Dam Attributes And Postnatal Piglet Survival

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Introduction

Pre-weaning mortality is a production and welfare problem for modern production systems. Approximately 10 to 35% (Tyler et al. 1990) of newborn piglets die within the first three weeks of life, with more than 50% of deaths in the first three to five days post-farrowing. The main causes of preweaning deaths are starvation and crushing (Alonso-Spilsbury et al. 2007) and both sow and piglet attributes are implicated. This paper explores novel traits recorded on the sow pre- and post-farrowing to establish which dam level factors are associated with mortality of a sow's biological piglets.

Materials and methods

Data were collected on multi-parous sows from two maternal (Large White and Landrace) and two terminal (Duroc and Large White) lines in a single herd from September to October 2009. Sows were transferred to the farrowing house at about 110 days after mating, weighed (WT110), scored for locomotion (LOCO) and scanned for back fat thickness (P2_110). Locomotion was scored on a subjective scale of 0 to 2 (normal to poor), after sows had walked for approximately 20 m.

In the farrowing house, body condition score (BCS) was subjectively assessed on a scale of 1 to 5 (emaciated to fat) based on cover over the hips and backbone. The absence or presence of shoulder lesions (SLESION) was scored as 0/1. Udder development was subjectively scored into three classes (0 = well developed, to 2 = poorly developed) before (USCORE) and after (USCOREF) farrowing. The presence or absence (1/0) of colostrum (COLOS) at transfer was assessed by manual stripping of the two most cranial and caudal teats. Sow agitation (AGIT) on human contact was measured on a 0 to 6 scale (0=avoiding any human contact, to 6=complete acceptance of contact) based on the approach of Lensink et al. (2009). The number of functional teats (FTEATS) was determined by subtracting cut and blind teats from the total number of teats observed. Sow-crate fit (CFIT) was scored from 0 to 2 (0=plenty of room, to 2= crate was fully filled when the sow was recumbent). An assessment of teat accessibility (TACC), from 0 to 2 (good to poor accessibility), was also done.

After farrowing, sow rectal temperature (RTEMP) was recorded. During piglet processing, sow nervousness (NERVE) was scored (0 = no movements or vocalization, to 2 = frequent

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movement and high vocalization) to measure how responsive sows were to vocal stimuli from handled piglets. Reproductive data included number born alive (NBA) and total born (TB). The number of piglets that survived until weaning (NSURV) for each biological dam was derived from individual piglet death records. Piglets could be cross-fostered. Lactation feed intake recording was limited to the first 7 days after farrowing. Average daily intake (LADI) over 7 days and total feed intake over the first 3 days after farrowing (FID3) were calculated. R software (version 2.10.0) was used to identify outliers, whereby values of recorded traits that either deviated by 1.5 times the inter-quartile range from its mean were deleted. After editing, the final data represented 405 sows from 194 sires and 343 dams, and 4402 piglets from 65 service sires. Three generations of additional pedigree were obtained for each sow; the total number of animals in the pedigree was 1793.

Estimates of genetic parameters were obtained using ASREML (Gilmour et al. 2006). Univariate analyses were used to develop models for systematic effects and to obtain initial estimates of genetic parameters under an animal model. Approximate F-tests were used to assess the significance of systematic effects and/or their interactions; only those effects significant at $P<0.05$ were retained. Systematic effects included transfer date (8 levels), sow line (4 levels) and parity group (4 levels). The interval in days from transfer to farrowing was fitted as a linear covariate for USCORE, COLOS, NERVE and NSURV. Correlations between specific traits were estimated in a series of bivariate analyses using the univariate model for each trait. For these preliminary analyses, all traits were treated as continuous variables.

Results and discussions

Characteristics of the data. All score traits were highly variable (CV>100%), to a lesser extent for CFIT or TACC with higher mean (Table 1). The CV for RTEMP was very low. Variation in the total feed intake of sows in the first three days (FID13) was less than variability in intake averaged over 7 days (LADI). Transfer date, line and parity group accounted for a large proportion of the observed variation in WT110, CFIT and TACC (Table 2).

Estimates of heritabilities. Heritability (h^2) estimates (Table 2) for WT110, P2_110, USCORE, RTEMP and the lactation feed intake traits (LADI, FID13) were moderate (~0.30) and similar to other literature estimates (Hogberg and Rydhmer 2000; Bunter et al. 2008). Body condition score and shoulder lesion were more highly heritable (0.63 and 0.42), although the incidence of lesions was low. In contrast, NERVE and CFIT were not heritable, while COLOS, AGIT, TACC, and USCOREF were lowly heritable. The differences observed in heritability estimates between USCORE and USCOREF might result from variability in suckling events and the extent of initiation of milk production at farrowing (Thodberg and Sørensen, 2006). LOCO and FTEATS were found to be moderately heritable (0.18 and 0.16), as well as the reproductive traits (TB, NBA and NSURV). Rothschild and Bidanel (1998) reported similar heritabilities for NBA and NSURV at 0.15 and 0.05, respectively.

Table 1: Descriptive statistics of the raw data for sow traits.

Trait	N	Mean (SD)	Min-Max	CV (%)
		Pre-farrowing data		
WT110 (kg)	403	372 (41.2)	189 - 371	11
P2_110 (mm)	335	17.7 (3.80)	8.2 – 28.9	21
BCS (1-5)	404	3.63 (0.88)	2 - 5	24
LOCO (0-2)	403	0.28 (0.47)	0 - 2	168
USCORE (0-2)	404	0.42 (0.60)	0 - 2	143
COLOS (0/1)	405	0.19 (0.39)	0/1	205
SLESION (0/1)	405	0.06 (0.23)	0/1	383
AGIT (0-3)	405	2.48 (0.57)	1 - 3	23
FTEATS	405	11.9 (1.07)	5 - 14	9
CFIT (0-2)	405	1.10 (0.80)	0 - 2	73
TACC (0-2)	405	1.14 (0.82)	0 – 2	72
		Farrowing data		
USCOREF (0-2)	405	0.17 (0.38)	0 - 2	224
NERVE (0-2)	405	0.42 (0.61)	0 - 2	145
RTEMP (^{o}C)	405	39.0 (0.54)	37.4 – 40.9	1
TB	396	12.4 (3.15)	2 – 21	25
NBA	396	10.9 (3.11)	1 - 18	29
NSURV	402	9.22 (2.82)	1-16	31
		Lactation feed intake data		
LADI (kg/day)	397	4.87 (1.20)	0.64 – 7.71	25
FID13 (kg/day)	398	13.6 (4.40)	0 - 24	32

See text for trait abbreviations.

Correlations. Birth litter size and NSURV were highly correlated genetically (>0.90, not presented) and phenotypically (Table 2), as previously observed by Casellas et al. (2004). Preliminary estimates of genetic and phenotypic correlations were not significant between the newly measured sow traits and their own piglet's survival. Genetic correlations are not presented due to high standard errors.

Conclusions

Characteristics of the sow pre- and post-farrowing were not strongly associated with their own piglet's survival. However, non-zero heritability estimates for some novel traits support further investigation. More data are currently being collected at the birth and nurse sow level, together with that of individual piglet's, to disentangle different sources of factors affecting piglet mortality. Future analyses will also accommodate more suitable methodology for non-continuous score and binary traits.

Table 2: Heritability (×100) and phenotypic variance ($\sigma^2 p$) from single trait models, along with the model R^2 and phenotypic (rp: ×100) correlations with NSURV.

Trait	Model effects	h^2±se	$\sigma^2 p$	R^2(%)	rp
WT110	D,L,PG	32±19	703	59	3±5
P2_110	D,L,PG	28±20	13.6	5.8	-3±6
BCS	D,L,PG	63±19	0.729	5.8	-3±5
LOCO	D,PG	18±16	0.196	11	0±5
USCORE	D,L,PG,INT	29±16	0.297	18	-5±5
COLOS (0/1)	D.INT	11±16	0.146	4.0	0±5
SLESION	D,PG	42±19	0.051	3.6	-5±5
AGIT	D	3±14	0.273	16	-
FTEATS	D,L,PG	16±15	1.053	8	6±5
CFIT	D,L,PG	B	0.278	57	-
TACC	D,L,PG	6±15	0.400	41	8±5
USCOREF	D,L,PG	9±15	0.127	12	1±5
NERVE	D,L,INT	B	0.366	1.6	-
RTEMP	PG	33±16	0.269	7.8	0±5
TB	L,PG	22±18	8.70	12	68±3
NBA	L,PG	14±17	8.15	10	86±1
NSURV	L,INT	18±18	6.92	13	-
LADI	L,PG	29±18	1.24	14	4±5
FID13	L,PG	15±16	18.2	6.0	-2±5

For trait abbreviations see text; Model effects: D: transfer date; L: line of sow; PG: parity group; INT: interval from transfer to farrow (days); B: estimate at zero boundary.

Acknowledgement

P. Tabuaciri's PhD study is supported by the Government of Fiji.

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