SELECTION FOR LEAN TISSUE GROWTH RATE IN SWEDISH YORKSHIRE PIGS ON LOW OR HIGH PROTEIN DIETS

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SUMMARY

Results from three generations of selection for lean tissue growth rate (LTGR) on two protein diets, high (HP), and low (LP), are presented. Heritabilities for LTGR, lean percentage and growth rate were estimated and correlations between them were calculated. HP pigs had higher LTGR, grew faster and were leaner than LP pigs. Genetic estimates and phenotypic trends differed considerably between lines.

INTRODUCTION

Growth rate and lean percentage are important traits in pig production. Selection for these traits could be performed in several ways. One way is to construct a selection index and give economic weights to the different traits. Another alternative to the selection index strategy is to combine the two components as one trait, LTGR (Lean Tissue Growth Rate) and use LTGR as a selection criteria (Fowler et al., 1976).

Several studies have indicated that there are a lot of different genotype environment interactions influencing the growth of the pig. Such interactions are largely responsible for the low genetic correlations estimated between traits recorded in different environments (Merks, 1988). Variation in appetite is one reason for genotype environment interactions (Johansson et al., 1987), but selection on a combination of daily gain and lean percentage will most often result in pigs with good appetites. Other studies have found indications of interactions between genotype and protein level in the feed (Bereskin & Davey, 1976; Petersson, 1979). This experiment was designed to study how selection for LTGR on two different protein levels influenced LTGR and related measurements. The results presented here are based on data from the base population and the first three of four planned generations. Comparisions are made between the two lines. Heritabilities, genetic progress and correlations are presented.

MATERIAL AND METHODS

A foundation stock of purebred halothane negative Swedish Yorkshire pigs was established in 1981. From this the base population was created. The selection lines were made by splitting litters into one High Protein line (HP) fed on a diet containing 18.5% CP (0.96% lysine) and one Low Protein line (LP), fed on a diet containing 13.1% CP (0.64% lysine). The energy level was 11.9 MJ/kg metabolizable energy (ME) in both feeds. The total daily ME offered was the same in both lines. The pigs were reared six in each pen and fed according to the mean pen live weight. Both lines were selected for Lean Tissue Growth Rate (LTGR).

When the pigs had reached 90 kg live weight, ultrasonic measurements of fat and muscle depths were taken on five places of the body (Stern et al., 1987). From these values, lean percentage in the carcass was predicted. Lean percentage was combined with weight (average of two consecutive weighings, one day apart) to predict lean content in the body. LTGR was calculated from growth (25 to 90 kg) and lean content.

Each generation in the selection experiment was divided into 3 batches, each batch consisting of 96 boars and 96 gilts which were performance tested. The 4 boars and the 16 gilts with the highest LTGR in each line were selected for producing the next generation.

Genetic parameters were estimated with REML (Restricted Maximum Likelihood) using an individual animal model according to Graser et al. (1987). The model included the fixed effect of batch (13 classes) and the fixed effect of sex. Random effects were animals and residual error. Genetic progress was calculated as mean breeding value of each generation.

The two lines were analysed separatly. These results are based on information from 2323 tested pigs from the base population and three selected generations.

RESULTS

Characteristics of the tested animals are presented in Table 1. The difference between lines in LTGR was 73 g/day in favour of the HP line. Lean percentage and growth rate were also higher in the HP line. The live weight at the ultrasonic measurement was 91.6 kg (SD 4.3 kg) for the LP line and 92.8 kg (SD 2.7 kg) for the HP line.

Table 1. Overall means and standard deviations for the two selection lines. n=2323

Trait	Line	Mean	S.D.
LTGR, g/day	LP	296	35
	HP	369	42
Lean percentage, predicted	LP	58.3	2.4
	HP	61.2	2.4
Growth rate, g/day	LP	712	94
	HP	843	86

Table 2. Estimates of heritability (on the diagonal) genetic (above) and phenotypic (below) correlations for the LP line. n = 1162

Trait	LTGR	Lean percentage	Growth rate
LTGR	**0.31**	-0.52	0.97
Lean percentage	-0.31	**0.44**	-0.73
Growth rate	0.96	-0.56	**0.37**

Table 3. Estimates of heritability (on the diagonal), genetic (above) and phenotypic (below) correlations for the HP line. n = 1161

Trait	LTGR	Lean percentage	Growth rate
LTGR	**0.41**	0.61	0.96
Lean percentage	0.19	**0.57**	0.61
Growth rate	0.96	-0.08	**0.25**

The heritability estimates of LTGR and lean percentage were higher in the HP line than in the LP line (Tables 2 and 3), whereas the heritability for growth rate was higher in the LP line.

The phenotypic and genetic correlations between LTGR and growth rate were very high in both lines. The genetic correlation between LTGR and lean percentage, however, was negative in the LP line and positive in the HP line.

The phenotypic trends are shown in table 4. The total progress in LTGR was 15 g/day in the LP line, compared to 49 g/day in the HP line. The corresponding genetic progress was 16 g/day in the LP line and 26 g/day in the HP line.

Table 4. Overall means for the base population (0) and deviations from the base population for the selected generations.

Line	Generation	n	LTGR g/day	Lean percentage	Growth rate g/day
LP	0	430	**286**	**58.4**	**688**
	1	275	+11	+0.4	+21
	2	270	+21	-0.4	+55
	3	187	+15	-0.4	+42
HP	0	433	**345**	**60.2**	**801**
	1	270	+24	+1.6	+36
	2	271	+44	+1.6	+81
	3	187	+49	+1.4	+95

DISCUSSION

The heritability estimate of LTGR was higher for the HP line than for the LP line. Different types of animals were selected in the lines. The pigs selected in the HP line, given a surplus of protein, grew fast and were lean. In the LP line a higher LTGR was achieved by a higher growth rate alone as lean percentage was slightly lower. Therefore the selection favoured different phenotypes, lean pigs in the HP line and fat pigs in the LP line.

One explanation for this may be the limitation in protein of the LP feed. LP pigs had less possibility to express their genetic potential for LTGR. Another reason could be that the method used to predict lean percentage was more accurate for lean pigs. Lean percentage was predicted from ultrasonic measurements, and Stern (1987) found that LP pigs were overestimated for lean percentage by about 3 percent units, whereas lean percentage of HP pigs was more accurately estimated.

When analysing the correlations between lean percentage and growth rate it must be remembered that the animals were group fed. The negative phenotypic correlations could have resulted from appetite and social behaviour. Pigs with high feed intake grow fast but lay down more fat, especially on the LP feed with a low protein content per MJ. Negative genetic correlations between lean percentage and growth rate, as in the LP line, may involve genetic differences in appetite.

Very high correlations were found between LTGR and growth rate in both lines. Selection for LTGR when feeding according to a weight scale seems to be similar to selection for growth rate. The estimates were, however, not consistent. Since LTGR was calculated from measurements of growth and of leanness these traits show autocorrelations with LTGR. Therefore the chance of getting negative definite matrices of variance components is high. Since LTGR was selected for, problems of bias could occur in the estimations of variance components and breeding values (Meyer & Thompson, 1984). A multiple trait method is probably better when analysing traits this closely correlated, when the population has been subjected to selection (Johansson & Sorensen, 1990).

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