow fitness
- Maintain economic efficiency of a small gilt pool

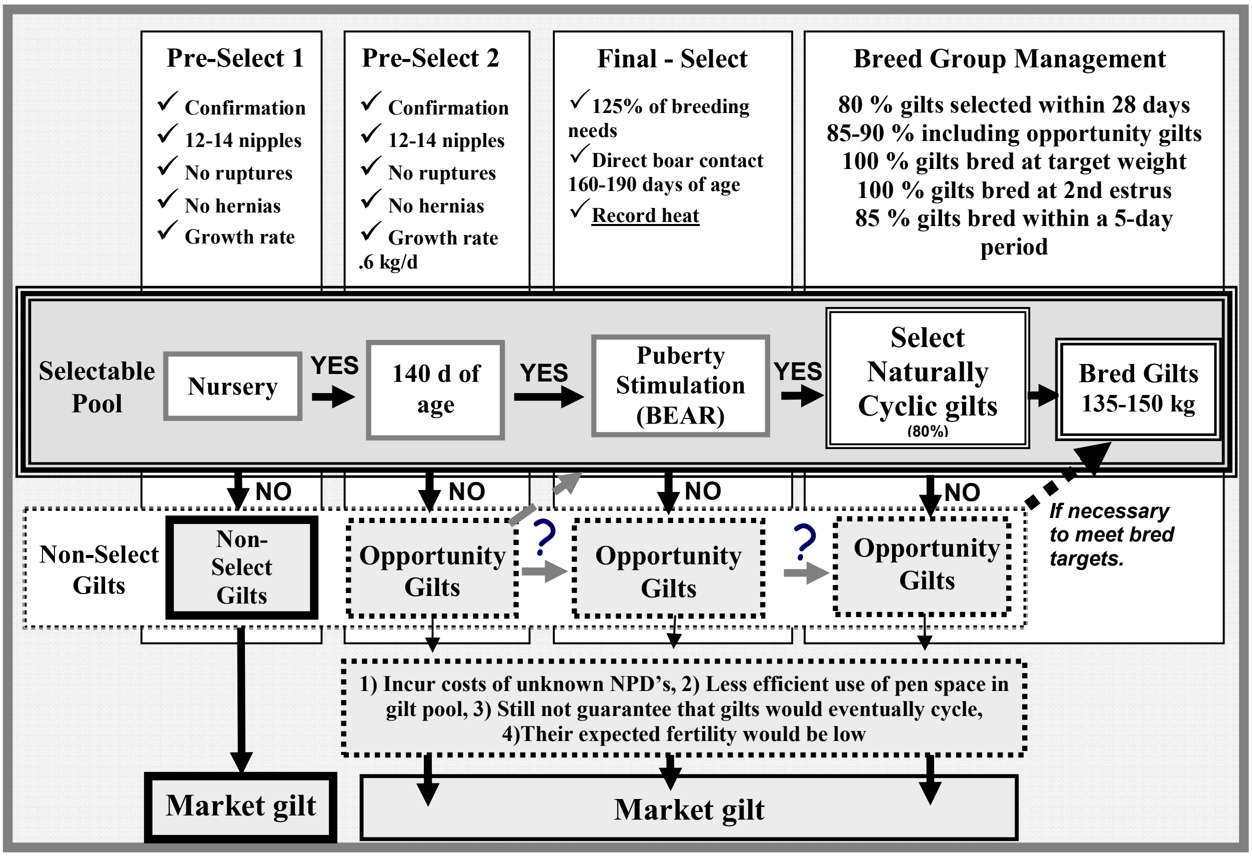

Figure 1. Schematic diagram of an efficient gilt management system (After Foxcroft et al., 2006).

The trend towards larger breeding sow herds seems to be decreasing the efficiency of breeding herd management. PigChamp data for 2006 showed that on larger breeding sow farms in the USA and Canada, annual herd replacement rates were often between 60 and 70 %, with a number of important consequences:

- A larger pool of replacement gilts is needed to meet increased replacement requirements.
- Suboptimal gilts are bred to meet breeding targets; they have lower performance and will be prematurely culled.
- Breeding herd parity distribution is unstable and biased towards lower parity females.
- Chronic over-crowding of pens in the gilt development area is needed to meet replacement needs
- Negative impacts on health and welfare result.
- Pressure to meet breeding targets results in less fertile gilts being bred using pharmacological interventions.
- Gilts are bred below target weights.
- General performance and morale of GDU staff declines and staff retention is low.

Longevity, in terms of parities in production, is also maximized in females that were initially mated at a younger age. Gilts initially bred > 10 months of age were less efficient, produced fewer pigs born alive lifetime, were culled sooner and showed a negative economic return over their economic lifetime (Culbertson and Mabry, 1995). Typically, most sow removals occur in the lower parities (ranging from 3.1 to 4.6), are unplanned, and primarily due to reproductive failure; only a smaller proportion of culls are due to lameness and/or locomotive problems (Engblom et al., 2007). At least three parities (potentially five, depending on the herd) are required from a sow before there is positive cash flow to a producer (as reviewed by Engblom et al., 2007).

Koketsu (2005) investigated relationships between herd age/parity structure and productivity in breeding herds. In this study sow herds were classified based on their parity structure stability as measured by the percentage of parity 0 and parities 3-5 in the herd. Herds that were considered stable, outperformed those herds that had high fluctuations in parity structure, stable herds had more pigs weaned per year, fewer NPD, higher farrowing rate, fewer gilts on inventory, lower replacement rates and a higher parity at culling.

Taking into consideration our current knowledge of gilt development and sow longevity we suggest a well run GDU is critical, as shown in Figure 1. This paper will focus on the benefits of identifying "select" gilts at an early age (a critical part of a successful GDU program) and the positive effects on sow lifetime productivity.

Key Risk Factors for Sow Longevity

Improving sow longevity, herd stability and maximizing lifetime performance in the sow herd represents a significant challenge that is best addressed in the GDU, by maintaining a constant input of high quality gilts into the breeding herd (the "Push" concept of gilt replacement management). Meeting and maintaining breeding targets is often the primary goal of a GDU. However, there are two key risk factors which, if not addressed by appropriate GDU management, will adversely affect lifetime productivity and overall profitability:

1) Selection of gilts with the greatest reproductive potential, and
2) Inappropriate management for body state at sexual maturity.

Invariably, sows will be culled or removed at each parity; and in general, industry standards for sow lifetime performance are suboptimal (Sporke, 2007). Therefore production benchmarks must be set (Figure 2). Targets might include 86% of gilts selected to reach first farrowing, and no more than 10% gilt fallout in each subsequent farrowing (Kummer 2008).

Selecting gilts with the greatest reproductive potential

The relationship between age at puberty and lifetime performance in Camborough 22 gilts was examined in a gilt development study conducted in collaboration with the Prairie Swine Centre, Saskatoon. Starting at approximately 140 days of age, pens of gilts were taken to a purpose built boar stimulation pen, and received 20 minutes direct exposure to mature epididiectomized boars daily as a pen group for pubertal stimulation. Puberty attainment was determined as the day gilts first exhibited the standing reflex in response to contact with a boar. Gilts were permitted up to 40 d of daily boar contact to exhibit pubertal estrus. "Select" gilts were recorded as cyclic by 180 days of age (Select) and were classified on the basis of age at puberty into 3 groups: 1) Early Puberty (EP) (< 153 d of age) n=87;

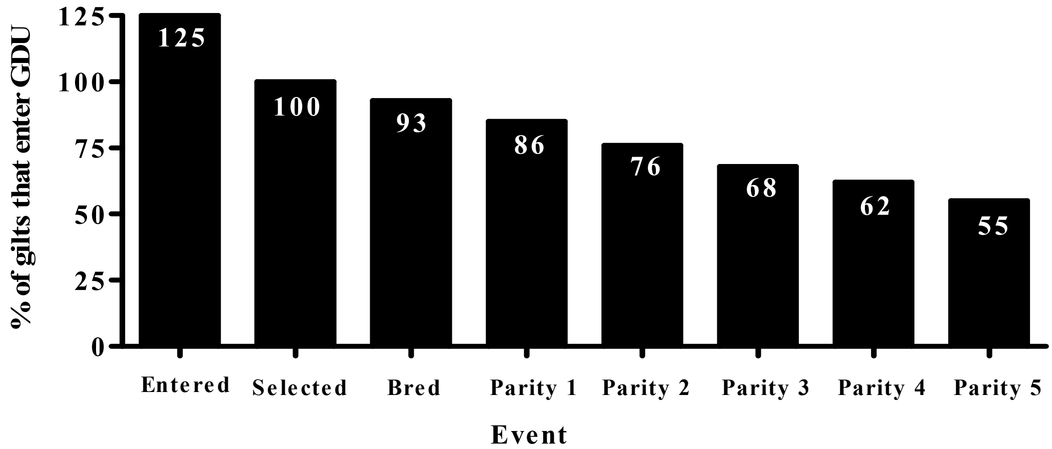

Figure 2. Projected targets for the percentage of gilts reaching each event milestone (Kummer 2008).

2) Intermediate Puberty (IP) (154 to 167 d of age) n = 146; or 3) Late Puberty (LP) (168 to < 180 d of age; n= 100). Gilts not exhibiting the standing reflex by 180 d of age were considered Non-responders (NR) or Non-Select (n = 107). At approximately d 18 of the 2nd estrous cycle, gilts were permitted fenceline contact with mature boars for detection of 3rd estrus. To determine sow lifetime performance, data were collected over three parities on: sow body weight, loin and backfat depth at farrowing and weaning; total litter size born alive, dead and mummies; weaning-to-estrus interval; retention rate; and reason for culling.

The percentage of gilts bred was highest for those expressing puberty within in the 40 day experimental cutoff, and approximately 95% of "select" gilts were successfully bred at 3rd estrus. Non-select gilts were returned to the herd at 180 days of age and were stimulated to reach puberty by a number of means (continued boar exposure, pharmacological means), although the methods were not recorded. Fewer Non-select gilts (73%) were eventually bred and produced a first litter.

Total pigs produced per sow lifetime is one measure of sow longevity. There was no difference in total born or born alive between classification groups, but parity differences were detected (Table 1). Although no differences were detected in total born or born alive over three parities, an increase in 2.6 total born and 2.2 born alive by parity 3 in Select gilts, represents a significant economic gain to the producer.

Approximately 60 and 50% of Select and Non-select gilts, respectively, farrowed three litters, which is below the selected target of 75% (Figure 3). However, Kummer et al. (2005) showed that this target is achievable, with approximately 70% of select gilts in their study going on to farrow three litters. Considering Select versus Non-Select gilts initially served from the perspective of retention rate from first service to farrowing their third litter, the slope of the "target" regression line was similar to the for Select gilts, whilst the slope of Non-select gilts was the most negative ($P < 0.03$; Figure 4). On average 14.3 % of Select gilts were removed at each parity, compared to 17.8% of Non-select gilts. Culbertson (2007) reported that once sows make it to third parity the overall retention in the herd increases and the slopes of the retention curves beyond this point become very similar. He concluded that problems with young female retention are the driver of unacceptable replacement rates. Clearly, a key area for improvement is from gilt entry until farrowing the third litter, with a special focus on those gilts that never farrow a litter and that are 100% unproductive in their lifetime.

Table 1. Mean total born and born alive in parities 1, 2 and 3, and overall by parity 3 by gilt classificastion and parity (least means squares ± S.E.).

	EP	IP	LP	Average of Select gilts	Non-Select gilts
Total Born[1]					
P1	10.7 ± 0.4 [a]	10.7 ± 0.4 [a]	11.6 ± 0.4		10.7 ± 0.4 [a]
P2	11.0 ± 0.4 [a]	11.9 ± 0.4 [b]	11.5 ± 0.4		11.2 ± 0.5 [a]
P3	12.7 ± 0.5 [b]	11.9 ± 0.4 [b]	12.6 ± 0.5		12.7 ± 0.5 [b]
Lifetime[2]	25.8 ± 1.7	24.6 ± 1.3	26.3 ± 1.7	25.4 ± 0.9	22.8 ± 1.7
Born Alive[1]					
P1	10.1 ± 0.4 [a]	10.0 ± 0.3 [a]	10.5 ± 0.4 [a]		10.1 ± 0.4 [a]
P2	10.4 ± 0.4 [a]	10.9 ± 0.3 [b]	10.6 ± 0.4 [a]		10.5 ± 0.5 [a]
P3	12.0 ± 0.5 [b]	10.9 ± 0.4 [b]	11.8 ± 0.5 [ab]		11.8 ± 0.5 [b]
Lifetime[2]	24.4 ± 1.6	22.7 ± 1.2	24.2 ± 1.6	23.6 ± 0.8	21.4 ± 1.6

[1] Total born or born alive, analyzed as repeated measures over parities 1 to 3.
[a,b] Least squares indicate parity differences ($P \leq 0.05$). No differences were detected within each parity between puberty group classification ($P > 0.05$).
[2] Total born or born alive over three parities, analyzed as the cumulative number of pigs born in parities 1 to 3, considering only those gilts served. If gilts were culled before reaching third parity, they were given a value of '0' for each subsequent parity. No significant differences were detected ($P > 0.05$).

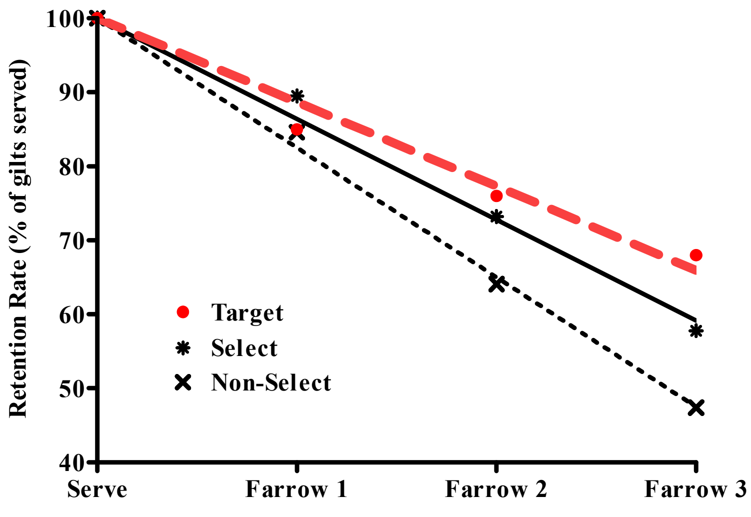

Figure 3. Percentage of Select vs Non-Select gilts farrowing three litters (SRTC unpublished data from collaborative studies with Prairie Swine Centre, Saskatoon).

Overall, considering all gilts originally on inventory, a higher percentage of Non-Select versus Select gilts never farrowed a litter and were 100% non-productive (neither gestating nor lactating), representing an important financial loss (Figure 4a). Considering only gilts initially served, Select gilts that responded promptly to boar stimulation were retained in the herd longer than Non-Select gilts and were removed mainly due to reproductive reasons (Table 2). Lucia et al. (2000) suggested that minimizing removals for reproductive failure is critical to optimizing lifetime reproductive efficiency. They suggested that reproductive management practices should be directed to reduction of NPD accumulation at early reproductive cycles, and that this could be achieved by implementing improved gilt management practices.

Of those gilts that farrowed at least one litter, the percent lifetime NPD decreased with increasing parity (Figure 4b); at each parity, LP and Non-select gilts spent a higher percentage of their herd life non-productive (Figure 4b). All sows returned promptly to estrus after weaning with approximately 89, 94 and 90% of sows at Parity 1, 2 and 3 being recorded in estrus within in 7 days of weaning. Although WEI was acceptable, sows that did not return to heat within 7 days accumulated a large number of NPD. This was probably largely due to ineffective management practices, and as reported by Koketsu (2005) leads to unnecessary accumulation of NPD due to extended first-mating or weaning to culling intervals. On the positive side, Rodriguez-Zas et al. (2006) suggested that additional benefits of longer retention of sows in the breeding herd would be a greater opportunity to recuperate the initial costs of developing replacement gilts, greater acquired immunity to diseases, greater salvage value of sows culled and lower replacement costs.

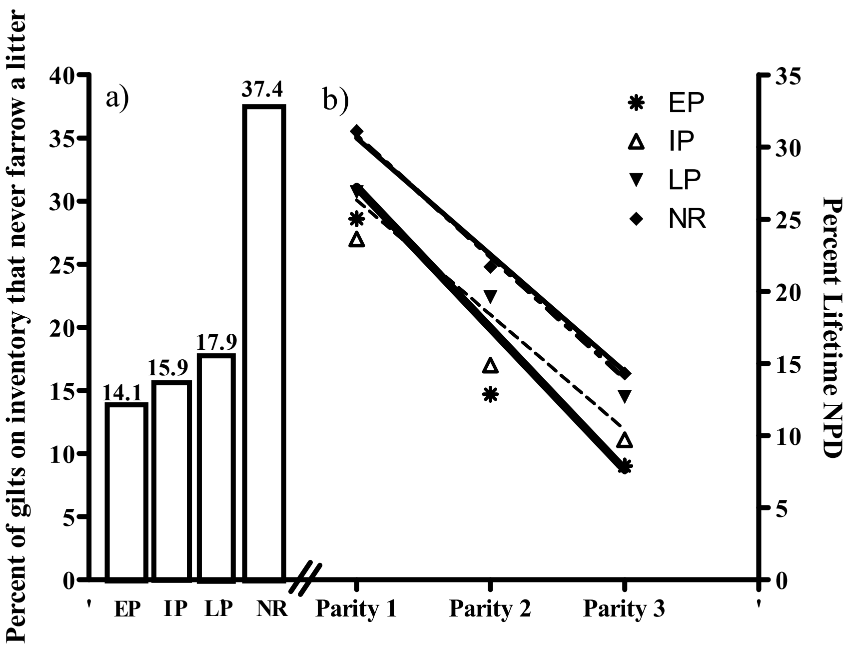

Figure 4. a) Percent of gilts originally on inventory that never farrow a litter; b) Percent lifetime NPD (total number of herd days – total number of productive days (lactation and gestation) divided by herd days (Lucia et al., 2000)) of all gilts that farrow at least one litter.

Table 2. Parity at removal and reason for culling (± S.E.) by puberty group classification. (SRTC unpublished data from collaborative studies with the PSC, Saskatoon).

	EP	IP	LP	Non-select
Parity at removal	1.7 ± 1.2	1.5 ± 1.0	1.6 ± 1.0	1.2 ± 1.0
Reasons for culling:				
Reproduction [1]	70.0	63.1	63.2	65.8
Litter performance [2]	15.0	18.4	13.2	5.3
Locomotion [3]	7.5	6.2	7.9	13.2
Disease/peripartum problems [4]	7.5	12.3	15.8	15.8

[1] Conception failure, failure to farrow, no observed heat, abortion.
[2] Farrowing productivity, lactation-weaning productivity, difficult farrowing, smaller litter size, retained pigs.
[3] Lameness, unsoundness, injury, downer syndrome, body condition.
[4] Rectal and uterine prolapse, vulvar discharge, hernia, gastrointestinal, urinary infection, abbcess, mastitis, heart failure, behaviour, unknown.

Taken together, these data lead to the obvious suggestion that the response to a standardized protocol of boar stimulation can be used to identify the 75 to 80% of gilts that are likely to be most fertile over their productive lifetime in the breeding herd.

Inappropriate management for body state at maturity.

Age. Body condition of gilts at first mating has a significant effect on lifetime performance. Gilts that do not have sufficient body condition when they are first selected and introduced to the farm generally fail to achieve a reasonable number of parities (Close and Cole, 2001). Experimental data and cost/benefit analysis clearly indicate that breeding on the basis of weight and recorded heat-no-serve is the most cost-effective strategy. Breeding on the basis of age is considered to be inappropriate and an inadequate benchmark, because 40 days of boar stimulation resulted in nearly 60 days variance in age at puberty, a 75 kg variation in body weight at first estrus, and the need to breed gilts at anywhere from 1st to 6th estrus if breeding weight targets of 130 to 150 kg (300 to 350 lbs) were to be met. In the study of Kummer et al. (2005) no difference in total born was observed between gilts inseminated at approximately the same weight but different ages. These authors concluded that breeding faster growing gilts at a younger age did not have repercussions for performance over three parities.

Weight. Results from experimental studies and cost/benefit analyses suggest that gilts should be bred at a target weight of 135 to 150 kg (300 to 350 lbs). According to Williams et al. (2005) gilts weighing less than 135 kg have less total pigs born over 3 parities than gilts weighing over 135 kg (Figure 5); There was also no advantage in breeding gilts heavier than 135 kg. Similarly, Kummer et al. (2005) reported no advantage in breeding gilts heavier than 140 kg. In addition, puberty stimulation should start about 30 days prior to gilts reaching the maximum allowable live market weight to avoid economic penalties for producers.

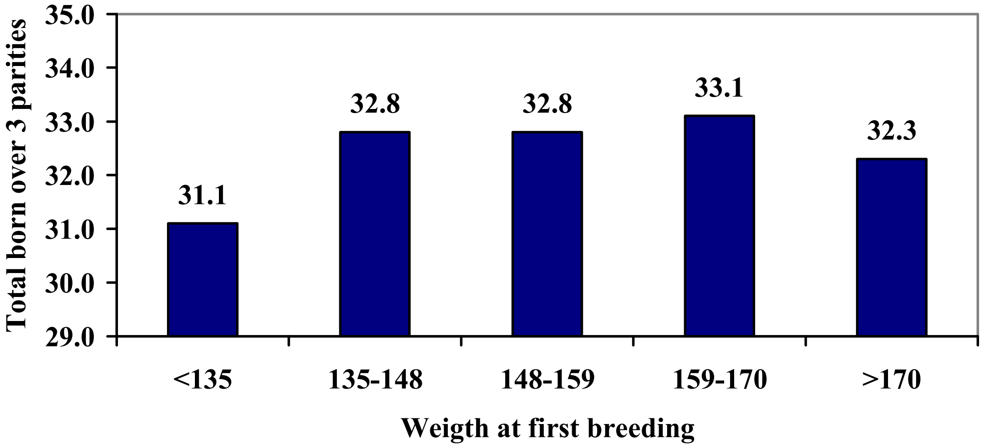

Figure 5. Total born over 3 parities according to breeding weight (Williams et al., 2005).

A consequence of the considerable variability in growth performance and age at sexual maturity within the cohort of gilts studied in our collaborative study with the Prairie Swine Centre, was a 75 kg weight difference between the lightest and heaviest gilts at first estrus. Despite the fact that all gilts were fed to "condition" during gestation through the entirety of this experiment, EP gilts were lighter than LP at every measured event (Figure 6). This has important impacts of mature body size, and may have important welfare consequences linked to premature culling due to lameness and other degenerative problems due to the increased mature body size of late maturing but fast growing gilts.

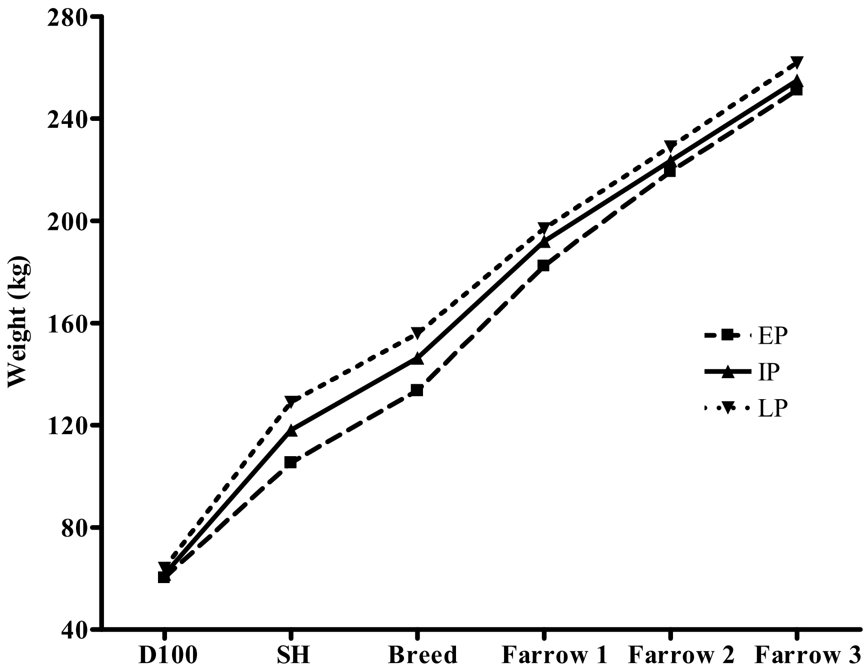

Figure 6. Body weight of EP, IP and LP gilts from 100 d of age to farrowing at third parity. (SRTC unpublished data from collaborative studies with the PSC, Saskatoon).

However, recent data indicate that a greater body mass after farrowing (>180kg) protects sows against the effects of excessive loss of lean mass during their first lactation if feed intake is low (Foxcroft et al., 2006). This suggests a lower threshold of body weight at breeding and farrowing the first litter should be considered. As mentioned above, our current recommendation is to breed gilts between 135 and 150kg, at second or third estrus. Assuming a 35 to 40kg weight gain during gestation, this results in a weight of >180kg after farrowing the first litter.

Adequate levels of back-fat are important to protect sows from physical injury, but there is no consistent evidence that increased back fat is an important factor in longevity and lifetime fertility of sows.

To meet these critical targets for breeding weight, information on gilt weight and growth rate, either at the onset of boar stimulation, or at the time of pubertal estrus, is increasingly becoming accepted as one of the key a non-negotiables of effective GDU management. We recommend that including a weigh scale within the GDU become obligatory from both a management and welfare perspective. An alternative to capturing a weight, would be the application of established allometric growth curves that take advantage of the high correlation between two body measurements, heart girth circumference and body weight. Given the accuracy of heart girth as a predictor of gilt weight it is an adequate substitution for determination of body weight during gilt stimulation (Pasternak et al., 2008). This estimation will allow producers to better manage gilt development for improved lifetime performance.

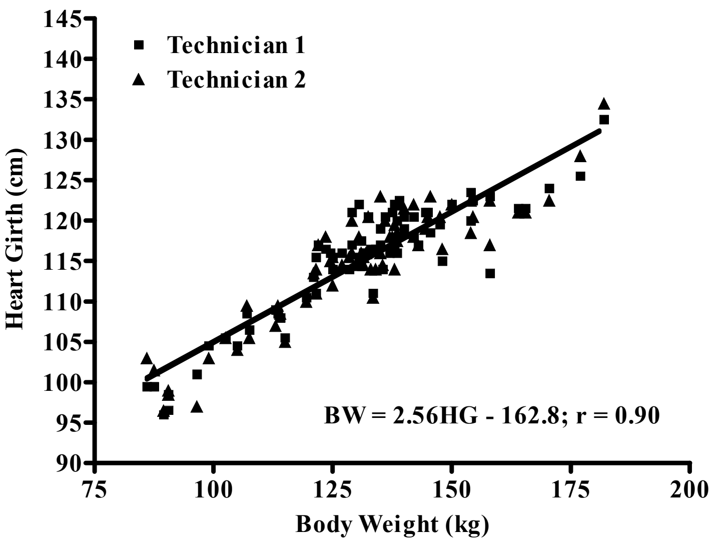

Figure 7. Relationship between Heart Girth and Body weight for two technicians separately. The linear regression equations for each data set over lap one another and have similar slopes and intercepts (Pasternak et al., 2008).

Estrus. More important than chronological age at mating (a function of management practices), is physiological age (number of estrous cycles). Early stimulation of gilts permits producers to take advantage of the increased productivity of gilts bred at second or third estrus. Generally, delaying breeding from 1st to 2nd estrus gives a 0.7 pig increase in first litter size. In contrast, delaying breeding from 2nd to 3rd estrus only increases litter size by 0.2 pigs for the same extra cost. Therefore, breeding should only be delayed to 3rd estrus in order to achieve acceptable breeding weights

Summary

Successful introduction and retention through the early parities drives lifetime performance of the breeding herd and represents an opportunity to improve and enhance overall production. Implementation of an effective GDU system (BEAR, Magic '42') is absolutely necessary and is the pivotal starting point in the system to select gilts with the greatest reproductive potential.

We recommend gilts that are cyclic within a defined number of days after boar exposure are considered "Select" gilts: All others are considered "opportunity" gilts and are only entered into the herd if breeding targets cannot be met from the Select pool. Non-Select "opportunity" gilts will have fewer pigs born lifetime, accumulate more NPD and have lower retention in the herd. Therefore, management systems should implement planned culling procedures and remove these sows early in their productive life.

Finally, gilts must have sufficient body condition (135 to 150 kg of body weight) and sexual maturity (at least second estrus) when first bred to be sure they achieve adequate number of parities (>3).

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