GENETIC CORRELATIONS OF GROWTH TRAITS BETWEEN HEIFERS AND BULLS REARED DIFFERENTLY

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SUMMARY

Genetic correlations were estimated between growth traits in Bonsmara heifers and bulls that were reared together until weaning, whereafter the heifers were reared extensively on natural pasture and the bulls intensively in feedlots. The genetic correlations between the sexes for preweaning traits were close to unity, whereas they were much lower and even close to zero for postweaning traits. Selection for growth traits on bulls in feedlots would probably not affect growth of heifers on pastures, indicating that feeder-breeder or sexual dimorphism may be genetically induced by different nutritional environments.

INTRODUCTION

In South Africa it is common practice to keep cows under extensive conditions and to feed slaughter animals to market finish in feedlots on concentrate diets. Maintenance requirements are proportionate to size at all ages, hence smaller cows have lower maintenance requirements than larger cows (Cartwright, 1970). A relatively small cow (breeder) with low feed or land cost/head producing large slaughter animals (feeder) is therefore desirable. It would thus be profitable to have a system of feeder-breeder dimorphism (Roux, 1992). The purpose of this study was to estimate the genetic relationship of growth traits between bulls in feedlots and heifers on natural pasture.

MATERIALS AND METHODS

Data of Bonsmara cattle reared at the Roodeplaat farm (28°22'E; 25°36'S) near Pretoria, which is classified as mixed sourish bushveld (Acocks, 1975), were used. The average annual rainfall is 620 mm and the carrying capacity of the veld 6ha/large stock unit. Bulls and heifers were reared together, until weaning, on natural pasture. After weaning the bulls were subjected to performance testing at Irene (28°13'E; 25°55'S), also near Pretoria, under intensive feedlot conditions, while the heifers remained on the natural pasture.

The data were corrected for effects such as age of mother, and year and season of birth using least squares procedures (Harvey, 1988). The data set included 24 sires with a total of 649 heifers and 554 bulls. Each sire had a minimum of 8 heifers and 8 bulls tested.

Genetic correlations had to be estimated between the same measurement on different animals and not as is usually the case between different measurements on the same animal. To avoid the computational complexities of REML (Schaeffer, Wilton and Thompson, 1978), such as iteration with the possibility of slow convergence or non-convergence in some instances, an approximate unweighted procedure for covariance component estimation suggested by Wiggans, Quaas and

Van Vleck (1980) was used. The same unweighted procedure was followed for variance component estimation, in contrast to the weighted procedure for variance components suggested by Wiggans *et al.* (1980). Estimates between -1 and +1 were obtained in this way. For further details Theron, Roux and Scholtz (1994) should be consulted.

Phenotypic correlations could not be calculated as the traits were measured on different animals. Pearson (ordinary) correlations were thus calculated between the sire means for heifers and bulls.

RESULTS

The least square means for bulls and heifers are listed in Table 1. On average the heifers lost 4.6kg, or 2% of their weaning weight by 12 months of age due to poor nutrition during winter, whereas the bulls gained 147.4 kg or 61% of their weaning weight in the feedlot during the same period. However, heifers probably showed compensatory growth and gained 132.1kg or 61% of their 12 month weight between 12 and 18 months.

Table 1. Least square mean weights and weight gains

		Heifers	Bulls
Weight (kg):	Birth (B)	36 ± 6	39 ± 6
	Weaning (W)	220 ± 28	240 ± 31
	12 months	217 ± 50	388 ± 72
	18 months	350 ± 33	-
ADG (kg/day):	B - W	0.90 ± 0.12	0.98 ± 0.14
	W - 12mo	-0.02 ± 0.25	0.92 ± 0.36
	12 - 18mo	0.37 ± 0.08	-

ADG - average daily gain

The genetic correlations of growth traits between sexes calulated by the adapted method of Wiggans *et al.* (1990) and Pearson correlations are listed in Table 2.

Table 2. Genetic (r_g) and ordinary correlations (r) of growth traits between halfsib Bonsmara bulls and heifers (s.e. estimated according to Robertson, 1959)

	r_g	r	s.e.
Birth weight	0.95	0.77**	0.02
Weaning weight	1.00	0.92**	0.02
12 month weight	0.79	0.57**	0.11
ADG (birth - weaning)	0.97	0.90**	0.00
ADG (weaning - 12 months)	0.01	0.01	0.19
[1]ADG (12 - 18 months)	0.04	0.02	0.21

[1]12 - 18 months of heifers and weaning - 12 months of bulls

**P < 0.01

There were no nutritional or environmental differences between bulls and heifers up to weaning as all calves were reared together on pasture. The genetic correlations between half-sibs of different sexes for birth weight, weaning weight and ADG from birth to weaning, are close to unity (Table 2), indicating that these traits in the two sexes are probably controlled by the same set of genes (Falconer, 1981).

After weaning the sex difference was completely confounded with nutrition and management as all bulls were fed in feedlots under intensive management and all heifers were grazed on pasture under extensive management. It was thus impossible to separate the effects of sex, nutrition and management in this study. The genetic correlations between the sex-environment combinations decreased after weaning with values of 0.79, 0.01 and 0.04 for yearling weight, ADG (weaning - 12 months) and ADG (12 - 18 months) respectively. According to Falconer (1981) this may indicate that different sets of genes are affecting the traits under different conditions. According to Robertson (1959) a genetic correlation around 0.8 has biological importance and a genetic correlation of 0.6 is a significant deviation from unity indicating that genotype-environmental interaction may affect performance.

DISCUSSION

Almost 65% of young animals slaughtered in South Africa are finished in feedlots. Performance testing of beef cattle is also often carried out under favourable feedlot conditions. The environment in which the selection of bulls is practised thus differs from that in which females are reared. Under some circumstances it may be advantageous to select for feedlot-pasture dimorphism, *i.e.* large body size on concentrate feeds, and small body size on pasture, since it is difficult to obtain market finish on large-framed cattle on pasture in most regions of South Africa.

According to the results of this study, feeder-breeder dimorphism can be genetically induced by feeding regime, since the genetic correlation between bulls and heifers for postweaning growth does not differ significantly from zero. This indicates that postweaning growth of bulls finished under feedlot conditions is probably independent from the postweaning growth of heifers reared under extensive pasture conditions. Selection for growth in bulls reared in feedlots would thus not affect the growth of heifers reared on pastures. This would be advantageous to the South African industry under present circumstances.

The fact that growth under feedlot conditions and growth under extensively pasture conditions may be different traits, should not be ignored in the estimation of breeding values and the construction of breeding plans. The importance of this aspect is stressed by the results of DeNise and Ray (1987) who found the correlation between sire breeding values of bulls tested intensively and heifers tested under semi-arid grassland conditions to be - 0.03.

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