

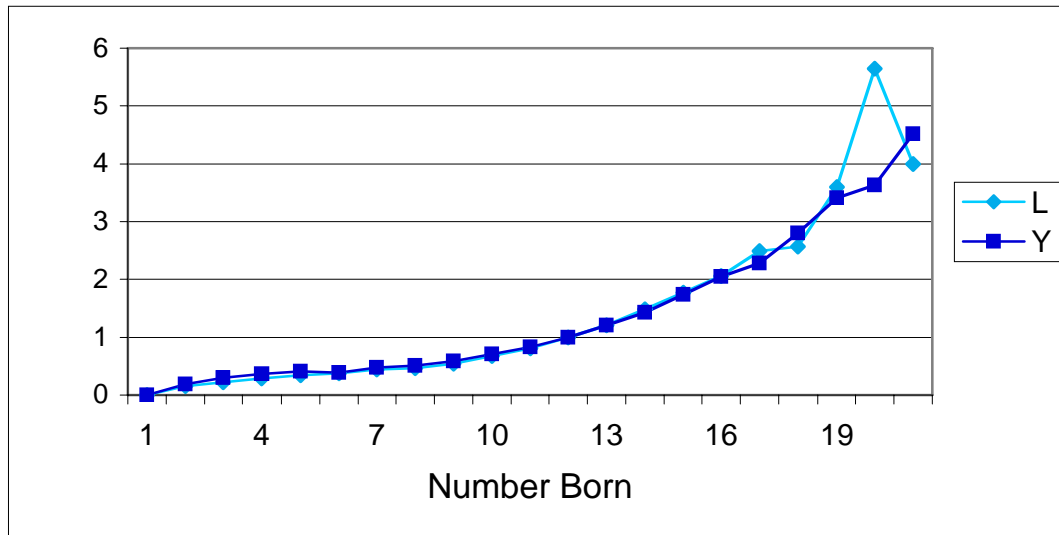
Piglet survival - Implications of large litter sizes: Genetic Focus on What is Happening as Litter Sizes Increase to Levels That Create Challenges to Survival

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Introduction

As an industry, our success in selecting for increased litter size is coming back to haunt us. Data from breeders' herds in Ontario and reports from elsewhere show that there is a non-linear relationship between litter size and piglet survival, especially peri-natal survival (e.g. Robinson and Quinton, 2002, Lecour, 2000). Data from Robinson and Quinton (2002) reproduced below as Figure 1 suggest that if we continue to increase litter size without worrying about survival, we can expect a corresponding and more rapid increase in piglet mortality in the peri-partum period at least.

Figure 1 Peri-natal Piglet Mortality Versus Number Born from Robinson and Quinton (2002)



Adding to this challenge is the low level of heritability for peri-natal and weaning mortality; 0.059 and 0.018 respectively in Ontario data adjusting for litter size and using a log transformation to account for the non-linearity with litter size and non-normality (Quinton *et al.*, 2005). Other estimates place heritabilities for peri-natal and weaning mortality around 0.05 to 0.09 and 0.02 to 0.03 respectively (Arango *et al.*, 2005).

What is Happening to Influence the Number of Piglets Weaned?

Survival has two components, both of which have been studied extensively. The first component is the birth and immediate post-natal survival; peri-natal survival. This is considered as a trait of the sow. National EBVs have been developed for peri-natal survival for Canadian breeders (www.ccsi.ca). These EBVs are based on data collected by the breeder for each litter; total number born and number alive after 24 hours. The second component of survival is a joint effort of the piglet and the sow to survive from the peri-natal period to weaning. This period is more difficult to study with field data if piglets are not identified individually as part of the data collection process and/or if piglets are cross-fostered to balance litter size with milking ability.

Piglet survival from conception to 24 hours post-partum is a combination of many factors, some of which may carry over into the post-partum period. However, the focus on peri-natal survival removes malformed and mummified fetuses and focuses on those fetuses that were carried normally to full term. Defined in this way, the trait includes the important effect of birth weight on survival (van Rens *et al.* 2005). Dutch estimates put peri-natal mortality in the 3 to 8% range with pre-weaning mortality accounting for about 10% (Van der Lende *et al.* 2001). From Figure 1 above, for an average litter size of 12 piglets born, mortality is about 8%. On this basis, let us consider that both sources of mortality have a similar impact on eventual number of piglets weaned.

Data Collection and Analysis

One of the biggest challenges with studying piglet survival is the nature of the data. Peri-natal survival is most often calculated as the difference between the number born alive and the total number born. However, the challenge for recording those numbers is to determine which piglets were born alive and subsequently died, which were stillborn and which died *in utero* at some point prior to farrowing. The point in time at which these counts are recorded can have an effect; a piglet may be born alive but fail to successfully nurse and will not survive for long. The current standard for data recording in Canada uses alive in the first 24 hours but in practice the count is taken when the litter is first observed sometime in the first 24 hours. Recording post-natal survival to weaning for purposes of genetic evaluation is more challenging since litter data collection systems used currently treat the litter as an aggregate and do not identify the piglets individually. Cross-fostering of piglets prior to weaning also distorts the true expression of survival since the maternal environment is not constant. Most of the sow productivity information collected in Canada comes from the breeder through their on-farm management software. While this dramatically increases the amount of data available for evaluations and analysis, it also increases the opportunity for a variety of definitions of the various traits to be applied. As long as breeders are consistent within-herd, these differences will become part of the management effect in the estimated breeding value (EBV) calculations. Breeders with multi-site operations where each site has a different manager need to be sure that site is part of the definition of management group.

Some analysis of survival post-partum to weaning treated solely as a trait of the sow can be done using breeder submitted aggregate litter data. In Canada, currently these data include the number and weight of piglets weaned and the weaning date. If one assumes that cross-fostering practices are similar for all litters, an EBV for survival to weaning as a trait of the sow can be generated. As noted above, with this assumption, the heritability of this trait was estimated to be 0.018 suggesting that minimal genetic progress can be made on this basis. Collection of ideal data for survival from post-partum to weaning requires individual identification of piglets and collection of data on cross-fostering including identifying the foster dam and date of fostering.

Survival data are never normally distributed. Analysis of these data therefore requires a pre-adjustment and transformation or a threshold model approach (eg. Ducrocq and Sölkner. 1998). Depending on the computing environment and the willingness to write custom software, the choice of approach may be limited by the capability of the available software and the computing requirements as the number of records and mortality per litter categories increases. Both

approaches yield similar estimates of heritability and (e.g. Quinton *et al.* 2005 and Arango *et al.* 2005) suggesting that for implementation purposes, a transformation may be the most expeditious route, especially for a system already using linear models. Both methods require an alternate representation of the EBVs to report the trait in a format that makes biological sense to producers.

Experimental approaches have looked at additional traits to have a means to look inside the uterine environment non-invasively. Placental efficiency, defined as the ratio of total litter birth weight and total placental weight, has been explored as a means to study placental organization as a quantitative trait (Mesa *et al.*, 2003). However, one such study concluded that birth weight was still a better predictor of survival than a ratio involving birth weight (van Rens *et al.* 2005).

Relative Economic Value of Improving Survival

The relative importance of improving survival as a component of improving sow productivity is significant. On a dollar per genetic standard deviation basis, for a market hog production system and an average litter size of 12 pigs, litter size is valued at \$27.30CAD, peri-natal survival at \$12.10CAD and survival to weaning \$5.00CAD. When the average litter size increases to 16 pigs, the value per genetic standard deviation of litter size becomes \$21.70CAD, for peri-natal survival becomes \$16.20CAD and for survival to weaning becomes \$6.60CAD. Push the litter size average to 20 pigs and the values become \$13.70CAD, \$20.20CAD and \$8.30CAD per genetic standard deviation of litter size, peri-natal survival and survival to weaning respectively (Quinton *et al.* 2005). Clearly the importance of piglet survival, especially peri-natal survival, increases dramatically as average litter size increases. As an industry we want to start thinking about piglet survival as we continue to improve sow productivity so we don't become victims of our own success.

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