Did Genetic Change Improve Production Efficiency in Three Landrace Breeds of South Africa?

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ABSTRACT: It is easy to achieve genetic change, but much more difficult to achieve genetic improvement. This study investigates the influence of selection on cow efficiency in three landrace beef breeds (Afrikaner, Bonsmara, Nguni) in South Africa over a period of 25 years. Cow efficiency was defined as kilogram calf weaned (KgC) per cow Large Stock Unit (LSU). Breeding values for direct weaning weight in the Afrikaner and Bonsmara changed by +6.7kg and +11.7kg, respectively. That for mature cow weight only changed in the case of the Bonsmara (+9kg). The phenotypic changes were +21kg, +15kg and -14kg for weaning weight; and +14kg, +16kg and -22kg for mature cow weight in the Afrikaner, Bonsmara and Nguni, respectively. Cow efficiency increased by 12.0% in the Afrikaner and by 2.7% in the Bonsmara and decreased by 7.3% in the Nguni breed. Possible reasons for the differences between the breeds are discussed.
Keywords: large stock unit; production trends; weaning weight

Introduction

Genetic change is easy to achieve. It results when animals that depart from average are selected as parents. Genetic improvement is much more difficult to achieve. It requires that the aggregate value of all favourable changes exceed losses caused by unfavourable changes. The influence of selection, if any, on the productivity of three of the landrace beef breeds in South Africa is unclear. Productivity is sometimes measured in kg meat from weaner calves but cow efficiencies when producing these weaner calves are often neglected. Standard cow efficiency measures like the calf/cow weight ratio (Mokolobate, (2013)) and calf weight/cow weight$^{0.75}$ tend to favour smaller cows. The aim of this study is to evaluate whether changes in weaning weight and mature cow weight over a period of 25 years in the landrace beef breeds improved cow efficiency.

Material and Methods

The three landrace breeds included in this study are the Afrikaner, Bonsmara and Nguni, each with unique breeding strategies, breed standards and different breeding objectives. The Afrikaner, a hardy breed with good mothering ability performs well under harsh conditions and has the ability to produce meat in extensive areas from natural grazing. In the past, its fertility has been questioned and much emphasis was put on artificial breed standards. However, this has changed in recent years and the focus shifted to production. The Bonsmara is a composite breed, developed in South Africa, from the Afrikaner, Hereford and Beef Shorthorn breeds. Performance recording was compulsory for this breed since its inception. The Bonsmara is a well-adapted breed for the warm and sometimes dry extensive farming conditions in South Africa.

The Nguni breed is the common breed amongst many traditional small-holder farmersin southern Africa and forms an integral part of the culture and cultural inheritance of many of the indigenous tribes. The Nguni became known for its ability to produce and reproduce under harsh environmental conditions (Maule (1973); Barnard and Venter (1983); Scholtz et al. (1991)). The interest in the Nguni from commercial breeders only began in the 1970's. The level of performance recording in this breed is low.

Performance and Pedigree data of seedstock animals were used for this study. The genetic trends for the breeds were obtained from the routine genetic evaluations done by the ARC for these breeds,using a multi trait model in PEST. Birth-, wean-, year-, 18 months and mature cow weight were the traits included in the model. Genetic trends over a period of 25 years were estimated for weaning weight of the calf andmature cow weight (1st cow weight after 4 years of age).

Phenotypic trends over a period of 25 years were estimated for calf weaning weight (corrected 205-day weight) and cow weight at weaning of calf, as well as cow efficiency, where cow efficiency was defined as kilogram calf weaned per large stock unit (KgC/LSU) (Mokolobate, et al. (2013)). In South Africa a Large Stock Unit (LSU) is defined as the equivalentof a 450 kg ox, with a weight gain of 500g/day on grass pasture with mean digestible energy concentration of 55% and requires 75 MJ metabolisable energy. (Meissner, et al. (1983))

The following equation developed by Neser and Scholtz (2013), was used to calculate the LSU for different weights of lactating cows:

$$y = 0.000008x^2 - 0.0054x + 2.13$$
where y = LSU units and x = cow weight

Genetic trends in corrected 205-day weaning weight (WW205) and mature cow weight (MCW), defined as the 1st weight after 4 years age of the dam, were estimated by regression analyses.

Results and Discussion

Genetic trends in WW205 for the Afrikaner, Bonsmara and Nguni breeds are presented in Figures 1, 2 and 3 respectively. The phenotypic trends in KgC/LSU for the respective breeds are presented in Figures 4, 5 and 6. The change in genetic merit and phenotypic changes for the three breeds are summarized in Tables 1 and 2.

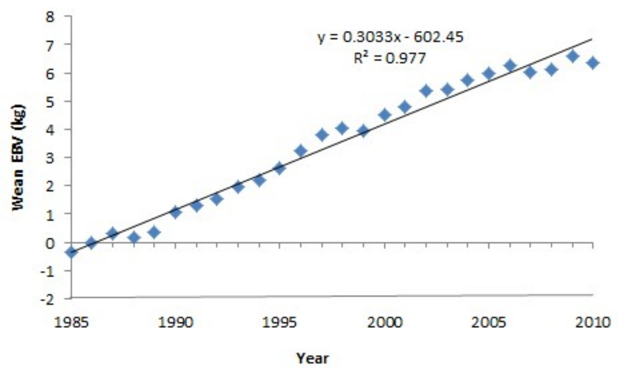

Figure 1. Genetic trend in WW205 (kg) for the Afrikaner

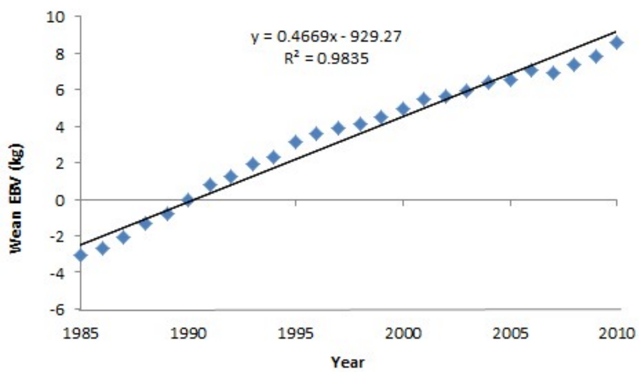

Figure 2. Genetic trend in WW205 (kg) for the Bonsmara

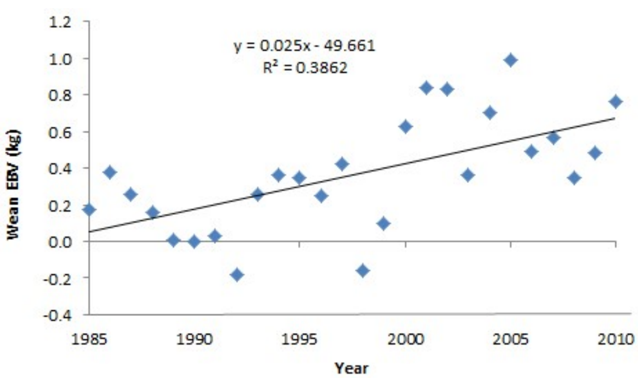

Figure 3. Genetic trend in WW205 (kg) for the Nguni

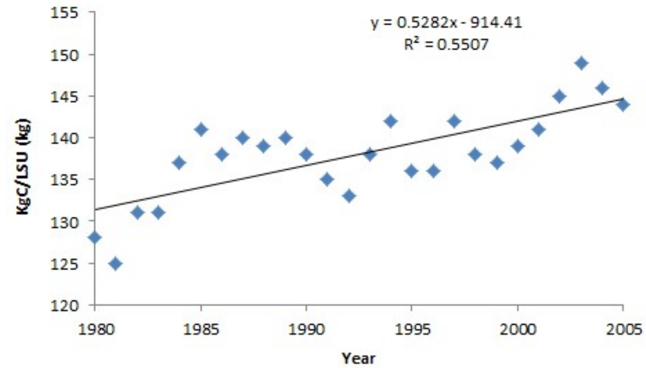

Figure 4. Phenotypic trend in KgC/LSU for the Afrikaner

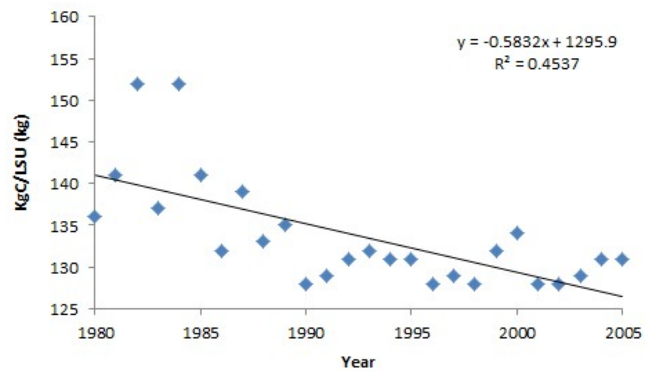

Figure 5. Phenotypic trend in KgC/LSU for the Bonsmara

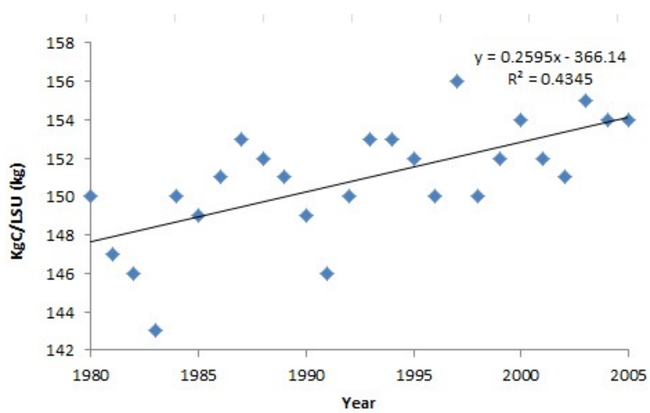

Figure 6. Phenotypic trend in KgC/LSU for the Nguni

Table 1. Genetic change (25 year period)

Breed	Wean Direct (kg)		Mature Weight (kg)	
	1985	**2010**	**1985**	**2005**
Afrikaner	-0.36	6.34	1.7	2.2
Bonsmara	-3.10	8.60	-6.1	3.1
Nguni	0.17	0.48	3.9	0.1

Table 2. Phenotypic Change (25 year period)

Breed	WW205 (kg)	MCW (kg)	KgC/LSU (%)
Afrikaner	21	14	12.0
Bonsmara	15	16	2.7
Nguni	-14	-26	-7.0

Estimated breeding values of direct weaning weight for the Afrikaner (from -0.36 to 6.34) and Bonsmara breeds (from -3.10 to 8.60), changed by +6.7kg and +11.7 kg respectively, with no significant change in the Nguni. The breeding values of MCW only changed in the case of the Bonsmara (+9kg) with no significant changes in the Afrikaner and Nguni. The phenotypic changes were +21kg, +15kg and -14kg for WW205; and +14kg, +16kg and -22kg for MCW in the Afrikaner, Bonsmara and Nguni, respectively. All cow weights were converted to LSU units and used to estimate the change in cow efficiency of the different breeds over a 25 year period. The KgC/LSU increased by 12.0% in the Afrikaner and by 2.7% in the Bonsmara, whereas it decreased by 7.3% in the Nguni.

There may be many reasons for the difference in the changes reported here, e.g. changes in the production environment, production region and production system. It can also be concluded that the breeding strategy followed by some breeds managed to increase calf weaning weight, while maintaining mature cow weight. This genetic change improved or decreased cow efficiency and increased or decreased the production efficiency of weaner calf production and consequently the carbon footprint.

Conclusions

Afrikaner: The breeding strategy followed by the Afrikaner breeders managed to increase calf weaning weight genetically (Figure 1), while maintaining mature cow weight (Table 1).This genetic change improved cow efficiency, as measured in KgC/LSU (Figure 1), resulting in more efficient breeding cows with less maintenance requirements and thereby reduced the carbon footprint of weaner calf production from Afrikaner cows.

Bonsmara: In the case of the Bonsmara the KgC/LSU also increased (Figure 5), in spite of the positive genetic trend of +9.2kg in MCW over a 25 year period (Table 1). The net effect was, however, an increase in cow efficiency of only 2.7% (Table 2).

Nguni: In the case of the Nguni there were no positive genetic trends (Table 1 and Figure 3). The phenotypic trends for WW205, MCW and KgC/LSU were all negative (Table 2), indicating that the Nguni did not show any improvement in production efficiency over time.

Not all breeds showed an improvement in cow efficiency and it seems that some breeds will have to reconsider their breeding strategies. Possible reasons for the differences between breeds are, (1) changes in the production environment, productionregion and production system, e. g. Nguni cattle are currently farmed with in areas that were traditionally regarded as unsuitable for cattle farming, (2) relative emphasis on pre-weaning and post weaning traits and (3) effects of climate change.

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