HERITABILITIES AND GENETIC CORRELATIONS BETWEEN PRODUCTION TRAITS IN VIETNAMESE PIGS

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SUMMARY

Fixed effects of herd*year*season of starting test period (Hd*Yt*St), ending age and sex influenced test daily gain (TDG), feed conversion ratio (FCR) and backfat thickness (BF), and explained 50-65, 51-70 and 77-85 % of the variation in Vietnamese Thuoc Nhieu (TN), Mong Cai (MC), Large White (LW) and Landrace (LR) breeds. Heritabilities for TDG, FCR and BF in TN, MC, LW and LR were consistently medium to high (0.30-0.51, 0.21-0.44 and 0.26-0.63). TDG were favourably correlated with FCR. TDG were consistently favourable in genetic correlation with BF, with the negative value, at -0.18, -0.20, -0.28 and -0.27 in TN, MC, LW and LR. FCR were consistently correlated favourably with BF in all breed genotypes (0.17-0.30). From the estimates of heritabilities and genetic correlations in this study, it is evident that selection for increased growth rate will lead to a corresponding improvement in the FCR and reduce BF in the Vietnamese pig industry.

Keywords: Heritability, genetic correlation, TDG, FCR, BF

INTRODUCTION

Almost all quantitative traits of economic importance are likely to be controlled by a number of genes and each has a relatively minor effect on the trait. On the other hand, each gene may affect not only one trait, but many. Therefore, when one trait is selected, other traits may also change genetically. This means the relationship between traits has to be considered when applying selection to improve animal production. Association between two traits can be caused by genes that affect both traits simultaneously, and is shown by the genetic correlation. Therefore, both heritabilities and genetic correlations are of importance in that they provide information regarding the degree to which individual criteria affect each other in the process of selection for Thuoc Nhieu (TN), Mong cai (MC), Large White (LW) and Landrace (LR) breeds.

Test daily gain (TDG), feed conversion ratio (FCR) and backfat thickness (BF) are the most important performance traits in pig production. If productivity of the pigs could be improved, then these traits should be considered. To do it, selection should be applied. The heritabilities and genetic correlations are important when consideration is given to selection schemes. This is the reason why in this study, these heritabilities and genetic correlations have been estimated.

MATERIALS AND METHODS

TDG, FCR and BF were recorded in 394, 678, 1724 and 902 pigs from purebred TN, MC, LW and LR respectively, during 9 years (1990-1998) from 7 herds and 2 seasons per year (May-Oct. and Nov.-Apr.). The performance TDG and FCR were recorded on all pigs from 70 days of age through to slaughter age. Slaughter age is 240 days for native breeds and 180 days for exotic breeds. TDG was calculated by dividing the difference between starting and ending weight by the time of the test period. However, FCR was calculated by dividing total feed consumed by total weight gained. BF was individually measured at the end of the test period at about 6 cm from the dorsal mid-line between the second and third last rib positions. All pigs that died due to illness or injury during the test period were not included in this study.

In the models for analyses of TDG, FCR and BF, Herd*year*season of starting test period (Hd*Yt*St) and sex were used as fixed effects. Age at end of test (Age) was fitted as a quadratic covariate in this model. The following fixed effect model was used for within breed analysis of TDG, FCR and BF.

$$\mathbf{y_{ijk} = \mu + a_i + b_j + Age + e_{ijk}}$$

Where: **y** is the observation of the k^{th} pig in i^{th} Hd*Yt*St of j^{th} sex on the trait of each breed, $\boldsymbol{\mu}$ is the population mean, $\mathbf{a_i}$ is the fixed effect of i^{th} Hd*Yt*St, $\mathbf{b_j}$ is the fixed effect of sex for j=1, 2, **Age** is the covariate of the ending age, and $\mathbf{e_{ijk}}$ is the random error on the ijk^{th} pig~(0, $I\sigma^2_e$).

These fixed effects explained 50-65, 51-70 and 77-85 % of the variation for TDG, FCR and BF, which was mainly due to Hd*Yt*St, ending age and sex in this model and they were highly significant for all TDG, FCR and BF traits, except for sex, which were not significant in the TN and MC breeds for both TDG and FCR, and ending age was not significant for BF in MC pigs. The reason for this may be that both sexes of TN and MC develop at the same rate and live weights are not different at the same age.

Statistical analysis. Fixed effects were analysed using the SAS, PROC GLM procedure (SAS 1993). Genetic parameters were estimated using a Derivative - Free Restricted Maximum Likelihood (DFREML) procedure applied to a multivariate animal model (Meyer 1993).

RESULTS AND DISCUSSION

Heritabilities and genetic correlations between production performance traits in TN, MC, LW and LR breeds are presented in Table 1.

Heritabilities for TDG, FCR and BF in TN, MC, LW and LR were consistently medium to high, at 0.30-0.51, 0.21-0.44 and 0.26-0.63, indicating the additive genetic variation was medium to high relative to total phenotypic variation. The estimates of heritability for TDG in this study were close to the values of 0.43, found in 1,814 and 1,374 German LW and LR boars (Von Felde *et al.* 1996), and 0.40-0.51 in other data sets of the same Vietnamese breeds (Duc 1997). The estimates of heritability for FCR in my study were similar to the values of 0.39-0.44 in other data sets of the same Vietnamese breeds (Duc 1997), but these findings were higher than the estimates of 0.19 found in 1,814 and 1,374 German LW and LR boars (Von Felde *et al.* 1996). The BF estimates for heritability from this study in LW and LR were lower than the estimate of 0.49 found in the same breeds in

Southern Vietnam (Hai *et al.* 1997). However, the heritability for BF of MC breed in this study was lower than the value of 0.70 in another data set (Duc *et al.* 1991).

Table 1. Estimates of heritability (on the diagonal) and genetic correlations with standard errors (below the diagonal) for TDG, FCR, and BF in TN, MC, LW and LR breeds using a multivariate animal model

Breed	Number of records	Trait	TDG	FCR	BF
	394	**TDG**	**0.50±0.13**		
TN	394	**FCR**	-0.44±0.14	**0.40±0.15**	
	390	**BF**	-0.18±0.12	0.17±0.10	**0.63±0.13**
	678	**TDG**	**0.51±0.10**		
MC	678	**FCR**	-0.54±0.13	**0.44±0.15**	
	671	**BF**	-0.20±0.10	0.21±0.16	**0.43±0.11**
	1,724	**TDG**	**0.30±0.06**		
LW	1,724	**FCR**	-0.57±0.10	**0.39±0.09**	
	1,700	**BF**	-0.28±0.20	0.30±0.11	**0.26±0.08**
	902	**TDG**	**0.47±0.11**		
LR	902	**FCR**	-0.63±0.12	**0.21±0.10**	
	902	**BF**	-0.27±0.14	0.25±0.10	**0.33±0.11**

TDG were favourably correlated with FCR. It varied from -0.44 to -0.63, indicating that selection for increase TDG leads to correlated improvements in FCR. In other words, when selecting for an increased TDG then FCR is expected to be decreased. This may be explained that pigs with high TDG may eat more feed and reach early market weight, spending less energy for their body maintenance. It could also be explained that the genes effect on daily gain were also affecting feed efficiency, but in the opposite direction. Testing for FCR is very expensive. The favourable correlation between TDG and FCR in Vietnamese pigs is a very important point economically, because of the testing cost, and the number of animals they will have to test will be reduced. Moreover, with a high heritability estimate for TDG, then higher genetic progress can be easily achieved. My results are in close agreement with the value -0.34 found in LR boars under tropical conditions in Zimbabwe (Pathiraja *et al.* 1990). However, these values were stronger than that of -0.29 found in three piggery pooled data set by Hai *et al* (1997). Although, these relationships were weaker than the genetic relationships between ADG and FCR (r=-0.64) found by Von Felde *et al* (1996), they were of the same sign.

Consistent favourable genetic correlations between TDG and BF were present in all breed genotypes. Genetic correlations between TDG and BF were negative, but showed smaller absolute magnitude compared with TDG and FCR, at -0.18, -0.20, -0.28 and -0.27 in TN, MC, LW and LR breeds. This indicates that in selecting pigs for an increase in TDG, BF will be decreased. Thus the genes affecting TDG may have an opposite effect on BF traits. The reasons might be due to that pigs had high TDG reach market weight early, then deposit less fat. These results are slightly higher than the of value -0.20 found in LR boars under tropical conditions in Zimbabwe (Pathiraja *et al.* 1990), or the value of -0.16 in Vietnamese Yorkshire (Y) found by Hai *et al* (1997). In contrast, these results disagree with the report from Lo *et al* (1992) and Von Felde *et al* (1996) who have demonstrated an undesirable genetic relationship between growth rate and BF.

FCR were consistently favourably correlated with BF in all breed genotypes. These values were moderate, varying from 0.17 to 0.30. This may be explained by the fact that genes affect FCR will also have an effect on BF in all breeds. Another explanation is that energy used for production of a lean carcass is more efficient than production of fat. These results are slightly lower than the value of 0.32 found in LR boars under tropical conditions in Zimbabwe (Pathiraja *et al.* 1990) and 0.30 in 32 central testing stations (Wood *et al.* 1991). However, these findings are similarly to the value of 0.21 found in three piggery pooled data set of Vietnamese LR and Y pigs (Hai *et al.* 1997). Therefore, in selecting for decreasing FCR, then the performance of BF trait will also be improved.

From the heritability and genetic correlation estimates in this study, it is evident that a conclusion points towards selection for increased growth rate, leading to a corresponding improvement in the FCR and reduced BF in the pig industry. Selection based on the TDG may have a higher response than FCR and BF due to more accurate data recording. Based on these results for selection, Vietnam will obtain improved performance and profit in the pig industry.

REFERENCES

Duc, N.V. (1997) *PhD Thesis*, The University of New England

Duc, N.V., Thien, N. and Vinh, N.C. (1991) *Proc. Vietnam Anim. Prod. Hanoi, p:16*

Hai, L.T., Vien, N.T. and Duc, N.V. (1997) *Proc. Assoc. Advmt. Anim. Breed. Genet.* **12**:181

Lo, L.L., McLaren, D.G., McKeith, F.K., Fernando, R.L. and Novakofski, J. (1992) *J. Anim. Sci.* **70**:2387

Meyer, K. (1993) DFREML. *User notes*, Version 2.1

Pathiraja, N., Mandisodza, K.T. and Makuza, S.M. (1990) *Proc. 4th Wrld. Congr. Genet. Appl. Livest. Prod.* **14**:23

SAS (1993) *User's Guide.* Version 6, Fourth Edition, SAS Institute Inc. Cary, NC

Von Felde, A., Roehe, R., Looft, H. and Kalm, F. (1996) *Livest. Prod. Sci.* **47**:11

Wood, J.D., Chritian, L.L. and Rothschild, M.F. (1991) *J. Anim. Sci.* **69**:3144