Proc. Assoc. Advmt. Anim. Breed. Genet. ***16****: 141-144*

RELATIONSHIPS AMONG TEMPERAMENT AND PRODUCTION TRAITS OF PIGS

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SUMMARY

Measures of temperament and production traits were analysed from 4,879 nucleus pigs. Genetic parameters for flight time (FT), standard deviation of multiple weights recorded over 20 seconds (SDWT), average daily gain (ADG), back fat (BF) and muscle depth (MD) were estimated. Flight time (0.20 ± 0.04) and SDWT (0.11 ± 0.03) were both heritable and negatively genetically correlated (-0.46 ± 0.14). Both temperament traits had favourable low to moderate genetic correlations with ADG, positive and negative respectively (FT: 0.21 ± 0.16; SDWT: -0.29 ± 0.19), but had unfavourable correlations with BF (FT: 0.26 ± 0.11; SDWT: -0.22 ± 0.14) of a similar magnitude. The genetic relationships between FT and SDWT with MD were negligible. All genetic correlation estimates had large standard errors. The results indicate that further research into FT and SDWT for pigs could lead to their use as selection criteria.

Keywords: Temperament, flight time, movement meter, heritability, correlation.

INTRODUCTION

Selection for improved temperament has been hypothesised as a means of improving carcase and meat quality traits (Reverter *et al.* 2003), animal welfare (Kanis *et al.* 2004) and animal behaviour (Murphy 1999). Crump *et al.* (2005) measured variability of individual pig weights recorded over a 20 second period and flight time upon release from the scales. Their results suggested that the traits were heritable. Similar measures have been used in beef cattle (Stookey *et al*. 1994; Reverter *et al.* 2003) and sheep (Murphy 1999). When considering a new trait for inclusion in a breeding program, the potential for improvement and the impact on other traits of interest must be assessed. The objective of this paper was to investigate the genetic parameters among the temperament and production traits.

MATERIAL AND METHODS

Data were available for boars and gilts from 4 commercial selection lines in a breeding nucleus, recorded from late 2003 to early 2005. The temperament traits included flight time (FT) and the standard deviation of 50 weight measurements recorded over 20 seconds (SDWT). These traits are described in detail by Crump *et al.* (2005).

Temperament data were matched to performance and pedigree data, to ensure that all required factors and covariates were present (Crump *et al.* 2005). Performance traits analysed were lifetime average daily gain (ADG: g/day) and scanned fat and muscle depths (BF and MD: mm). Records were restricted to those animals recorded from 130-160 days of age with a live weight between 70-115kg.

*AGBU is a joint venture of NSW Department of Primary Industries and the University of New England

Animals were reared and processed in pens, although this was not recorded. Therefore, processing groups (PG) for temperament data were formed (Crump *et al.* 2005). For production records a contemporary group (CG) replaced PG and was defined as a combination of sex and week of testing of the pig. Where a PG or a CG contained less than five individuals, the corresponding data were removed. A summary of the remaining data from 4,879 animals is given in Table 1.

Table 1. Summary of data characteristics for average daily gain (ADG: g/day), fat depth (BF: mm), muscle depth (MD: mm), flight time (FT: secs) and the standard deviation of weight (SDWT: kg)

Trait	N	Mean and SD	Range
ADG	4,879	644 ± 58.1	452-870
BF	4,879	11.1 ± 2.47	3.80-24.5
SDWT	4,879	0.85 ± 0.42	0.06-4.38
MD	4,028	61.6 ± 7.02	38.0-89.0
FT	3,567	2.03 ± 1.27	0.02-8.40

Fixed effects for FT and SDWT were determined using the PROC GLM procedure of SAS (SAS 1996). Significant effects for temperament traits included selection line (LINE), littersize at birth, PG, along with linear, quadratic and cubic regressions on position in PG nested within size of the PG. Encouragement score, rated from zero to five as to how much effort was required to move the pig from the scales, was also fitted for FT. Age at testing was fitted for SDWT. Fixed effects models for ADG included LINE and CG, while linear and quadratic regressions on weight were also fitted for BF and MD.

ASREML (Gilmour *et al.* 1999) was used to estimate genetic parameters under an animal model. Starting values for bivariate analyses were obtained from univariate analyses, and the significance of litter effects was assessed by conducting a likelihood ratio test. Litter effects were significant for SDWT, ADG and BF and so were included in further analyses. Bivariate analyses were performed to obtain starting values for the final 5-trait model, from which parameter estimates are presented.

RESULTS AND DISCUSSION

Heritabilities. Flight time had a moderate heritability (0.20 ± 0.04), indicating that genetic improvement is possible if there is adequate variability in the target population (Table 2). SDWT had a lower heritability of 0.11 ± 0.03. Estimates for FT of beef cattle range from 0.29 (Reverter *et al.* 2003) to 0.35 (Burrow & Corbet 2000).

The heritability of ADG (0.12 ± 0.03) and BF (0.34 ± 0.04) were within the ranges reviewed by Clutter and Brascamp (1998). The heritability of MD was moderate (0.40 ± 0.04), and this was higher than a previous estimate of 0.21 from a different commercial pig population (Hermesch *et al.* 2000).

Genetic correlations. Correlations between the production traits were consistent with other studies (e.g. see review by Clutter & Brascamp 1998). The estimated genetic correlation between FT and SDWT was -0.46 ± 0.14. A higher FT and lower SDWT should indicate pigs that become less agitated, and are less active, than their contemporaries. Considering this, we would expect that the genetic correlation between these traits would be negative. A likelihood ratio test indicated that the correlation between FT and SDWT was significantly different from minus one, indicating that the traits were not genetically the same.

There was a positive genetic correlation between FT with ADG (0.21 ± 0.16) and BF (0.26 ± 0.11). However, the latter relationship was unfavourable and suggests that single-trait selection for decreased BF will cause a correlated increase in pig activity which may indicate a worsening of temperament. These results were higher than estimates between FT and ADG and P8 fat scans for beef cattle of 0.09 and 0.16 respectively (Reverter *et al.* 2003). The genetic correlation between SDWT and ADG (-0.29 ± 0.19) was favourable as less active pigs gain more weight than their contemporaries, but the correlation with BF (-0.22 ± 0.14) was unfavourable. The correlations between temperament traits and MD were negligible, which were similar to results reported by Reverter *et al.* (2003) for beef cattle.

Table 2. Estimates of genetic correlation (r_g, below diagonal), phenotypic correlation (r_p, above diagonal), heritability (h^2; bold, on diagonal) and phenotypic variances (σ_p^2)

	ADG	BF	MD	FT	SDWT
σ_p^2	2934	4.51	29.7	1.30	0.16
ADG	**0.12 ± 0.03**	0.19 ± 0.02	0.02 ±0.02	0.04 ± 0.02	-0.05 ± 0.02
BF	-0.33 ± 0.15	**0.34 ± 0.04**	0.01 ± 0.02	0.04 ± 0.02	-0.02 ± 0.02
MD	-0.05 ± 0.13	-0.06 ± 0.09	**0.40 ± 0.04**	-0.003 ± 0.02	0.02 ± 0.02
FT	0.21 ± 0.16	0.26 ± 0.11	-0.04 ± 0.12	**0.20 ± 0.04**	-0.13 ± 0.02
SDWT	-0.29 ± 0.19	-0.22 ± 0.14	-0.03 ± 0.13	-0.46 ± 0.14	**0.11 ± 0.03**

ADG: average daily gain, BF: back fat, MD: muscle depth, FT: flight time, SDWT: standard deviation of weight

Phenotypic and litter effect correlations. Phenotypic (Table 2) correlations between the five traits were generally very low, with the exception of the low phenotypic correlation between ADG and BF. Only correlations between FT and BF, FT and SDWT, FT and ADG, SDWT and ADG and BF and ADG exceeded their standard errors. Litter effect correlations (Table 3) were high for ADG and BF (0.66 ± 0.16) and low to moderate, but with large standard errors, for SDWT and ADG (0.16 ± 0.20) and SDWT and BF (0.22 ± 0.31). Parameter estimates were similar from bivariate and multivariate analyses.

Table 3. Litter effect variance as a ratio of the phenotypic variance (c^2; bold, on diagonal) and litter effect correlation (r_c; below diagonal) estimates

	ADG	BF	SDWT
ADG	**0.10 ± 0.02**		
BF	0.66 ± 0.16	**0.03 ± 0.01**	
SDWT	0.16 ± 0.20	0.22 ± 0.31	**0.03 ± 0.01**

ADG: average daily gain, BF: back fat, SDWT: standard deviation of weight

CONCLUSIONS

This study has shown that both the novel temperament measures for pigs were heritable and correlated when measured under commercial conditions. In combination with adequate variability, these results indicate that progress for improved temperament in pigs can be achieved through selection. Flight time and standard deviation of weight were favourably correlated with average daily gain but unfavourably correlated with back fat. This suggests that single-trait selection for decreased backfat may cause a correlated worsening of temperament, resulting in more agitated, nervous animals which could have welfare implications. Genetic correlations between temperament traits and muscle depth were negligible. However, the high standard errors of parameter estimates indicate that these results should be carefully interpreted. Further research, which is planned, using increased numbers of animals and data from other herds should provide more accurate estimates describing relationships between temperament, production, carcase and meat quality traits.

ACKOWLEDGEMENTS

We acknowledge the support for this project from Australia Pork Limited under project APL1711. Conscientious collection of data by Cefn staff is gratefully acknowledged.

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