PRODUCTIVITY AND EFFICIENCY OF CATTLE BREEDS

(From: "Characterization of beef cattle breeds by virtue of their performances in the National Beef Cattle Performance and Progeny Testing Scheme". S.Afr.J.Anim.Sci.,1996,26(1) by S J Schoeman)

Breed averages for 16 breeds over 14 years. Nearly 3/4 mil. weaning records and growth test data of 15000 bulls - E*d.*

The purpose of this report is to rank the most numerous beef cattle breeds which took pert in the National Beef Cattle Performance and Progeny Testing Scheme (PTS) for individual growth traits and some productivity and efficiency indices. Data from Progress Reports of the Scheme were re-analysed for this investigation. Some authors (Brown & Dinkel, 1982; McMorris & Wilton, 1986) hold the belief that differences between breeds are strongly related to differences in mature breed size and that almost no differences in biological efficiency exist between breeds. Although the data of the scheme are subjected to criticism, the scheme nevertheless provides a useful source of information for breed comparison purposes. One point of criticism is that it does not take into account the effect of differences in production environments and management levels.

In South Africa, however, lack of funds prohibits expensive breed comparison on a variety of production environments, thus leaving us with the data of the PTS as the only data source for breed characterization purposes. It is furthermore believed that herds in all breeds are to a large degree subjected to differences in production environments and management levels, consequently cancelling some breed biases owing to environment. It is therefore assumed that breed averages reflect to a large degree true breed effects.

Materials and Methods

Breed average values were obtained from the 1980 to 1985 and 1986 to 1993 reports of the PTS respectively. These two averages per breed were then pooled by calculating weighted averages per breed for a number of traits. These included 745400 weaning records and 14990 Phase C records of young growing bulls of the 16 most prominent breeds taking part in the Scheme. The first were recorded on the cow herd by breeders on the farm, while the latter were derived from central testing centre data. For the Phase C, only those evaluated over the 140-day period were included in the analysis.

The operation of the PTS will not be discussed here. For more detail, Anon (1986) or Bergh (1990) could be consulted. Simple correlation and regression procedures were calculated for a variety of traits. Since only breed averages could be estimated, valid tests for statistical significance between breeds were not possible.

Birth Weight

Average between-breed birth weight was 35.9kg and it varied from 27kg for the Nguni to 41Kg for the Charolais and South Devon (Table 1). Breed average birth weights are highly correlated with average breed mature size, as estimated by dam weight at weaning.

The lower than predicted value of the Brahman (6.8%) may be due to a negative maternal effect which restricts birth weight (Cartwright, 1973; Robertson et al., 1986; Comerford et al., 1987; Tawonezvi et al., 1988). A more favourable birth to weaning weight ration for Simmentaler calves compared to higher ratios for Charolais and Hereford sires, led Paterson et al. (1980) to believe that it might be possible to select sire breeds to produce fast-growing calves with low birth weights. This 'favourable ratio' is more likely the result of a high weaning weight in Simmentalers owing to their high milk production, than to a restricted birth weight. One would expect those breeds with birth weights higher than their respective predicted values to be inclined to more dystocia problems compared to those with birth weights lower than their predicted values.

Weaning Weight and Pre-Weaning Growth Rate.

Breed average weaning weight varied from 161 kg for the Nguni to 235 kg for the Charolais and Simmentaler (Table 1). The Angus, Hereford and Sussex calves which weighed 8.4% and 6.8% less, while the Santa Gertrudis and Simmental produced calves which weighed 6.3% and 5.9% respectively more than their predicted weaning weights. This may be the result of between-breed differences in milk production. It is known that the Hereford is a low milk producing breed (Reyneke & Bonsma, 1964: Jenkins & Ferrell, 1992). All dual-purpose breeds, except the South Devon, produced calves heavier than their respective predicted weaning weights.

Simmentaler and Charolais produced the fastest growing calves. Breeds which rank high for mature size, are also high

ranking for pre-weaning growth rate,

Simmentaler had the highest weaning weight (236 kg) and

produced the fastest growing calves (965g) - Ed.

Pre-weaning efficiency on the other hand, which was defined as pre-weaning ADG/$C_{0.75}$, was unaffected by mature size. The Shorthorn. Santa Gertrudis and **Simmentaler** had the highest efficiencies, while the Afrikaner, Nguni, Hereford and Sussex were the least efficient breeds.

Post-weaning growth rate

Average daily gain (ADG) of young bulls in the feedlot (Table 2) was also correlated with mature cow size, Afikaner (-12.2%), Brahman (-14.5%) and Limousin (-7.0%) performed more poorly than predicted values. The Angus (15.5%) and **Simmentaler** (13.8%) on the other hand were, compared to their predicted values, the best performing breeds.

Breed group rankings were fairly similar for 540 days ADA of heifers and ADG of bulls in the feedlot. The correlation between ADG of bulls under feedlot conditions and mature cow weights was 0.686. The same applied to the correlation between pre-weaning ADG and post-weaning ADG of heifers.

ADG compared to size: Simmentaler and Angus are the best. - Ed.

In the case of the first, there are a few noteworthy exceptions. Although the rankings of breeds were fairly similar for actual growth rare between the pre- and post-weaning phases, it was not the case for relative growth rate (RGR). Laster et al. (1976) reported that breeds which ranked high for pre-weaning RGR, but low for post-weaning RGR, tended to reach puberty earlier. The ratios of pre-weaning RGR/post-weaning RGR were estimated (Table 1) and varied from 3.2 for the Hereford to 11.3 for the Drakensberger. If the finding of Laster et al. is true, it would mean that the Hereford is sexually very early maturing and that the Drakensberger is the latest maturing breed. This ratio was, however, not significantly correlated to age at first calving.

Productive efficiency

Cow productive efficiency was defined as (Calf WW/CW) x Calving rate. Across breeds the average of this index was 1.68. The Afrikaner has the lowest and the Shorthorn the highest efficiencies. Efficiency was furthermore independent of breed mature size. The Shorthorn, Angus and **Simmentaler** were the most efficient breeds, while the Afrikaner was the least efficient breed. Calving rate., which is an important part of the productive efficiency index, varied from 0.76 (Afrikaner) to 0.88 (Angus). Contrary to what was found by Roux & Scholtz (1984), calving rate was related neither to cow mature weight nor to weight of bulls at the end of the Phase C test.

Low productive efficiency: Simmentaler and two others lead the list of 16 - Ed.

Ratios of calf weight to cow weight: (CW) or to cow metabolic weight ($CW_{0.75}$) have often been used as estimators of efficiency, Dinkel & Brown (1978) were of the opinion that this tends to bias these ratios in favour of smaller cows. In this study, efficiency was independent of breed mature size. Smaller breeds were not more efficient than larger breeds. This is also contrary to what was found at the Omatjenne Research Station. where Nguni was found to be the most efficient (Schoeman, 1989).

Roux (1992) illustrated the importance of sexual dimorphism as far as herd efficiency is concerned and calculated fairly large differences in sexual dimorphism between breeds. In this study, sexual dimorphism was calculated as the end of Phase C test body weight (approx. 430 days of age) of bulls mature body weight of cows at weaning of their calves. Sexual dimorphism values then varied from 0.86 to 1.06, a difference of 23.3%. Breed productive efficiency was significantly influenced by breed sexual dimorphism. It is interesting that the dual-purpose breeds, viz. the **Simmentaler,** Shorthorn and Pinzgauer ranked higher for both efficiency and sexual dimorphism. This may be the result of both a high direct effect (growth rate) and a high maternal effect (milk production) of dams of these breeds.

General

The profitability of a beef enterprise depends on two major components, viz. a productivity (growth) and a maternal component (reproduction and milk production). These data also demonstrated that their are important differences in individual traits and efficiency among breeds. Ranking of breeds may be totally different for different traits.

Body weight it any stage as well as weight gain is strongly related to breed mature size as estimated by dam weight at weaning. There are exceptions, however. The Charolais is the fastest growing breed with the highest mature size. However, it ranked just above average for pre-weaning growth efficiency and on average for productive efficiency. The Afrikaner ranked lowest for almost all traits. The **Simmentaler,** on the other hand, is amongst the highest ranking breeds for all traits. It makes this breed a logical choice as a terminal sire line but most likely, also as a dam line under very favourable conditions. Choice of breeds for any production system (e,g. crossbreeding) within a specific environment should therefore be considered with great caution.

Breed group means for body weight, growth rate (ADG) and feed conversion efficiency (FCE) of young bulls.

BREED	n	Final Weight (kg)	ADG (g/day)	FCE (g/kg feed)
Afrikaner	489	396	1196	132
Bonsmara	4988	483	1534	145
Brahman	1070	431	1200	142
Brown Swiss	76	541	1674	141
Charolais	210	561	1815	154
Drakensberger	520	464	1435	138
Hereford	928	481	1554	148
Limousin	113	481	1450	142
Nguni	344	353	1167	141
Pinsgauer	535	534	1637	143
Angus	852	482	1629	145
Santa Gertrudis	1142	506	1626	148
Shorthorn	200	470	1538	139
Simmentaler	2387	553	1751	146
South Devon	526	550	1733	151
Sussex	610	466	1521	147
Total/Average	14990	485	1529	144

The following conclusions can be made from this table:

The relationship between weaning weight and the ADG (r = 0.07) and FCR (r = 0.04) is almost non existent. Preweaning growth is thus unrelated to post weaning growth and efficiency.

Initial weight is also unrelated to ADG (r = 0.03) and poorly related to FCR (r = 0.16).

Final weight is (as expected) highly positively correlated with total feed intake (r = 0.66), ADA (r = 0.75) and ADG (r = 0.65).

ADG is highly negatively correlated with FCR (r = 0.67) or, in other words, ADG is highly positively correlated with feed conversion efficiency.

Because of the lack of unity between ADG and FCR, direct selection for feed conversion efficiency through selection for FCR should receive serious attention, because of the moderate heritability (h2 = + 30 to 35%) of FCR.

Shoulder height and body length is highly positively correlated (r = 0.85). Both have, however, poor relationships with ADG and FCR.

Scrotum circumference is fairly positively correlated with final test weight (r = 0.42), but is poorly

correlated with shoulder height (r = 0.14) and body length (r = 0.17).