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THE TULI

ITS CAPACITY AS FEEDLOT STEER AND ITS POTENTIAL TO YIELD HIGH QUALITY BEEF.

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INTRODUCTION

Cattle indigenous to Africa are often misnamed as Bos indicus, based on their phenotype (conformation and hump), while it has geen shown that most of these brees are more related to Bos Taurus (European cattle) than Bos indicus. Like, Bos indicus cattle, these breeds are well adapted to harsh environments and are collectively known as Sanga or Sanga (Bos taurus africanus). In countries like Australia, the grading system automatically discriminates against humped animals on the basis of the incorrect assumption that such animals are indicus derived. However, various studies have shown that Sanga or Sanga derived cattle may well adapt to feedlot conditions and produce meat of comparable quality as Continental and British breeds. To our knowledge there is little information available describing and comparing the growth performance, carcass yield and meat quality of the Tuli as Sanga derived breed under South African feedlot conditions. This paper attempts to inform the reader of these qualities in comparison with other Sanga breeds and an indicus breed according to a study done at ARC, Irene. Grainfed Tuli, Drakensberger, Bonsmara, Nguni, and Brahman steers were compared for feedlot performance, yield and meat quality.

GROWTH PERFORMANCE

Table 1: Breed comparisons for growth performance and carcass yield

	BO	BR	DR	NG	Tuli
Average days on feed	132	132	132	132	132
ADG(kg/day)B	1.7	1.5	1.8	1.5	1.7
FCR(kg/kg)B	5.96	5.41	5.69	5.95	5.42
Final weight (kg)	467	413	454	391	418
Cold carcass weight(kg)	270	235	265	227	241
Dressing (%)	57.8	56.8	58.3	58.0	57.5

Breeds: *Bonsmara (BO), Nguni (NG), Drakensberger (DR), Tuli and Brahman (BR)*

The Drakensberger and Bonsmara tend to produced heavier carcasses, while that of the Tuli and Brahman was about 30kg lower than the 270kg average carcass weight according to the SA Feedlot Associations statistics. Nevertheless, the Tuli will still be suitable for grain feeding under South African feedlot conditions. The dressing % of the Brahman was slightly lower than most other while that of the Tuli was similar to that of the Bonsmara in this study. The higher dressing % of the Brahman was probably due to lower carcass fatness (see average fat thickness of rump and loin; Table 2). Both the Tuli and Brahman showed very favourable feed conversion ratios and the Tuli group gained weight at the same rate as the Bonsmara group.

YIELD

Table 2: Breed comparisons for carcass measurements and yield parameters

	BO	BR	DR	NG	Tuli
P8 fat thickness (mm)	7.5bc	6.3ab	7.6abc	8.1bc	7.5abc
Rib fat thickness (mm)	7.3cd	4.0a	8.4d	7.2cd	6.7bc
Round meat yield (%)$_B$	72.9ab	72.1ab	72.5ab	71.8a	73.0ab
Trimmed fat (%)$_B$	10.8ab	10.9ab	11.3ab	12.0b	10.5ab
Bone Yield (%)$_B$	16.4a	17.1b	16.2a	16.2a	16.5ab
Kidney & channel fat (%)	3.30c	2.53a	3.57c	3/23bc	3/48c
Marbling (%)$_C$	1.43	1.46	1.73	1.53	1.52

Breeds: *Bonsmara (BO), Nguni (NG), Drakensberger (DR), Tuli and Brahman (BR)*

"Both the Tuli and Brahman showed very favourable feed conversion ratios and the Tuli group gained weight at the same rate as the Bonsmara group."

The round, that will include the hind shin, rump, silverside, knuckle (thick flank) and topside, was removed from the bone and trimmed of excess fat as an indicator of lean yield. On a proportional basis (%), only small differences in meat yield were evident with the Nguni showing the lowest yield and the Tuli and Bonsmara the highest yield. In addition, the Tuli had the least trimmed fat and lower bone yield than the Brahman. Both the Tuli and Drakensberger tend to have more kidney and channel fat than the other breeds. Marbling in our country has very little value because the levels reached under our standard commercial feeding regime (1-3%) are not sufficient to show any effect on palatability.

MEAT QUALITY

Shear force measures the tenderness of meat using a Instron Machine equipped with a Warner Bratzler device to shear through standard specimens of cooked meat prepared according to a standard procedure. Higher values indicate less tender meat. Previous studies have shown that threshold values of 4.6 kg and 3.9 kg for "retail" and "food service" meat exist for beef samples that were prepared according to the same specifications as those used by ARC-Irene Sensory laboratory. Ultimately, one needs at least a shear force of 4.6 kg to have a steak rated at least "slightly tender" by consumers and lower than 3.9 kg to be acceptable in the food service (restaurants). In another study consumers were able to differentiate between three categories of tenderness, viz. 2.3 to 3.6 kg, 4.1 to 5.4 kg and 5.9 to 7.2 kg. Ninety four percent of the consumers preferred the first category and was willing to pay a premium for improved tenderness. According to these benchmarks none of the breeds were suitable for retail or food service if loin steaks were sold unaged (or aging limited to 2 days). For the second example of differentiation, Brahman steaks sorted into the poorest category and those of the other breeds in the middle category. When aged for 21 days steaks of all breeds except the Brahman were suitable for the food service sector and the steaks of the Drakensberger, Bonsmara and Nguni sorted into the preferred category but also still very acceptable. Since tenderisation through aging of meat is mostly the result of the actions of proteolytic enzymes (in particular the calcium dependent proteolytic enzymes or CDPs) on the muscle fibre breakdown, various biochemical and histological tests can confirm Warner Bratzler tenderness results. Generally speaking the CDP system consists of calpain enzymes responsible for breaking down muscle structure and their inhibitor, calpastatin, which inhibits this process. Interestingly, these systems are involved in muscle protein turnover in live animals. In simple terms higher calpastatin activity may increase muscle weight gain due to higher retention. After slaughter, the same system facilitates tenderisation of muscle. Histologically (microscopic study of cell tissue), the length of the myofibre (or the contracting unit of the muscle) will indicate the progress in the aging process as a result of the CDP system and will relate to tenderness. Shorter fragments indicate more or faster breakdown of the myofibrillar structure (Figure 1).

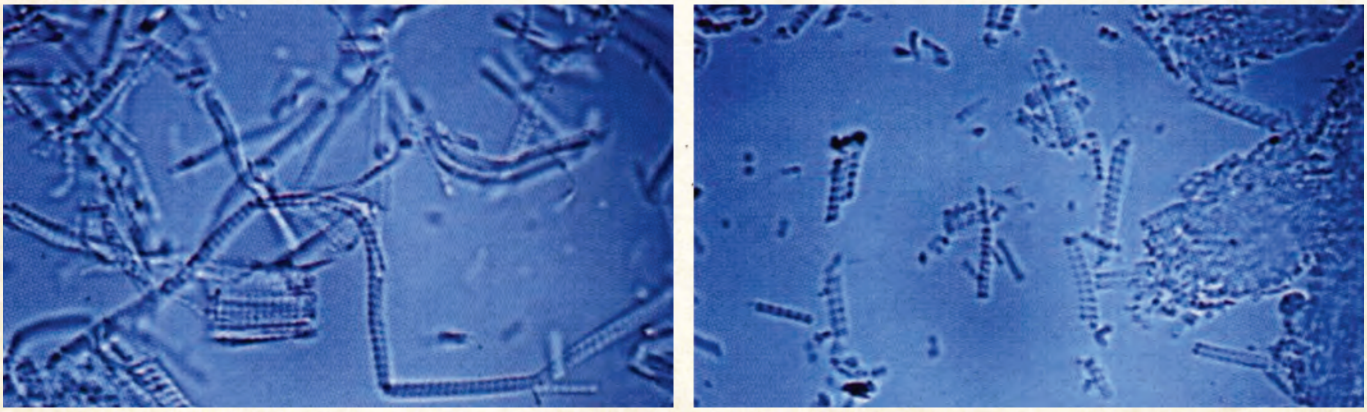

Figure 1: Change in fragment length from 2 (left) to 21 days (right) post mortem.

Myofibrillar fragment length in Table 3 Shows that Tuli (43,8 micron) had an advantage over the Brahman (45.7 micron) even after 2 days aging and this advantage was maintained. Although most of this advantage was cancelled out by prolonged aging the Tuli still had shorter MFL's and probably benefitted from early advanced aging. Further confirmation that Tuli steaks should age well, was the lower enzyme activity ratios which showed a lower inhibitor: enzyme (calpastatin: calpain) activity ratio compared to the Brahman. The ratio was slightly higher than those of the other breeds, though.

Connective tissue properties do not play a major role in tenderness of the loin muscle because loin muscle is a relative low-connective-tissue muscle type compared to e.g. the shin or topside. Nevertheless, proportion of soluble collagen in Tuli loins was higher than that of the Brahman an slightly higher than those of the other breeds meaning that a lower proportion of the muscle collagen was resistant to heat and could therefor contribute to better tenderness.

CONCLUSION

Any research results should always be approached with caution as it only represents a sample of a larger population. Nevertheless, based on the results from this project and the benchmarks used for feedlot performance and meat quality, the Tuli is an indigenous breed that should perform well in the South African beef industry. The results confirm that it is capable of performing well under feedlot conditions and could produce high quality beef in addition to its inherent ability to thrive under extensive conditions. ■

"Connective tissue properties do not play a major role in tenderness of the loin muscle because loin muscle is a relative low-connective-tissue muscle type compared to e.g. the shin or topside."

Table 3: Breed comparisons for shear force tenderness, muscle biochemistry and muscle histology (loin muscle)

	BO	BR	DR	NG	Tuli
Shear force (kg)					
2 days aging	5.07	6.57	5.28	5.13	5.84
21 days aging	3.41	4.64	3.30	3.49	3.90
2 vs. 21 days	1.66	1.93	1.98	1.64	1.94
Myofibrillar fragment length (μm):					
2 days aging	39.5	45.7	37.7	38.3	43.8
21 days aging	25.6	28.0	25.8	25.4	26.2
2 vs.21 days	13.9	17.7	12.0	12.8	17.7
Proteolytic enzyme activity:					
Calpastatin: μ-calpain ratio	4.57	7.73	5.30	5.20	6.0
Connective tissue properties					
Togal collagen (mg/g)	3.95	3.83	4.16	4.13	4.06
Soluble collagen (%)	20.9	19.7	22.6	22.6	23.4

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Casman Tuli

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POLLED BEEF CATTLE

Moving towards DNA technology for selection of polled beef cattle

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INTRODUCTION

The advantages of polled animals for the commercial cattle industry are well known. Polled cattle have the advantage of being easier to manage, take up less feeding space in feedlots and the risk of injury, bruising and potential carcass damage is decreased, thereby also decreasing economic losses. Although there is the option of dehorning, worldwide there is an increased awareness of animal welfare, accompanied by an increasing pressure for more humane practices during animal handling. This is especially true for dehorning of cattle and in certain European countries, like Denmark, dehorning is already banned. Besides raising welfare concerns, dehorning is labour intensive, time consuming and causes stress to the growing calf.

Breeding polled animals would be a welfare friendly alternative, as well as a long-term solution to dehorning. Selection practices in the past focused on phenotypic selection by making use of pedigree information and test mating. Test matings are time consuming, expensive and require accurate records. It would make more sense to select animals on a genotypic level, where it is possible to identify animals carrying either one of two polled alleles. Therefore, it is important to revisit the inheritance of polledness, as well as the ongoing research which enables genetic selection of polledness using DNA based technology.

Early mode of inheritance of polledness

Horns in cattle consists of a pneumatised core that is fused to the frontal bone which grows outward from the skin at the base of the horn, while polledness is the condition of being naturally hornless. Polledness is an observable phenotype that can be identified at a relatively young age and does not change with age. A third phenotype, namely scurs, develop as small horn-like growths in the same area as horns on the skull, but these abnormal horns are loosely attached to the skull. The scurs phenotype, however, develops approximately after four months of age and needs to be confirmed between 18 and 24 months of age.

The polled phenotype is known to be dominant since 1906 and was first described by Auld (1927). The first model for the inheritance pattern was proposed by Long and Gregory (1978), which suggested that four genes interact independently to control the inheritance of polled, scurs and horns. Georges et al. (1993) refined the model of polled inheritance and mapped the Polled locus to bovine chromosome 1 (BTA1). The polled gene is dominant and if present, will suppress the expression of the horned gene.

Two alleles are present at the Polled locus, P and p, and animals carrying the P allele are phenotypically polled. PP animals will be homozygous polled, while Pp animals will be heterozygous polled and are carriers of a horned allele. Animals carrying two p alleles will be horned. Due to dominance, there cannot be distinguished between the homozygous and heterozygous polled phenotype and therefore it is necessary for a test to identify carriers of the polled and horned alleles. Polled alleles will be passed on to offspring in different proportions, depending on the polled status of the parent animals. For example, if a homozygous polled (PP) bull is mated to a horned (pp) cow, there is a 100% chance that the offspring will be polled (Pp), as shown in Table 1. However, this chance decrease to 50% when a heterozygous polled (Pp) bull is used.

Table 1: The possible genotype proportions and respective phenotypes for different mating situations of horned, heterozygous and homozygous polled individuals

Mating	Genotype	Phenotype
PP x pp	100 % Pp	Polled
Pp x Pp	25 % PP	Polled
	50 % Pp	Polled
	25 % pp	Horned
PP x Pp	50 % PP	Polled
	50 % Pp	Polled
Pp x pp	50 % Pp	Polled
	50 % pp	Horned

The matter of polled and horned inheritance is further complicated by the presence of the Scurs locus, as the Polled locus interacts with the Scurs locus in a mechanism called epistasis.

For the scurs phenotype, the expression is sex-influenced, meaning the expression of scurs is different between male and female animals. In males, the heterozygote (Scsc) is usually scurred, while in females only the homozygote (ScSc) will be scurred. Also, for the scurs phenotype to be expressed, an animal needs to be heterozygous for the Polled gene (Pp), implying that homozygous polled (PP) and horned animals (pp) will not express the scurs phenotype.

Moving towards DNA technology

The Bovine genome sequence has been completed in 2009, which provided genomic information and resulted in the development of high density SNP chips. This molecular technology provides the opportunity to study the Polled and Scurs genes on a genomic level. Various research groups across the world investigated the polled trait in cattle and contributed to the development of diagnostic tests where DNA markers are applied to identify polled and horned animals using a biological (e.g. blood or hair) sample of the animal.

A research group in Australia linked the polled phenotype to a DNA marker (CSAFG29) on BTA1. They identified alleles 303 and 305 of CSAFG29 to be associated with the polled phenotype in Brahman, Angus, Hereford and Limousine cattle. Currently, this Australian research group uses a ten marker haplotype to associate the polled phenotype based on probability. Even though the 303 and 305 alleles can be used to identify polled animals in *Bos taurus* and *Bos indicus* cattle, it has not been validated in South African cattle breeds and previous testing showed low accuracy.

A 202bp mutation on BTA1 was detected by a group of German researchers and a strong association with the polled phenotype was found in almost all European cattle. It was proposed that this mutation was responsible for polledness in *Bos taurus* breeds. This proposed mutation was confirmed by French researchers and at least two different genetic variants have been identified for the Polled gene, namely the Celtic (PC) and Friesian (PF) mutations.

In collaboration with a French research group (INRA), Bonsmara, Drakensberger, Hereford and Tuli animals have been tested for these mutations. It was determined at the Department of Animal and Wildlife Sciences (UP), that the Celtic mutation is responsible for polledness in the Bonsmara and Drakensberger breeds and it was possible to distinguish between homozygous and heterozygous polled animals by using a relatively simple PCR based test. **Although this test can distinguish between homo- and heterozygous polled animals, the test cannot identify scurs on a genotypic level and further research is required.**

Practical implications for the Tuli

The causative mutation for polledness in the Tuli breed could not be confirmed at the Department of Animal and Wildlife Sciences (UP), due to a small sample size, as well as inaccurate recording of the polled, horned and scurred phenotypes. Incorrect phenotyping affects research related to the Polled and Scurs genes, since phenotypic information is crucial to obtain accurate results and validation on a genotypic level. It is, therefore, necessary to emphasize the importance of accurate phenotypic recording of the horn status of animals, including the presence of the scurs phenotype. Polledness is an easily observable phenotype and can be identified at an early age, while scurs are more difficult to identify and only develop later in life (Figure 1). Horns and scurs might look very similar at a young age and it is important that animals should be inspected both at a young age, as well as between 18 to 24 months of age.

Figure 1: Example of the polled (A), scurred (B) and dehorned (C) phenotypes.

Once the Celtic mutation has been validated as the causative mutation for polledness in the Tuli breed, DNA based technology can be a feasible option to select for polled Tuli animals, especially where stud bulls are involved. By either using pedigree analysis or phenotypic identification, polled animals can be identified, and commercial testing can be considered for confirmation of such animals, as well as to identify whether the animals carry one (Pp) or two (PP) polled alleles. ■

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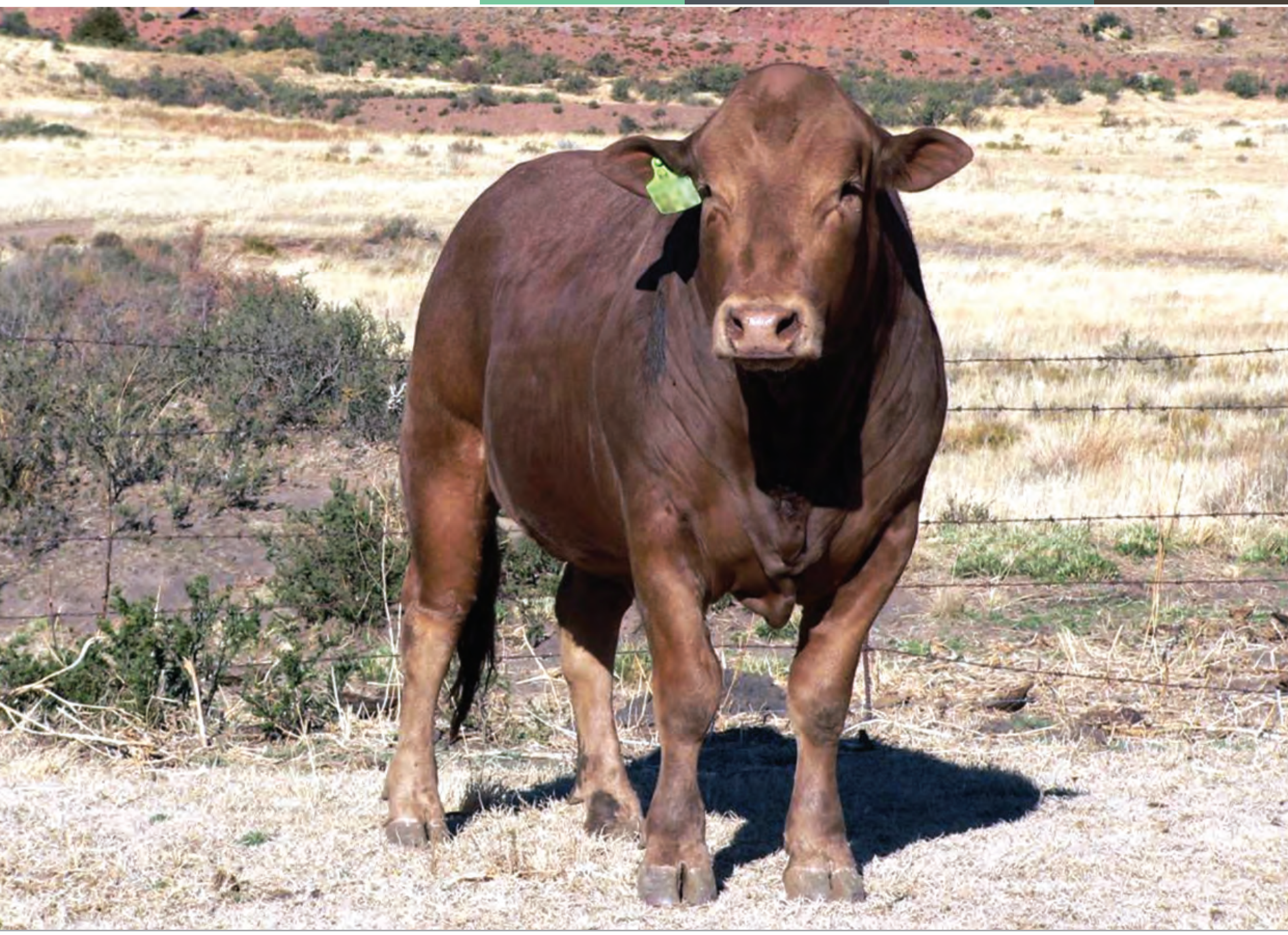
KEY CONCEPTS

Genome – the complete set of genes or genetic material present in an animal
Gene – the basic physical unit of heredity
Locus – the specific site of a gene on the DNA
Alleles – two versions of a gene and only two alleles can be present at a time, because the animal can inherit only one allele from each parent
Homozygous – the animal has two identical alleles for that specific gene
Heterozygous – the animal will have two different alleles for that specific gene
Epistasis – interaction between two or more loci (genes) influencing the phenotype of a single trait

Table 1: A punnet square indicating the possible genotypic outcomes when mating two heterozygous polled individuals

Mating	P	p
P	PP	Pp
p	Pp	pp



TULI IN BOTSWANA

CHARL VAN ROOYEN

Way back (1970) Tuli was already one of the widely used Sanga and Bos Indicus breeds in our neighbourhood country Botswana.

Unfortunately, due to various reasons a lot of the purebred indigenous breeds in Botswana, notwithstanding the fact that they were doing very good in the below mentioned research done, their numbers did not increase as much as was expected. However the Tuli breed is gradually coming back in the country, especially amongst commercial farmers.

It is so important that the South African Society must play a part in helping Botswana breeders to take note of the excellent qualities of the Tuli under extensive farming conditions.

TEN YEARS OF ANIMAL PRODUCTION AND RANGE RESEARCH IN BOTSWANA (1980)

Animal Production and Research Unit, Ministry of Agriculture, Botswana Research Paper

Botswana, South Africa's northern neighbour, was one of the first countries to import Tulis and the breed soon became established there. The Botswana Animal Production Research carried out trials on five widely used Sanga and Bos Indicus breeds over a ten year period from 1970 – 1980. These trials aimed to assess the merits of the five breeds in a number of economically important traits.

Calving Percentage of Five Breeds in Botswana Trials

Breed	No. of Cows	Calving %
Afrikaner	3,591	67.5
Bonsmara	288	82.9
Brahman	614	72.2
Tswana	1,106	80.0
Tuli	1,549	86.6

Reconception Rates of Cows with Calves at Foot

Breed	No. of Cows	Calving %
Afrikaner	1,208	51,2
Tswana	533	74,5
Tuli	960	80,5

Production from Weaning to 18 Months

Breed	No. of Animals	Weaning Weight (kg)	No. of Animals	18 mth. Weight	Percent Mortality	Gain (kg)	%Gain on Weaning Weight
Tuli	1,063	175.8	1,007	287.2	5.3	111.4	6.5
Bonsmara	151	204.3	136	315.4	9.9	111.1	5.5
Tswana	1,433	179.0	1,310	293.5	8.5	114.5	6.4
Brahman	308	184.2	293	308.6	4.8	124.4	6.7
Afrikaner	1,709	174.3	1,505	278.1	11.9	103.8	6.0

Productivity Index

Combining reproduction, viability and growth results, a productivity index was calculated for the breeds in the trial.

Breed	Calving %	Mortality % to 12 years	18 month weight	Weight of 18 month calf / cow / year	Index
Tuli	86.6	7.2	287.2	230.8	109
Bonsmara	82.9	17.5	315.4	215.7	101
Tswana	80.0	9.4	293.5	212.7	100
Brahman	72.2	18.6	308.6	181.4	85
Afrikaner	67.5	13.5	278.1	162.4	76

This work indicates a very strong link between calving percentage and productivity. This together with a low calf mortality appears to be far more important to overall productivity than simply the averag weight of the calf crop.