DIRECT RESPONSE ON RESTRICTED FEEDING AND CORRELATED RESPONSE ON FULL FEEDING TO SELECTION IN PERFORMANCE TEST TRAITS IN PIGS

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SUMMARY

Direct response on restricted feeding and correlated response on full feeding to selection in performance and meat production traits of boars were compared and genetic and phenotypic parameters and genotype by feeding interaction were estimated for Landrace pigs. Index selection for daily gain, backfat thickness and eye muscle area were conducted for boars on restricted and gilts on full feeding for six generation. Data consisted of records from 291 candidate boars and 141 full sib boars. Traits recorded in the performance test were age at end of the test (90AGE), average daily gain(DG), feed intake(FI), daily feed intake(FID), feed conversion ratio (FCR), backfat thickness (BF) and eye muscle area(EM). The correlated responses in FID and DG on full feeding were greater than the direct response in these on restricted feeding. The estimates of heritability for performance traits (DG, FI, FID and FCR) were higher on full feeding than on restricted feeding. The phenotypic and genetic correlations between DG and BF were positive on full feeding (0.213, 0.192), but almost null on restricted feeding (0.085, 0.037). The phenotypic and genetic correlations between DG and FCR, DG and FI were larger on restricted feeding than on full feeding. On the contrary, those between DG and FID were larger on full feeding than on restricted feeding. Genetic correlation between the feeding regimes for 90AGE (0.771) and FI (0.772) were both near 0.8 and that for DG was slightly lower (0.650) but it was almost null for FID (0.101). These results indicate that a selection system that boars were tested on a restricted feeding and gilts were tested on a full feeding might be effective in improving performance traits of pigs.

Keywords: genetic by feeding interaction, correlated response, genetic parameter, selection, pigs

INTRODUCTION

In pig breeding for performance test traits, feeding regimens (full feeding and restricted feeding) are very important for efficient selection. On restricted feeding, a correlation between daily gain and backfat thickness was negative (Mikami et al 1979) and a negative high correlation between daily gain and feed conversion ratio (Wylli et al. 1979) was reported. Selection for lean growth with testing on a restricted feeding regime may be preferable to testing animals on an ad libitum feeding regime (Cameron and Curran1995). But, genotype by feeding regime interactions for growth rate were reported (Cameron

1993, Cameron and Curran 1995; Bidanel and Ducos 1996).

Idex selection for daily gain, backfat thickness and eye muscle area for six generations were completed in Miyagi Pref. Anim. Indust. Exp. Stat. In this experiment, performance test traits were measured for boars and gilts which had been on individual restricted feeding and on group full feeding respectively. Full sib boars were also individually performance tested on full feeding at every generation. The aim of this study is to examine the correlated response to selection on full feeding in performance test traits and to estimate genetic parameters and genetic correlations between the traits measured on restricted and full feeding regimes.

MATERIALS AND METHODS

Ten boars were allocated to mate with 44 gilts in each generation.. Average of one boar (total 50 boars) and three gilts per litter were taken from the gilts and performance tested under restricted feeding and group full feeding, respectively. Further 25 full sib boars from half of the gilts also performance tested similarly on full feeding regime.. The generation interval was one year. Performance test started at 30kg body weight for all pigs and ended at 90kg body weight. Feed intake was restricted according to the previous Japanese performance test method. Total numbers of animals, sires and dams were shown in Table 1. Body weight was measured weekly and feed intake was measured at 50kg, 70kg and the end of the performance test.. Performance test traits measured in this study were age at 90kg body weight (90AGE), daily gain (DG), feed intake (FI), daily feed intake (FID), feed conversion ratio (FCR), backfat thickness (BF) and eye muscle area (EM).

Table 1. Data structure

	No. animals	No. sires	No. dams
Restricted feeding	291	57	236
Full feeding	141	31	140

(Co)variance components were estimated using a restricted maximum likelihood procedure applied to bivariate individual animal models. The analysis were carried out using the 3.2 version of REML VCE program (Groeneveld, 1996). A statistical model used in this analysis included the fixed effect of selection generation and the random effect of the additive genetic effect of each animal and initial age (30kg) as covariates.

RESULTS AND DISCUSSION

Table 2 presents the least square means at each generation and coefficients of regression on generation of the performance test traits measured under restricted and full feeding. The coefficient of regression on generation shows that correlated response of FID and DG under full feeding were greater than direct response under restricted feeding. Although an average degree of daily feed intake restriction during 30kg-90kg was 92% of full feeding, during early stage of growth (30-50kg), the degree of feed restriction

was rather strong (82.1%) then it gradually decreased at later stage.

Table 2. Least square means and coefficient of regression on generation for traits in restricted and full feeding regime.

	90AGE		DG		FI		FID		FCR		BF		EM	
	R	F	R	F	R	F	R	F	R	F	R	F	R	F
Mean	154	148	785	860	183	180	2..29	2.49	2.92	2.90	1.76	1.85	33.1	33.4
b	-1.57	-2.11	15.2	21.9	-3.0	-1.08	.007	.047	-.051	-.050	-.06	-.04	.190	-.01

b: Coefficient of regression on generation.

Table 3 indicates estimates of heritability, genetic and phenotypic correlation of the performance test traits on full and restricted feeding regime. Generally, the estimates of heritability for growth traits such as feed intake, daily gain were higher on full feeding than on restricted feeding. There are differences between both feeding regimes in genetic and phenotypic correlation among the traits. The genetic and phenotypic correlations between DG and FCR were higher on restricted feeding than on full feeding.

Table 3. Estimates of heritability, genetic and phenotypic correlation of the traits with full and restricted feeding regime.

		90AGE	DG	FI	FID	FCR	BF	EM
90	F	**0.281**	-.928	0.875	-.593	0.810	-.048	0.939
AGE	R	**0.197**	UE	0.949	-.178	UE	0.036	0.531
DG	F	-.851	**0.772**	-.630	0.787	-.743	0.192	UE
	R	-.848	**0.213**	-.943	0.292	-.922	0.085	-.577
FI	F	0.404	-.318	**0.415**	0.099	UE	0.558	UE
	R	0.884	-.708	**0.182**	0.035	0.079	0.121	0.314
FID	F	-.644	0.744	0.302	**0.317**	-.192	0.698	0.001
	R	-.390	0.459	0.042	**0.124**	0.115	0.148	-.590
FCR	F	0.365	-.436	0.861	0.272	**0.609**	0.423	UE
	R	0.775	-.879	0.823	-.058	**0.236**	0.136	0.448
BF	F	-.146	0.213	0.401	0.519	0.423	**0.514**	0.703
	R	0.014	0.037	0.166	0.262	0.124	**0.588**	-.602
EM	F	0.086	-.161	-.079	-.236	-.150	-.147	**0.105**
	R	0.106	-.028	0.099	-.018	0.002	-.158	**0.342**

F: Full feeding, R: Restricted feeding. Heritability (in bold) on the diagonal, with genetic correlations above and phenotypic correlations below the diagonal. UE:Unestimated due to diffusion.

On the contrary, those between DG and FID were higher on full feeding than on restricted feeding. This suggests that the response on full feeding was due mainly to an increased voluntary feed intake, while the response on restricted feeding was attributed to mainly to improved efficiency(Webb and Curran 1986).

Similar estimates were observed for the genetic and phenotypic correlations among DG, FID and FCR estimated on full and restricted feeding as previously reported (Wyllie et al; 1979; Cameron and Curran 1995).

The estimates of genetic correlation for the performance test traits with full and restricted feeding were shown in Table 4. The genetic correlation for FCR, BF and EM were not possible to estimate due to diffusion. The estimate of genetic correlation for daily feed intake (DFI) was very low and those for 90AGE (0.771) and FI (0.772) were about 0.8 . The estimates of DG was slightly low (0.650) . Cameron (1993) , Cameron and Curran (1995) reported that the genetic correlation between feeding regimes for growth rate was very low , but it was not significantly different from unity for backfat depths. The restriction of feed in their experiment was 0.75 g/g of the daily feed intake of pigs given feed ad libitum.. In present experiment, the level of restriction was 82.1% of full feeding during early stage of test but gradually the restriction eased and almost the same as the level of full feeding during last stage(70kg-90kg) . This suggests that degree of feed restriction may be related to genotype by feeding interaction for daily gain.

Table 4. Estimates of genetic correlation for the performance test traits measured on full and restricted feeding regime.

	90AGE	DG	FI	FID	FCR	BF	EM
rG	0.771	0.650	0.772	0.101	UE	UE	UE

UE: Unestimated due to diffusion.

These results indicate that index selection for daily gain, backfat thickness and eye muscle area on restricted feeding in boars and on full feeding in gilts increased daily gain and daily feed intake on full feeding in boars and suggest that moderately restricted feeding regime was more efficient in improvement of performance test traits.

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