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Evaluating Environmental Effects on Growth Performance and Carcass Characteristics of South African Large White Pigs

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ABSTRACT Genetic improvement of growth and carcass traits and animal management require proper identification and evaluation of non-genetic effects on these traits. Performance data were on 20079 Large White pigs from 29 herds, while carcass data comprised of 5406 records from 20 herds. The animals were tested between 1990 and 2008 and carcass evaluated between 1993 and 2007. The traits analyzed were backfat thickness (BFAT), test period gain (TPG), lifetime gain (LTG), feed conversion ratio (FCR) age at slaughter (AGES), lean percentage (LEAN), drip-free lean percentage (DLEAN), drip loss (DRIP), dressing percentage (DRESS), carcass length (CRLTH) and eye muscle area (AREA). PROC REG and GLM were used to determine significant effects. Herd of origin, year of testing and their interaction significantly affected all traits. Most traits were not affected by season of testing, while all traits were significantly affected by sex. Testing environment affected all growth traits except for LTG. All traits decreased with increasing feed intake, while age at the start of the test was associated with decreases in most traits. On-test treatments do not compensate for pre-test underperformance. Castrates produce higher carcass yields of less quality than females, while performance testing has best results when done at the testing centres in summer. There is need to adjust for fixed effects when performing genetic evaluations in these pig populations.

INTRODUCTION

The value of a meat animal is realized when its product is marketed and weighed against the input costs incurred. Growth and its associated traits in pigs reflect to a certain degree the value of the animal; hence live measurements can be used to evaluate an animal. Valuable pigs are the ones which from each unit of food energy, waste least in such processes as, digestion and physical activity and retain most by favouring conversion of metabolizable energy to lean than conversion to fat tissue (Webster 1977). This has desirable implications on enterprise profit, as feed constitutes a large portion (60 – 70 %) of pig enterprise costs (Hoque et al. 2007). Thus, pig characteristics that are positive for profitability are high growth rate, food conversion ratio and low carcass fatness (McPhee and MacBeth 2000). Improvement has been achieved in some breeding programs through selection for lean growth rate (McPhee et al. 1991; Cameron 1994).

Success of these breeding programs is facilitated by the variation that exits in growth and carcass traits in pigs. This variation can be partitioned into genetic and environmental. Environmental variance, albeit not transferable from parent to offspring, plays an important part in the performance of livestock and their products. Knowledge of non-genetic factors helps in standardizing management of the breeding animals. Some non-genetic effects, such as, farm, sex and age on growth and carcass traits have been reported in literature for sheep (Cassady et al. 2004), pigs (Serrano et al. 2008), goats (Maghoub et al. 2004) and cattle (Nephawe et al. 2006). It is therefore imperative that non-genetic factors be considered in livestock improvement programs in order to accurately estimate breeding values.

Therefore, proper identification and estimation of non-genetic effects on growth and carcass traits being evaluated is a necessity in pig improvement schemes. In South Africa, there is a paucity of information on non-genetic factors affecting carcass characteristics of centrally tested pigs. The purpose of this study was to evaluate the environmental effects on growth and carcass traits in the South African Large White breed.

METHODOLOGY

The South African Pig Performance Testing Scheme is conducted to extend and improve the

National Pig Herd by means of scientifically founded and proven methods and practices. Performance testing occurred throughout the year on castrates and females, such that at any point in the year there were animals being tested. The animals were tested and slaughtered at three testing centres, namely Irene, Elsenburg and Cedara. The pigs were tested under Phases A, B, D and E. Records available from performance testing were for Phases B and D. Phase B testing is the central boar and gilt performance and carcass quality test phase, conducted at the three testing centres. On the other hand, Phase D is the on-farm testing of pigs. Under the Phase B, every year each member submited 44 pigs (22 boars and 22 gilts) for testing. These 44 pigs were to represent a minimum of five herd sires per breed or line, or 50 % of the herd sires per breed or line. On arrival, pigs were treated for internal and external parasites and quarantined under the supervision of the responsible State Veterinarian. All pigs were randomly selected for performance testing between 18 and 24 kg. The animals were individually penned and fed until they commenced testing at 027 kg. Animals were kept on solid concrete floors. When testing commenced, the pigs were individually fed *ad libitum* using self feeders and water was also available *ad libitum* during the test period. Parameters of growth rate, feed consumption and age at slaughter (086 kg) were measured on these animals. Backfat measurements were taken using a Backfat Scanner A100 probe at 77 kg and at slaughter (86 kg), 6.5 cm from the midline between the second and third last rib (T23 position). Weighing during the test period was done weekly without any change in the feeding routine and performance testing was completed at a live weight of 086 kg. The Phase D scheme involves on-farm performance testing of boars and gilts, measuring growth rate, ultrasonic backfat measurements and, where possible, feed intake and feed conversion efficiency.

Animals from the performance testing scheme (Phase B) were randomly selected for carcass-evaluation. The animals were electrically stunned with 250 V for 7 – 10 sec. Animal ethics approval was obtained from the Agricultural Research Council Animal Ethics Committee. This was followed by the scraping and removal of the entrails. A State veterinarian or meat inspector performed the necessary inspection of the carcass after slaughtering. The carcasses were then hung in a cold storage room for chilling where they remained for 24 hours. The carcass was then split in the middle along the midline. A loin sample, measuring approximately 2 cm thick and 15 cm long, was cut off at the T23 position. The average mass of the loin samples was recorded in grams. Each loin sample was placed into a nelton bag and tied accordingly to prevent the loin sample touching the bottom of the barrier bag or air coming into the barrier bag. The mass in grams of each new empty and clean barrier bag was recorded before placing in the loin sample. This parcel was stored in a refrigerator between 0 and 5^{o}C for 48 hours, after which the loin sample in the nelton bag was removed from the barrier bag. The mass of the barrier bag, which included exudates collected as drip, was recorded in grams. Measurements for the T23 fat and muscle were taken using an ultrasonic probe at the T23 position.

The data used were on 20079 growth performance records and 5406 carcass records from 29 and 20 herds, respectively. These data were obtained from the Integrated Recording and Genetic Information Systems (INTERGIS) database. These animals were tested between 1990 and 2008 and carcass evaluated between 1993 and 2007. Carcass length and eye muscle area were evaluated between 1998 and 2007, hence they had 2267 records.

The growth traits analyzed were ultrasonic backfat thickness (BFAT), test period weight gain (TPG), lifetime weight gain (LTG), test period feed conversion efficiency (FCR), which was computed as the amount of feed consumed to gain 1 kg body mass, and age at slaughter (AGES). Analysis of carcass traits was done on lean percentage (LEAN), drip-free lean percentage (DLEAN), drip loss (DRIP), dressing percentage (DRESS), carcass length (CRLTH) and eye muscle area (AREA). DRESS was calculated by expressing cold carcass weight (carcass weight after chilling) as a percentage of weight at slaughter. CRLTH was measured from the anterior edge of the first rib to the pubic bone using a measuring tape. AREA was determined using a square grid. The summary statistics for the traits analyzed are shown in Table 1. LEAN, DLEAN and DRIP were calculated using the following formulae (Equations 1 to 3), respectively (Bruwer 1992).

$$\text{LEAN (\%)} = 72.5114 - (0.4618 \times \text{T23 fat}) + (0.0547 \times \text{T23 muscle}) \quad [1]$$

$$\text{DLEAN (\%)} = 29.37 + (0.56 \times \text{LEAN \%}) - 3.1 \sqrt{(\text{T23 fat})} \quad [2]$$

$$\text{DRIP (\%)} = \frac{(\text{combined drip + bag weight (g)} - \text{bag weight (g)})}{\text{weight of chop (g)}} \times 100 \quad [3]$$

where, T23 fat and T23 muscle are fat and muscle thicknesses, respectively at T23 position.

Table 1: Summary statistics of growth and carcass traits and covariates for large white pigs

	N	*Mean*	*Min*	*Max*	*SD*
BFAT (mm)	20079	12.3	7.0	24.0	2.9
TPG (g/day)	20079	1019.0	690.5	1327.0	107.3
LTG (g/day)	20079	676.6	524.4	814.2	50.3
FCR	20079	2.1	1.4	3.1	0.3
AGES (days)	20079	127.7	106.0	164.0	10.2
LEAN (%)	5406	69.2	65.0	72.0	1.4
DLEAN (%)	5406	56.8	52.0	61.0	2.0
DRIP (%)	5406	3.08	0.29	5.46	2.03
DRESS (%)	5406	77.6	69.0	85.0	3.0
CRLTH (cm)	2267	77.2	65.0	85.0	2.1
AREA (cm^2)	2267	40.0	19.3	64.4	5.8
FEED (kg)	20079	140.1	95.5	185.5	15.0
AGEB (days)	20079	70.7	51.0	92.0	6.2
STWT (kg)	20079	29.7	25.0	32.0	1.8

N – number of records, SD – standard deviation, BFAT – backfat thickness, TPG – test period weight gain, LTG – weight gain from birth to slaughter, FCR – feed conversion ratio during test, AGES – age at slaughter, LEAN – lean percentage, DLEAN – drip-free lean, DRIP – drip loss, CRLTH – carcass length, DRESS – dressing percentage, AREA – eye muscle area, FEED – total test period feed intake, AGEB – age at the beginning of test period, STWT – weight at the start of test

The original growth data contained 81411 animal records and animals with missing feed intake and feed conversion records were removed, which amounted to 59089, while original carcass data comprised of 5492 records. These data were then edited to remove values that were greater or less than three standard deviations from the mean. The final data analyzed are shown in Table 1. Animals with missing birth and testing dates were removed and the data was checked for normality. Since animals were expected to commence testing at 27 kg live weight the traits were adjusted to 27 kg live weight. Seasons of testing were defined as wet season (October – March) and dry season (April – September). The significant effects of covariates on each trait were determined using PROC REG of SAS (SAS 2003) by checking for independency and multicolinearity among covariates. Then the covariates which had significant effects on the response variable were taken to the GLM Procedures of SAS (SAS 2003), where they were combined with class variables, to get the final model for each trait. Effects of interactions between independent variables were also determined. Preliminary analyses showed no differences between growth or carcass traits due to test centre, suggesting uniformity in testing standards of the three testing stations. The following model equation (Equation 4) was used in the development of the models for all the traits.

$$y_{ijklm} = \mu + H_i + Y_j = S_k + SEX_1 + \beta_0 (TFI)_{ijklm}$$

$$+ \beta_1 (AGEB)_{ijklm} + C_x C_y + _{ijklm} \qquad [4]$$

where, y_{ijklm} is the observed trait, H_i is the effect of the i^{th} herd of origin, Y_j is the effect of the j^{th} year of testing, S_k is the effect of the k^{th} season of testing, SEX_l is the effect of the l^{th} sex of the animal, β_0 and β_1 are the regression coefficients of the observed trait on the respective covariate; $(TFI)_{ijklm}$ is the test period total feed intake, $(AGEB)_{ijklm}$ is the age at the beginning of the test period, $C_x C_y$ is the interaction effects and e_{ijklm} is the random error term.

RESULTS AND DISCUSSION

Herd of origin affected (P <0.001) all growth and carcass traits. Table 2 shows the summary statistics of the Least Squares means for the growth and carcass traits. The standard errors and standard deviations show the magnitude of variations within and between herds, respectively. Differences in growth performance and carcass characteristics in pigs were attributable to the birth and rearing environment (Gentry et al. 2004). Herd performance differences may suggest carry-over effects from pre-test performance differences, which are a result of different environmental conditions. Growth performance is determined during the prenatal period (Petersen et al. 1997; Gentry et al. 2004; Foxcroft et al. 2006). Bee (2004) observed the effect of gestation feeding on carcass quality of progeny. Thus, pre-test environment has an effect on growth and carcass attributes (Beattie et al. 2000; Gentry et al. 2002, 2004; Hansen et al. 2006). These results suggest that differences in growth performance may be due to differences in management practices applied in different farms. Management at different farms should be best in order to produce pigs that perform well during the growth period and produce desirable carcasses.

All growth and carcass traits were affected (P <0.001) by year of testing. The Least Square means for the effect of year of testing on growth and carcass traits are shown in Figures 1a to 1e and 2ato 2f. The decrease in backfat thickness from 1990 to 2008 is desirable to consumers who prefer lean

Table 2: Summary statistics of least squares means for growth and carcass traits for large white pigs

	Herds	*Mean (±s.e.)*	*Min (±s.e.)*	*Max (±s.e.)*	*SD*
BFAT (mm)	29	12.9±0.1	10.3±0.2	15.4±0.1	1.1
TPG (g/day)	29	986.5±4.5	893.1±3.6	1059.1±1.8	36.9
LTG (g/day)	29	650.7±1.1	569.8±1.6	704.7±0.8	30.3
FCR	29	2.3±0.0	2.1±0.0	2.4±0.0	0.1
AGES (days)	29	133.1±0.4	122.3±0.2	150.7±0.3	6.4
LEAN (%)	20	68.7±0.2	67.4±0.1	69.5±0.1	0.8
DLEAN (%)	20	56.1±0.2	54.3±0.2	57.3±0.1	0.8
DRIP (%)	20	3.69±0.2	2.19±0.7	4.81±0.2	0.62
DRESS (%)	20	77.6±0.3	75.5±0.2	79.3±0.2	1.0
CRLTH (cm)	7	77.3±0.3	75.9±0.5	78.7±0.8	0.7
AREA (cm^2)	7	40.3±0.8	35.4±1.9	43.7±0.5	2.2

s.e. – standard error, SD – standard deviation, BFAT – backfat thickness, TPG – test period weight gain, LTG – weight gain from birth to slaughter, FCR – feed conversion ratio during test, AGES – age at slaughter, LEAN – lean percentage, DLEAN – drip-free lean, DRIP – drip loss, CRLTH – carcass length, DRESS – dressing percentage, AREA – eye muscle area

meat. There were decreasing trends for age at slaughter that is favourable to the farmers as fewer days to slaughter translate to less feed consumed, which constitutes about 60 – 70 % of pig enterprise costs (Hoque et al. 2006). There were increases in both test period and lifetime weight gains from 1990 to 2000 as well as general increases in lean and drip-free lean from 1993 to 2007. Drip loss decreased from 1993 to 1998, after which there was no discernible trend. A general decline in carcass yield was observed, depicted by decreasing eye muscle area in Large White. The jumps observed in drip loss and dressing percentages may be attributed to the amount of data collected that were not consistent (not presented) over the years. Although these animals were in total confinement, carry over effects from their respective herds may explain the observed differences during the years, as shown by the significant herd effect and its interaction with year of testing on growth and carcass traits (Cassady et al. 2004). These trends may

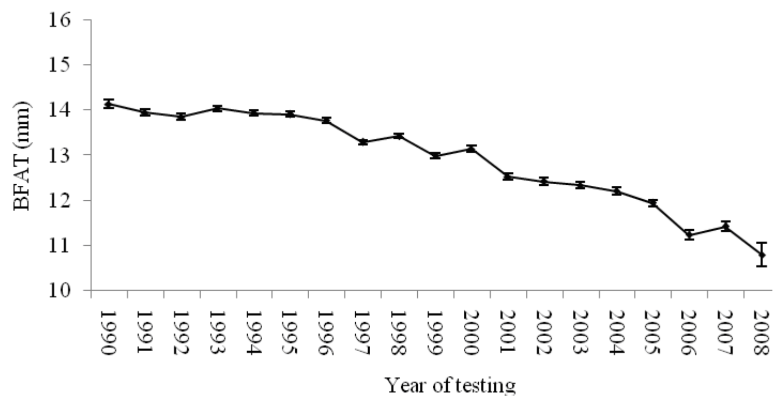

Fig. 1a. Phenotypic trend for backfat thickness

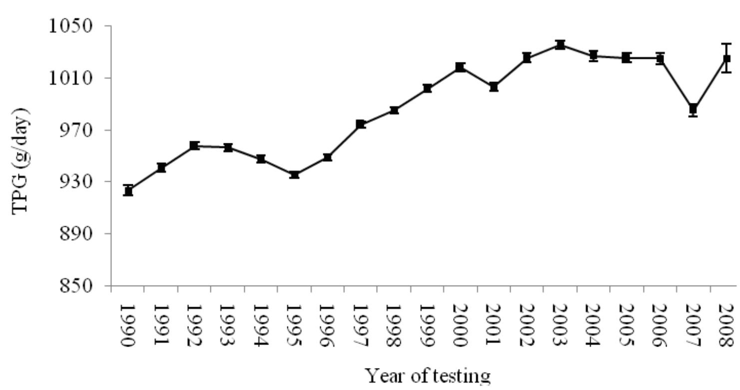

Fig. 1b. Phenotypic trend for test period weight gain

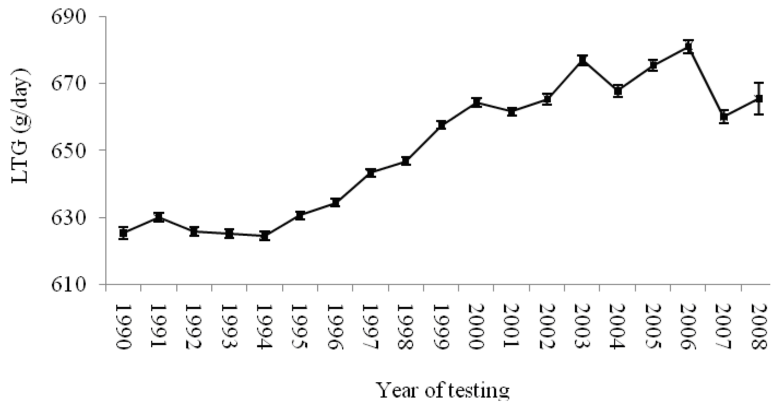

Fig. 1c. Phenotypic trend for lifetime weight gain

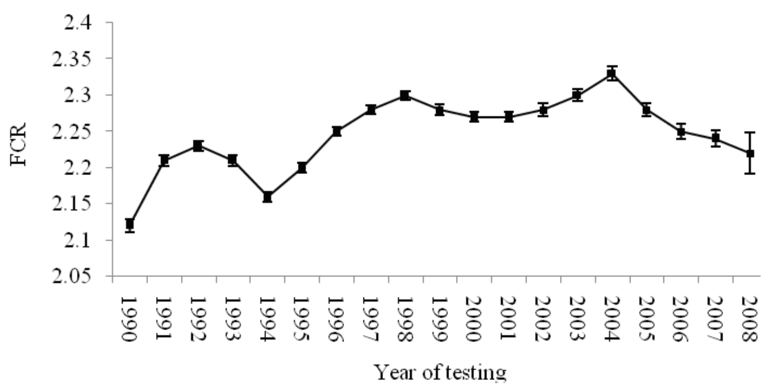

Fig. 1d. Phenotypic trend for feed conversion ratio

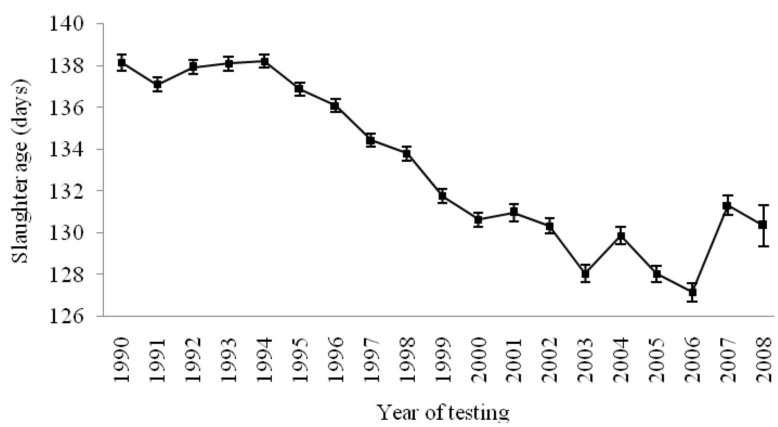

Fig. 1e. Phenotypic trend for age at slaughter

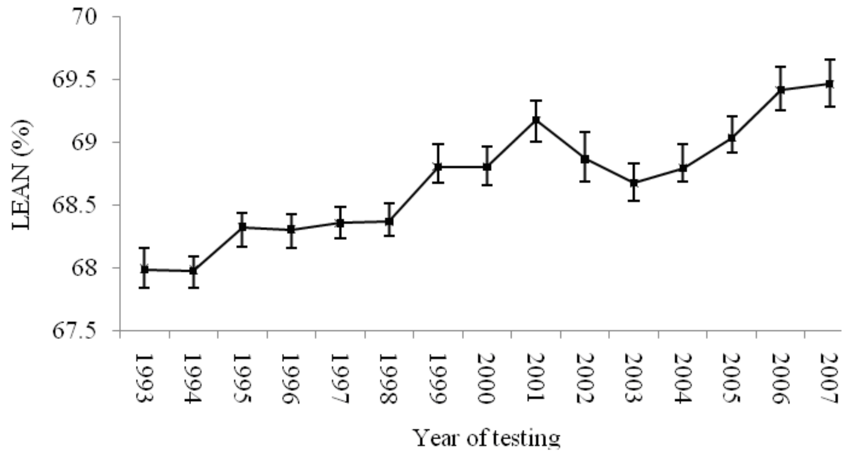

Fig. 2a. Phenotypic trend for lean percentage

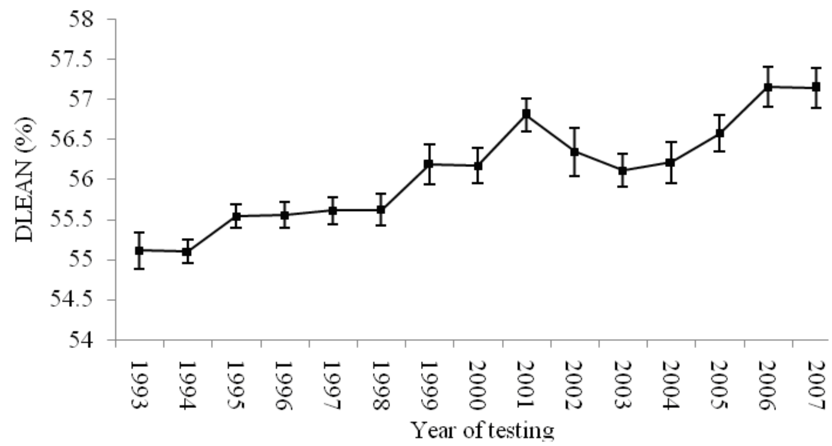

Fig. 2b. Phenotypic trend for drip-free lean percentage

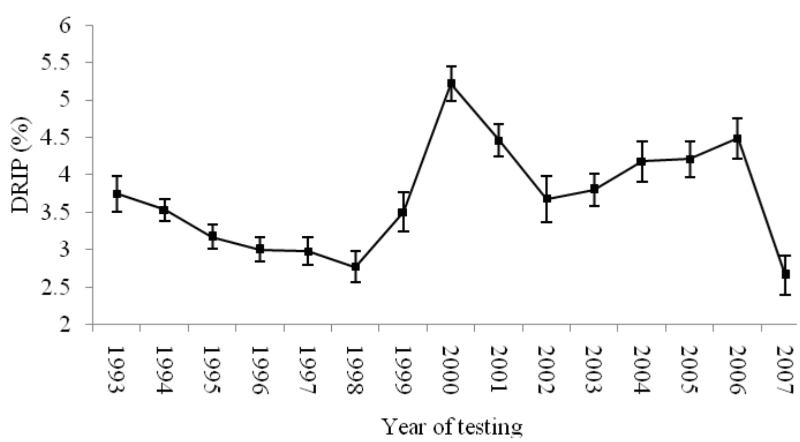

Fig. 2c. Phenotypic trend for drip loss percentage

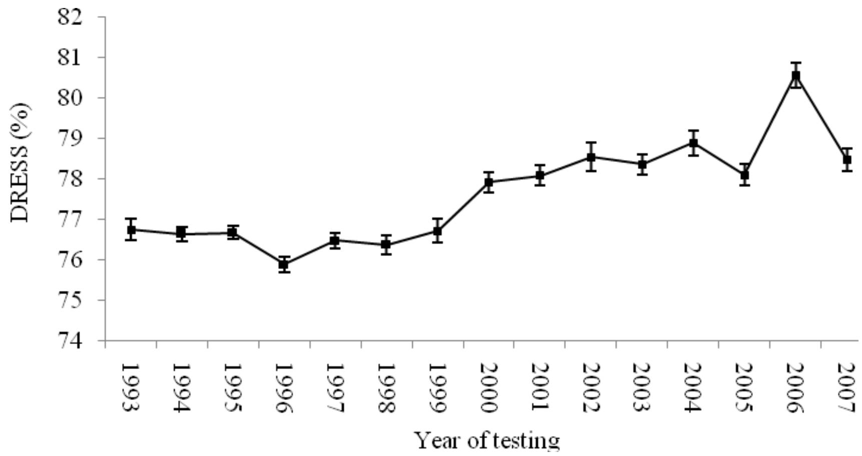

Fig. 2d. Phenotypic trend for dressing percentage

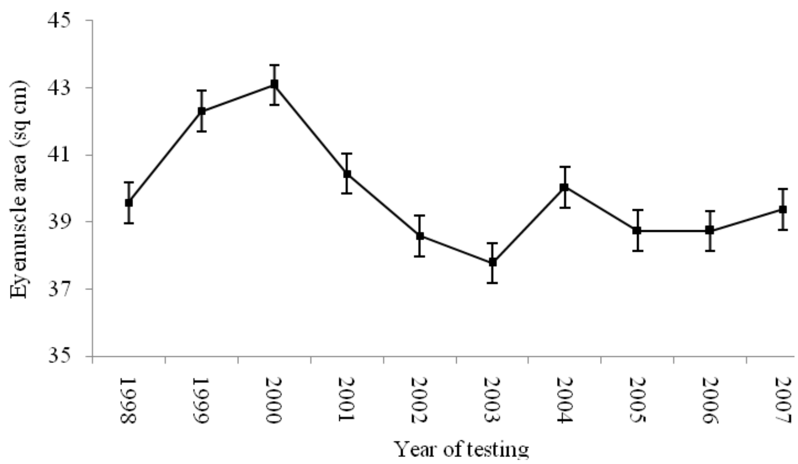

Fig. 2e. Phenotypic trend for carcass length

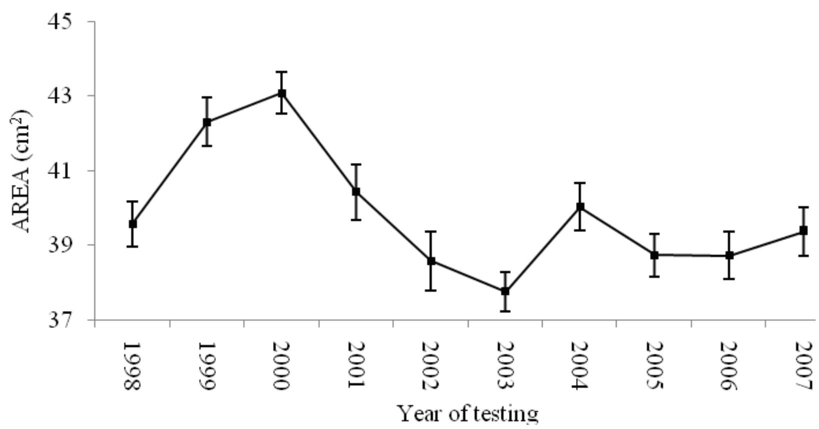

Fig. 2f. Phenotypic trend for eye muscle area

also suggest changes due to selection and/or management practices. Growth traits have been reported to be heritable (Johnson et al. 1999; Nguyen and McPhee_2005; Oh et al. 2005; Chimonyo and Dzama 2007). Prenatal environmental influences may be exerted on growth and carcass characteristics (Foxcroft et al. 2006). Nilzen et al. (2001) and Gentry et al. (2002, 2004) observed the effect of birth and rearing environment on growth and carcass characteristics. These trends may also suggest response to selection on these or other correlated traits.

The effects of season of testing on growth and carcass traits are contained in Table 3. As expected, differences were observed in feed conversion efficiency, with summer-tested pigs being more ($P < 0.001$) efficient than winter-tested pigs. Pigs tend to eat more feed in cold weather to compensate for the greater metabolic demand for heat production (LeDividich et al. 1987). No significant effect ($P > 0.05$) of season of testing on backfat thickness, age at slaughter and weight gains was observed. However, Chikwanha et al. (2007) reported an increase and decrease in body conditionscore in boars and lactating sows, respectively due to season. Environmental temperature is known to affect the performance, voluntary energy intake, and heat production of growing pigs (Close, 1987; Le Dividich et al. 1987; Bee 2004). Trezona et al. (2004) observed that pigs were fattest and leanest during spring and autumn, respectively. Winter-tested pigs produced 0.28 cm shorter ($P < 0.001$) carcasses than the summer-tested pigs. Since these pigs were tested under similar conditions, the differences may thus be attributed to the carry-over effects of the pre-test rearing seasons. This has been confirmed by Nilzen et al. (2001) and Gentry et al. (2002; 2004), who reported the effects of birth and rearing environment on carcass traits. The results from this study suggest that performance testing has best results when done in summer.

Table 4 contains the effect of sex on growth and carcass traits. The thicker ($P < 0.001$) backfat in castrates may be attributed to the larger ($P < 0.001$) amounts of feed consumed during the test period. Weight gains for castrates were less ($P < 0.001$) compared to those of females. These results are in agreement to those in literature (Weatherup et al. 1998; Latorre et al. 2003). Contrary to this, Augspurger et al. (2002) reported better growth rates in males and attributed it to their greater feed intake. Although there were no sex differences in feed conversion efficiency in the current study, Nieuwhof et al. (1991), Friesen et al. (1994) and Latorre et al. (2003) observed poor feed conversion efficiencies in males. Females were leaner ($P < 0.001$) than castrates, while smaller ($P < 0.01$) eye muscle areas were observed in females. Serrano et al. (2008) observed that castrates produced more carcass yield, were fatter and had shorter carcasses. Castrates have a low capacity for protein deposition and a high rate of fat accretion (Campbell and Taverner 1985). Mayoral et al. (1999) and Lattore et al. (2003) found no differences in carcass characteristics attributable to sex. The results portray differences in hormonal control of the respective traits and show that females produce lower carcass yields that are leaner and exude less.

Table 3: Least squares means (±s.e.) for the effect of season of testing on growth and carcass traits in large white pigs

	N	*Summer*	*N*	*Winter*
BFAT (mm)	9195	$12.9^{a}\pm0.0$	10884	$12.9^{a}\pm0.0$
TPG(g/day)	9195	$989.1^{a}\pm1.5$	10884	$983.9^{a}\pm1.2$
LTG (g/day)	9195	$652.2^{a}\pm0.7$	10884	$649.2^{a}\pm0.6$
FCR	9195	$2.2^{a}\pm0.0$	10884	$2.3^{b}\pm0.0$
AGES (days)	9195	$132.8^{a}\pm0.1$	10884	$133.4^{a}\pm0.1$
LEAN (%)	1926	$68.7^{a}\pm0.1$	3480	$68.7^{a}\pm0.1$
DLEAN (%)	1926	$56.1^{a}\pm0.1$	3480	$56.1^{a}\pm0.1$
DRIP (%)	1926	$3.74^{a}\pm0.1$	3480	$3.65^{a}\pm0.1$
DRESS (%)	1926	$77.7^{a}\pm0.1$	3480	$77.5^{a}\pm0.1$
CRLTH (cm)	694	$77.5^{a}\pm0.1$	1573	$77.2^{b}\pm0.1$
AREA (cm^2)	694	$40.5^{a}\pm0.3$	1573	$40.0^{a}\pm0.3$

N – number of records, BFAT – backfat thickness, TPG – test period weight gain, LTG – weight gain from birth to slaughter, FCR – feed conversion ratio during test, AGES – age at slaughter, LEAN – lean percentage, DLEAN – drip-free lean, DRIP – drip loss, CRLTH – carcass length, DRESS – dressing percentage, AREA – eye muscle area, values with the same superscript within for breed and season are not significantly different

Table 4: Least squares means (±s.e.) for the effect of sex on growth and carcass traits in large white pigs

	N	*Castrates*	*N*	*Females*
BFAT (mm)	5417	$3.3^{a}\pm0.04$	14662	$12.6^{b}\pm0.0$
TPG(g/day)	5417	$948.6^{a}\pm1.8$	14662	$1024.4^{b}\pm1.4$
LTG (g/day)	5417	$637.7^{a}\pm0.8$	14662	$663.7^{b}\pm0.6$
FCR	5417	$2.3^{a}\pm0.0$	14662	$2.2^{a}\pm0.$
AGES (days)	5417	$135.7^{a}\pm0.2$	14662	$130.5^{b}\pm0.1$
LEAN (%)	2557	$68.6^{a}\pm0.1$	2849	$68.8^{b}\pm0.1$
DLEAN (%)	2557	$55.9^{a}\pm0.1$	2849	$56.3^{b}\pm0.1$
DRIP (%)	2557	$3.85^{a}\pm0.1$	2849	$3.54^{b}\pm0.1$
DRESS (%)	2557	$78.4^{a}\pm0.1$	2849	$76.9^{b}\pm0.1$
CRLTH (cm)	1058	$77.2^{a}\pm0.1$	1209	$77.4^{b}\pm0.1$
AREA (cm^2)	1058	$41.6^{a}\pm0.3$	1209	$39.0^{b}\pm0.3$

N – number of records, BFAT – backfat thickness, TPG – test period weight gain, LTG – weight gain from birth to slaughter, FCR – feed conversion ratio during test, AGES – age at slaughter, LEAN – lean percentage, DLEAN – drip-free lean, DRIP – drip loss, CRLTH – carcass length, DRESS – dressing percentage, AREA – eye muscle area, values with the same superscript within for breed and season are not significantly different

The effect of feed intake on growth and carcass traits are shown in Table 5. Total feed intake was associated with decreases ($P < 0.001$) in weight gains. Affentranger et al. (1996) and Akdag et al. (2008)

reported the effect of feed intake on growth performance in pigs. Contrasting results showing increased weight gains with increasing level of feed intake have been reported (Garcia-Valverde et al. 2008). This may suggest that animals consuming less feed under ad-lib conditions are more efficient. Increasing backfat thickness due to increased feed intake observed in the current study is in agreement with the observations of Garcia-Valverde et al. (2008). This can be attributed to the increased activity of lipogenic enzymes associated with increased energy intake (Daza et al. (2007). These observations suggest an optimum feed intake to achieve the desired growth performance. Increasing feed intake was associated with decreasing (P <0.001) lean percentage, drip-free lean percentage, drip loss and dressing percentage. These results are in agreement to earlier reports (Affentranger et al. 1996; Akdag et al. 2008). Ramaekers et al. (1996) observed contrasting results showing increased lean content with increasing feed content when feed intake was restricted. Nutrient digestibility increases with level of feed intake (Haydon et al. 1984) and the absorbed nutrients are used for maintenance and lean gain (Scharlach and Kleyn 1996). When energy consumption exceeds requirements, the extra energy is converted to fat and stored (Scharlach and Kleyn 1996). The differences may be attributed to the fact that total feed intake was used in the current study instead of average daily feed intake. Thus, the instead of average daily feed intake. Thus, the effect of feed intake on growth performance and carcass attributes may be properly ascertained using average daily feed intake.

Table 5 contains the effects of age at the beginning of the test on growth and carcass traits. Age at the beginning of the test period affected (P <0.001) backfat thickness, growth rates and lean percentages. Daza et al. (2007) reported contrasting results, where higher growth rates were observed in pigs that started the test at an older age. They attributed this to compensatory growth as such pigs had shown slower growth rates during the pre-test period, which were however not measured in the present study. Average daily gain and carcass weight, as a consequence of older age at the beginning of the free-range fattening period has been previously reported (Daza et al. 2007). Variations in carcass characteristics due to age have been reported (Mayoral et al. 1999; Daza et al. 2005; Daza et al. 2007). Contrary to the current results, younger pigs at the beginning of the fattening period hadinferior carcass characteristics in Iberian

Table 5: Regression coefficients of feed intake and age at the beginning of test on growth and carcass traits

	N	*FEED (kg)*	*N*	*GEB (days)*
BFAT (mm)	21000	0.027±0.001	21000	-0.014±0.002
TPG(g/day)	21000	-2.438±0.044	21000	-0.984±0.103
LTG (g/day)	21000	-0.436±0.015	21000	-4.268±0.036
FCR		ns		ns
AGES (days)	2100	0.141±0.004		¥
LEAN (%)	5406	-0.037±0.001	5406	-0.021±0.004
DLEAN (%)	5406	-0.051±0.002	5406	-0.031±0.006
DRIP (%)	5406	-0.010±0.002		0.007±0.003
DRESS (%)	5406	-0.065±0.008		ns
CRLTH (cm)		ns		ns
AREA (cm^2)		ns		ns

N – number of records, BFAT – backfat thickness, TPG – test period weight gain, LTG – weight gain from birth to slaughter, FCR – feed conversion ratio during test, AGES – age at slaughter, LEAN – lean percentage, DLEAN – drip-free lean, DRIP – drip loss, CRLTH – carcass length, DRESS – dressing percentage, AREA – eye muscle area, FEED – total feed intake during test period, AGEB – age at the beginning of the test period, ns – effect not significant, ¥ – effect not included in the analysis

pigs (Daza et al. 2007). These results portray an unfavourable relationship between starting age and weight gains. An optimum age should be established for commencing testing in these pig populations. Observations from the current study may encourage the testing of younger animals at the beginning of the performance test period.

The only interaction observed in this study was between herd of origin and year of testing, which affected (P <0.001) all growth and carcass traits in the two breeds. This suggests that there are inconsistent carcass characteristics in animals tested from different herds over the years. These results are in agreement with those reported by Cassady et al. (2004). Wallenbeck et al. (2009) observed a herd-year-season interaction when they investigated the genotype × environment interaction in Hampshire boars. These results emphasize the influences of pre-testing period treatments on growth performance and carcass characteristics being carried over to slaughter, despite uniform treatment during the test period. Therefore, during genetic evaluation these effects may be combined to adjust for their effect on carcass traits.

In South Africa, there is a paucity of information on environmental factors affecting carcass characteristics of centrally tested pigs. The purpose of this study was to evaluate the environmental effects on growth and carcass traits in South African Large White pigs. These results point out that optimum management at farm level is a prerequisite for optimum growth performance and carcass quality and yield, which cannot be compensated by on-test treatments. Castrates produce higher carcass yield, while females produce better carcass quality. Younger pigs at the start of test may be preferable in order to improve carcass leanness and yield. The results discourage feeding pigs ad lib if carcass quality is to be improved, but carcass yield is unaffected. Investigation of the effect of feed intake on growth and carcass traits in these pig populations may be improved by use of average daily feed intake.These results underline the need to adjust for fixed effects when performing genetic evaluations in this pig population.

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