

The influence of genetics and environment on indicators of piglet pre-weaning survival

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Introduction Recent estimates of total pre-weaning piglet mortality range between 16-19% (MLC 2006). With environmental modification using the farrowing crate reaching its potential to decrease mortality, as well as raising serious welfare concerns, a different approach to effectively address piglet survival is needed. Genetic breeding programmes implemented in alternative farrowing systems could prove a viable option.

Materials and methods Behavioural and physiological indicators of pre-weaning piglet survival were measured on both gilts (N=65) and their piglets (N=757) in a genetic selection group bred for High (postnatal) Survival (HS) and a Control group (C) farrowing in Indoor loose-housed (I) and Outdoor (O) farrowing systems in a 2x2 design. The gilts were offspring from a previous generation selected for survival traits (Roehe *et al.*, 2007) and bred under outdoor conditions. GLMM analysis was used to determine which factors influenced prenatal survival (comparing stillborn piglets with piglets surviving to weaning) and postnatal survival (comparing piglets that were born alive but subsequently died with surviving piglets). GLM analysis was used to compare indicators at a litter level. Potential survival indicators measured included piglet weight and body shape, as measured by ponderal index (PI: birth weight/crown-rump length³), body mass index (BMI: birth weight/crown-rump length²) and abdominal circumference (AC), piglet temperature and behavioural development (e.g. latency to reach the udder, a teat and to suckle), placental traits and gilt behaviours such as posture changes, crushing and aggression.

Results In the O environment total mortality tended to be higher in the C litters than the HS litters (18% vs. 12%, $W_1=3.60$, $P=0.058$), and this tendency was even lower in live-born mortality (C:13% vs. HS:10% $W_1=1.69$ $P=0.193$). In the I environment there were no significant differences in either total mortality (C:12% vs. HS:15% $W_1=0.07$ $P=0.797$) or live-born mortality (C:8% vs. HS :11%, $W_1=0.04$ $P=0.842$). Regardless of environment or genotype, important indicators of prenatal survival were body shape and size (PI: $W_1=35.50$ $P<0.001$, BMI: $W_1=37.45$ $P<0.001$ and AC: $W_1=39.97$ $P<0.001$), farrowing birth order ($W_1=10.93$ $P<0.001$) and placental efficiency ($W_1=6.38$ $P=0.012$). Postnatal survival indicators are shown in Table 1, with birth weight and behavioural development being the most important indicators in multivariate analyses. Indicators were independent of environment, but there were genotype interactions with temperature and time to udder as survival determinants. Gilt behaviour affected piglet postnatal survival: piglets that died had mothers that were more careless with their posture changes (unsupported lying: $W_1=6.37$ $P=0.012$), crushed more ($W_1=5.61$ $P=0.018$) and were more aggressive (Pawing: $W_1=7.06$ $P=0.008$. Rooting: $W_1=4.94$ $P=0.026$ and Biting or Mouthing: $W_1=6.90$ $P=0.009$). When comparing survival indicators at a litter level, regardless of environment, C gilts showed more crushing incidents (both fatal and non-fatal; Figure 1). In the I environment, HS gilts were more aggressive to their offspring and were the only genotype to show savaging ($F_{1,63}=21.83$ $P<0.001$); 40% of the HS-I gilts mouthed or bit piglets.

Table 1 Postnatal survival indicators. GLMM univariate results comparing surviving and dying piglets. Environment (E) and genotype (G) interactions indicated by P-values using GLMM.

Indicators	Wald	P-value	Interactions	
			E	G
Birth weight	15.54	<0.001	0.594	0.161
BMI	6.96	0.008	0.531	0.666
AC	19.50	<0.001	0.437	0.453
2h temperature	5.72	0.017	0.864	0.019
24h temperature	6.34	0.012	0.235	0.027
Time to udder	7.44	0.006	0.548	0.046
Time to teat	10.22	0.001	0.455	0.746
Time to suckle	8.21	0.004	0.511	0.781

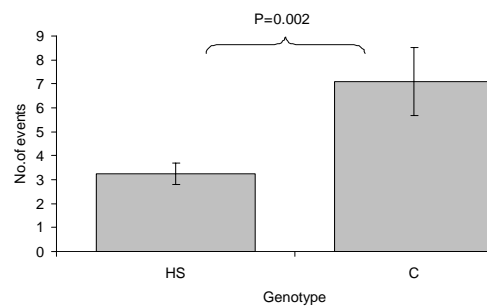


Figure 1 Differences in crushing behaviour between HS and C gilts. P-value using GLM

Conclusions There is potential to breed for high survival in alternative farrowing systems to the crate. The genetic selection programme had the most significant impact in the outdoor environment. The mortality results in the indoor environment illustrates the genotype by environment interactions and the potential to further improve survival. Indicators of prenatal survival were generic across systems, with piglet shape being the most important survival indicator. Postnatal survival indicators included birth weight and behavioural development. In both systems, C gilts showed more crushing behaviour than HS gilts. However, there are potential undesirable side-effects of selecting for HS in the indoor system, with HS gilts showing heightened aggression towards their piglets.

References Meat Livestock Commission. 2006. The Pig Yearbook 2006.

Roehe R, Shrestha NP, Mekki W, Knap PW, Smurthwaite KM, Jarvis S, Lawrence AB, Edwards SA. 2007. Genetic analyses of piglet survival and individual birth weight on first generation data of a selection experiment for piglet survival under outdoor conditions. Proceedings of the British Society of Animal Science, p65.