GENETIC PARAMETERS FOR TESTOSTERONE PRODUCTION IN BOARS

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SUMMARY

Data were collected from 1982 to 1989 from 66 sires and 358 Duroc boars. Testosterone levels were measured from peripheral blood samples before (PRE) and after (POST) GnRH challenge. Data were collected on testes volume at 168 d (TVOL), average daily gain (ADG), and backfat (FAT). Heritabilities for PRE, POST, TVOL, ADG, and FAT were .37, .26, .33, .42, and 0, respectively. PRE and POST had moderate and large positive genetic correlations with ADG and TVOL, respectively. TVOL was positively correlated with ADG. Selection for testis size or testosterone production should be equally effective. However, it appears that selection for testes size would result in larger changes in growth than selection for testosterone. Apparently, neither testes size nor testosterone have an influence on FAT. Testes measurements appear to be good predictors of both basal and challenge testosterone levels.

Key words: testosterone, boars, testes measures, growth, fat

INTRODUCTION

The potential impact of intense selection for male traits on reproductive and/or production efficiency is largely overlooked in swine production. Genetic parameter estimates for testosterone levels, testicular traits and correlated growth traits of boars are sparse. High heritabilities have been recorded for testicular traits (Coulter et al., 1976; Neely et al., 1982; and Toelle et al., 1984). Effects of exogenous testosterone in promoting deposition of muscle protein and establishing a positive nitrogen balance in castrated animals have been well documented (Lund-Larsen et al., 1977). Neely et al. (1982), have shown that testicular measures are highly heritable and useful for predicting sperm production. Neely et al. (1982) also stated that selection for testes size should not adversely affect growth performance traits except through reduction in selection intensity.

The objectives of this study were to evaluate selection response and to estimate phenotypic and genetic parameters of basal and GnRH-stimulated testosterone levels in the blood of young boars.

MATERIALS AND METHODS

Data were obtained from 66 sires and 358 purebred Duroc boars at 168 d of age, over the period 1982 to 1988 at North Carolina State University, Raleigh, N.C. Blood samples were drawn over an 8 h period from an indwelling catheter in the jugular vein. Five samples, drawn at 30 minute intervals, were the pre-GnRH testosterone measures (PRE). GnRH challenge was then given and 8 samples were obtained at 15 minute intervals and 4 additional samples at 30 minute

intervals. The last 12 samples constitute POST. Testosterone was determined by radioimmunoassay.

Each generation 25 high and 25 low boars were sampled and five boars from each line were selected based on POST. There was no selection of females. Son-sire regressions were used to obtain heritabilities and genetic correlations.

RESULTS

Means and standard deviations for the traits are shown in Table 1. Heritability estimates are presented in Table 2. Basal testosterone levels had a slightly higher heritability than challenge testosterone (.37 vs .26). TVOL and ADG had moderate heritabilities. These results agree closely with the estimates of Eden et al. (1978) and Toelle et al. (1984). FAT had a negative son-sire regression coefficient and the heritability was assumed to be zero. One possible explanation for this is that ultrasound techniques may not be effective in estimating backfat of boars.

Table 1 Means and Standard Deviations of Growth Traits, Testicular Traits and Testosterone Levels

Trait[1]	N	Mean	Standard Deviation
PRE ng/ml	358	24.42	22.93
POST ng/ml	358	75.22	48.04
TVOL cm^3	358	420.39	130.40
ADG kg	358	0.50	.07
FAT mm	358	18.50	2.96

Table 2 Heritability Estimates and Standard Errors

Trait[1]	h^2	SE.
PRE	.37	.16
POST	.26	.21
FAT	.00	.14
TVOL	.33	.13
ADG	.42	.10

Table 3 contains son-sire regression coefficients. Each dependent trait of the boar was regressed on PRE and POST of the sire. These regressions can be

[1]PRE - basal testosterone
POST - testosterone levels after GnRH
TVOL - testes volume at 168 days
ADG - average daily gain
FAT - backfat adjusted to 104 kg

viewed as realized responses to selection. These regressions suggest that selection for PRE would result in significant increases in testes size and growth rate. However, the regressions of growth and testes size on POST were nonsignificant. Because PRE measures basal levels of testosterone, it may be more closely associated with levels that affect growth, whereas POST is a response to GnRH challenge and measures what could be produced and not what is present. Thus, it may be expected that PRE would be more closely related to growth.

Table 3 Son-sire Regression Coefficients

	SON'S TRAIT				
SIRE'S TRAIT[1]	PRE	FAT	TVOL	ADG	POST
PRE	.187*	.001^{ns}	1.490**	.001*	.163^{ns}
POST	.062^{ns}	.002^{ns}	.343^{ns}	.000^{ns}	.130^{ns}

PRE and POST were highly correlated phenotypically and moderately correlated genetically (Table 4). Both PRE and POST had high genetic and moderate phenotypic correlations with TVOL. FAT had very low correlations with all traits. ADG was moderately correlated with TVOL, but had no relationship to POST and a moderate genetic correlation with PRE.

Table 4 Phenotypic (Above Diagonal) and Genetic (Below Diagonal) Correlations

Trait[1]	PRE	POST	TVOL	ADG	FAT
PRE		.86**	.31**	.07^{ns}	-.04^{ns}
POST	.42		.26**	.01^{ns}	-.06^{ns}
TVOL	.77	.64		.44**	-.06^{ns}
ADG	.39	.07	.52		.05^{ns}
FAT	0	0	0	0	

Figure 1 depicts changes in PRE and POST over generations 0 to 8. Testosterone values increased in the low line from generations 1 to 3, but appears relatively stable from generations 3 to 8. Because we could not maintain a control, it was not possible to determine if these fluctuations were due to genetics or environment. Further selection differentials in the low line were hindered because many select boars would not service sows. However, the high line continues to diverge from the low line and testosterone levels, both basal and after GnRH challenge, are over twice that of the low line. It should be noted that, although selection was for POST, PRE has responded at least equally as a percentage of the mean.

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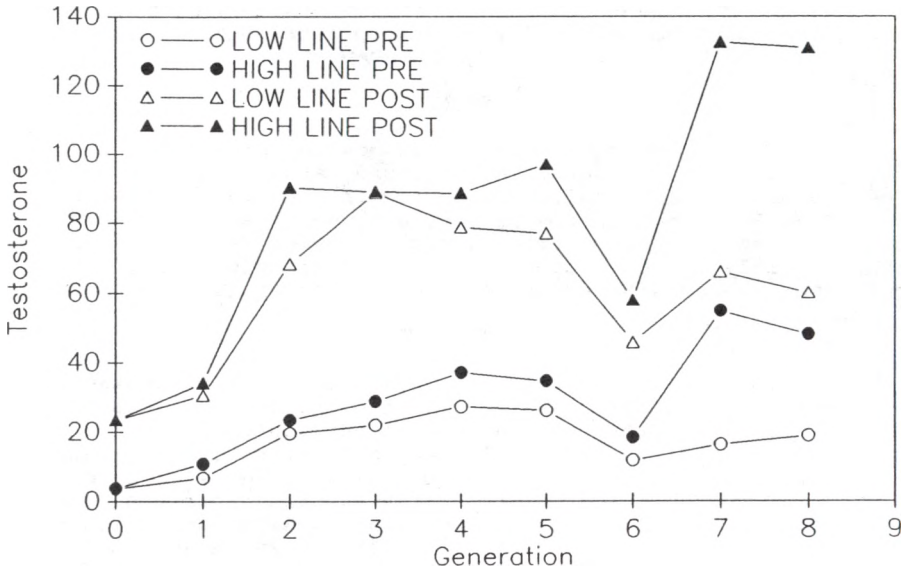
1 See page 2 for definition of trait.

* P<.05

** P<.001

ns not significant

Figure 1 Selection for Testosterone Levels in the Boar Before (PRE) and After (POST) GnRH Challenge



DISCUSSION

Testicular traits are intriguing with respect to their quantitative inheritance patterns. Important heterosis effects have been reported (Wilson et al., 1977; Neely et al., 1980). However, the moderate to high heritabilities for testicular traits reported by Toelle et al. (1984) agrees with the present study. It is unusual to find a trait with both large heterosis effects and relatively high heritabilities.

These results lead to the conclusions that selection for increased testosterone should be effective and would result in favorable responses in growth and testes size.

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