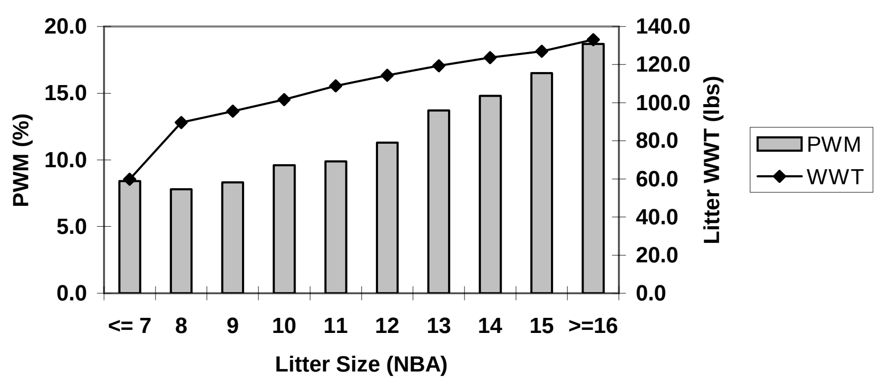
Improving weaned pig quality in today's large litters

J. Holl and T. Long
Smithfield Premium Genetics Group, Rose Hill, NC.

Introduction

Reproductive efficiency is an important component of profitable pig production. Litter size has been used in the swine breeding industry as a major indicator of reproductive efficiency. As a result, litter size has increased and continues to be a primary objective in most maternal-line selection programs. With increases in litter size, total litter weaning weight has also increased (Figure 1.).

Figure 1. Total Weaning Weight and Preweaning Mortality by Litter Size



Total weaning weight is a function of pig quantity and quality. Pig quality can be associated with individual pig weights and survivability. As litter size increases, total weaning weight increases at a decreasing rate. As shown in Figure 1., larger litter sizes not only wean more weight, but also have higher preweaning mortality. Increased litter size has been associated with smaller, more fragile piglets. Therefore, the system-wide impact of increased litter size could be limited due to production losses and inefficiencies associated with decreased pig quality. In order to maximize the economic impact of increased genetic potential for litter size, pig quality should be addressed and incorporated into selection programs.

Materials and Methods

Data were recorded from pureline Large White animals at SPG nucleus farms. Farms were negative for porcine reproductive and respiratory syndrome virus (PRRSv), Actinobacillus pleuropneumonia (APP), and Mycoplasma hyopneumonia (Myco). At birth, numbers of stillborn and live born pigs were recorded along with individual birth weight. Cross-fostering was done within 24 hr of birth. Individual mortality events and dates were recorded on each pig. For this analysis, pre-weaning mortality was defined as a stillborn pig or a pig that died before weaning. At weaning (17 to 25 d), individual weaning weight and nurse dam were recorded for each pig. A portion of the pigs was subsequently finished with serial feed intake data recorded using Osborne FIRE feeders. At approximately 170 d, pigs were weighed (WT), and ultrasound measurements for backfat (BF), loineye depth (LD), and intramuscular fat (IMF) were recorded.

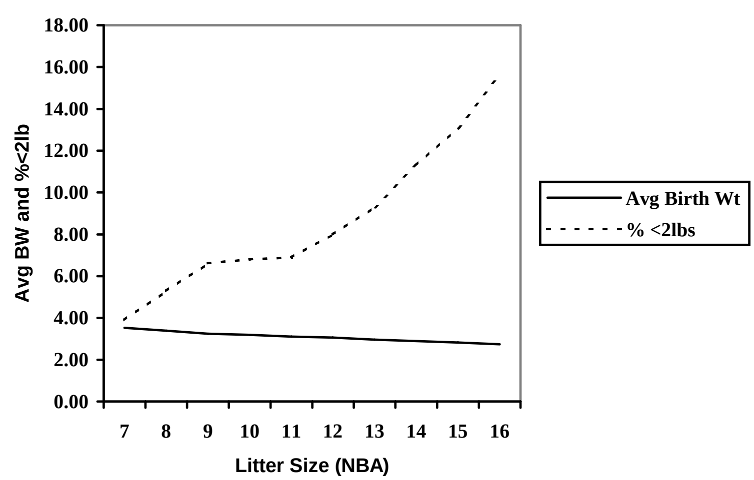
A threshold-linear model was used to analyze preweaning mortality and birth weight. The model included fixed effects of dam parity, birth litter size, and contemporary group. Contemporary group was defined as piglets born on the same farm, year, and month. Piglet gender was used as a fixed effect for birth weight only. Random effects included direct and maternal additive genetic, litter, and residual effects. For preweaning mortality, nurse dam was fit for the maternal genetic and litter effects.

Regression analyses were done to determine birth and weaning weight impacts on subsequent performance. Regression of birth and weaning traits on off-test traits (WT, AFI, BF, LD, and IMF) included fixed effects of contemporary group, gender, and a covariate of age. Contemporary group was defined as piglets weighed on the same farm, year, and week.

Results and Discussion

When evaluating phenotypic associations, an indirect relationship existed between litter size and average birth weight (Figure 2). As litter size increased, birth weight decreased. More specifically, the percentage of pigs that were born weighing less than 2 lbs increased. A greater percentage of lighter pigs died during the preweaning phase compared to heavier piglets. For pigs less than 1.5 lbs, only 47% survived to weaning. For pigs between 1.5 and 2.0 lbs, 64% survived to weaning. Pigs weighing between 2.0 and 3.0 lbs had about 85% survival, and pigs weighing over 3.0 lbs at birth had a 95% survival rate. Therefore, processes to increase average birth weight in larger litters may reduce preweaning mortality.

Figure 2. Birthweight by Litter Size



Estimates of heritabilities and genetic correlations between birth weight and preweaning mortality from the joint threshold-linear model are shown in Table 1. Maternal heritabilities were greater than direct genetic heritabilities. A greater opportunity may exist to place selection pressure on improving the sow's ability to successfully raise a litter rather than selecting on the direct genetic effects. Genetic correlations between birth weight and preweaning mortality were negative for direct and maternal components. These estimates were in agreement with estimates reported by Damgaard et al. (2003) and Hogberg and Rydhmer (2000). Thus, a pig's genetic predisposition for increased birth weight would also correlate to a greater ability to survive. In addition, a sow's genetic predisposition for producing heavier piglets at birth was correlated with a genetic predisposition for weaning a greater proportion of piglets. Consequently, lighter piglets would be more apt to die before weaning. However, selection to decrease preweaning mortality may increase birth weights.

Table 1. Heritabilities and genetic correlations for direct (d) and maternal (m) genetic components for birth weight (BW) and preweaning mortality (PWM)

	BW_d	BW_m	PWM_d	PWM_m
BW_d	0.04	-0.24	-0.34	-0.09
BW_m		0.15	0.12	-0.16
PWM_d			0.03	-0.66
PWM_m				0.09

Results from regression of birth and weaning traits on off-test production traits are shown in Table 2. Increased birth and weaning weights were associated with faster postweaning growth, but were not associated with greater daily feed intake. Increased birth and weaning weights were also associated with less fat, muscle depth, and intramuscular fat. However, the magnitude of effects, although significant, is relatively small considering the amount of variation in early age pig weights. Assuming a weaning weight of 12 lbs, 190 days to 250 pounds, and 0.70 inches backfat, an increase of 1 lb or 8.3% in weaning weight would result in a decrease of 1.5 days to market and 0.02 inches reduction in backfat. These phenotypic relationships indicate that increasing birth and/or weaning weights may have some beneficial impacts on finishing performance and carcass characteristics.

Table 2. Regression of birth weight(BW), weaning (WWT) weight and weaning age on Days to 250 lbs, Test weight, average daily feed intake (AFI), ultrasound backfat (BF), ultrasound loin depth (LM), and ultrasound intramuscular fat percentage (IMF).

	BW				WWT				Wean Age			
Trait	Estimate[a]				Estimate[a]				Estimate[b]			
Days to 250	-0.62	±	0.01	**	-0.15	±	0.01	**	0.01	±	0.01	NS
Test Wt (lbs)	1.27	±	0.03	**	0.32	±	0.01	**	-0.02	±	0.02	NS
AFI (lbs)	0.0014	±	0.0022	NS	0.0002	±	0.0006	NS	-0.0007	±	0.0012	NS
BF (in)	-0.0023	±	0.0002	**	-0.0003	±	0.0001	**	-0.0003	±	0.0001	**
LM (in)	-0.0007	±	0.0003	**	-0.0003	±	0.0001	**	-0.0001	±	0.0001	NS
IMF	-0.0050	±	0.0009	**	-0.0008	±	0.0003	**	-0.0003	±	0.0005	NS

[a]Effect per one-tenth pound increase in wt
[b]Effect per one day increase in wean age

One method to increase weaning weights is to increase weaning age. Although weaning age was positively associated with weaning weight, weaning age did not have as many significant associations with growth and carcass traits. This was in contrast to a report by Main et al. (2004). However, the study herein looked at an older range in weaning age compared to the other report. Therefore, using management to change weaning weight by changing weaning age may not have a desired impact on down-stream growth performance.

Other research has reported that heavier pigs at weaning are more likely to survive in the post-weaning phase (Larriestra et al. 2006 and de Grau et al. 2005). Using management practices such as increasing weaning age to increase weaning weight may help decrease post-weaning mortality. In addition, genetic relationships between weaning weight and post-weaning mortality need to be evaluated for possible use in selection objectives.

Conclusions

Selection has effectively increased the number of pigs born alive. However, increased litter size has been associated with reduced pig quality in terms of smaller piglets and higher preweaning mortality. In order to fully capture the potential impact of litter size selection, selection should include components of pig quality.

References

Damgaard, L.H., Rydhmer, L., Lovendahl, L. and Grandison, K. 2003. *J. Anim. Sci*. 81:604-610.

de Grau, A., Dewey, C., Friendship, R. and de Lange, K. 2005. *Can. J. Vet. Res*. 69:241-245.

Hogberg, A. and Rydhmer, L. 2000. *Acta Agric. Scand. Sect. A*. 50:300-303.

Larriestra, A.J., Wattanaphansak, S., Neumann, E.J., Bradford, J., Morrison, R.B. and Deen, J. 2006. *Can. Vet. J*. 47:560-566.

Main, R.G., Dritz, S.S., Tokach, M.D., Goodband, R.D. and Nelssen, J.L. 2004. *J. Anim. Sci*. 82:1499-1507.