Beef Cattle management and systems development

Researcher: Dr Michiel M Scholtz

Team members: Mr Maliviwe Mpayipheli, MSc. (Agric) - ARC
Ms Anette Theunissen MSc. Agric
Dr L Frylinck PhD. (Bioch) - ARC
Dr P E Strydom PhD. (Animal Science) - ARC
Mr T Jonker MSc. (Animal Science) – DALR&RD
Mr M Ferreira B (Agric) - DALR&RD
Ms H Snyman Nat. Dipl. (Food Tech)
Ms J Anderson Nat. Dipl. (Anal Chem)
Ms R E Visser B (Home Econ)
Ms J M Van Niekerk B (Home Econ)
Mr A Mtsweni (Carcass Classifier and Meat Inspector)

Research Institute: ARC-Animal Production Institute

Research focus area: Livestock production with global competitiveness

Full Title of the project

Beef cattle management and systems development for optimal production.

Aims of the project

- To evaluate the innovative terminal mating system by means of Nguni and Angus crosses.
- To compare the adaptability of Nguni-Angus crosses to feedlot and grass-fed production systems.
- To conduct carcass and meat quality studies on feedlot and grass-fed Nguni-Angus cross-bred offspring.

Executive summary

South Africa has indigenous beef cattle breeds such as the Nguni that are widely recognized for attributes such as fertility, low maintenance inputs, ease of calving, adaptability, resistance to internal and external parasites, resistance to tick-borne diseases, good temperament, longevity, browsing and good walking abilities. Historians estimate that these indigenous breeds developed over a period of more than 1200 years in Southern Africa, which led to the development of breeds that are well adapted to the environmental extremes of Southern Africa.

Livestock production is an important agricultural activity in the Northern Cape and many other parts of South Africa. Continuous deterioration in beef cattle production environments as well as alternative grass-fed production systems necessitates the reviewing and evaluation of current production and breeding strategies. The importance of indigenous breeds that are adapted to the anticipated warmer climate, lower nutritional value of the grazing and harsher conditions will increase. Crossbreeding between British / European and indigenous breeds may thus become more important to increase beef production in the near future, where management is at relatively high levels, but where conditions are harsh.

The aim of this study was to evaluate the Nguni in a terminal crossbreeding system. The production phase was done at the Vaalharts Research Station of the Northern Cape Department of Agricultural, Land Reform and Rural Development near Jan Kempdorp. The feedlot phase was conducted at the ARC-Animal Production Institute at Irene in Gauteng.

The average 205-day adjusted weaning weight (WW) of the Angus x Nguni calves were 181 kg and that of the pure Ngini calves 146 kg. Altough the adjusted weaning weight of the Angus x Nguni calves was 35 kg higher than that of pure Nguni calves, the difference was not significantly. This can be attributed to the large variation in weaning weights, with that of the pure Nguni calves ranging from 56 kg to 230 kg and that of the Angus x Nguni calves from 105 kg to 303 kg. The adjusted weaning weight also increased with increase of the age of the cow until cows were 5 years, then it decreases. The cow weight at

weaning did not seem to have an effect on the weaning weights of the calves. If cow efficiency is expressed as kilogramme calf weaned per Large Stock Unit, the cow efficiency of cows with Angus x Nguni calves improves by 25%.

In a comparison of the feedlot performance of the Angus x Nguni to that of pure Nguni, Angus, a tropical adapted breed, a composite breed and a European breed, the growth rate of the Angus x Nguni (1.79 kg/day) was higher than that of the pure Nguni (1.29) and tropical adapted breed (1.45) and similar to that of the pure Angus (1.76) and composite breed (1.72). Only the growth rate of the European breed (2.09) was higher than that pf the Angus x Nguni.

The overall feedlot performance of the Angus x Nguni calves were good. The average daily gain of the male and heifer calves were 1.77 and 1.41 kg/day respectively. The feed conversion ratio (kg feed/kg gain) was 5.59 and 6.61 respectively. Some of the crosses were slaughtered and marketed through a commercial abattoir and there was no price discrimination against the lighter Angus x Nguni heifers carcasses (171 kg) compared to the heavier Bonsmara x Charolais male carcasses (237 kg).

On the veld the average daily gain for the Angus crossbred oxen was 33% higher than that of the purebred Nguni oxen and in case of the heifers it was 22% higher. These results indicate that the Angus x Nguni can produce a calf that can be finished from grass and still meet the requirements of age class "AB" at point of slaughter.

As a result of the very large variation in weaning weights, some non-genetic factors affecting 205 day-adjusted weaning weight, post-weaning average daily gain and feed conversion ratio of pure Nguni and Angus x Nguni calves were evaluated as part of this study. It was found that in addition to the sex of the calf, weaning weight was also affected by age of the dam, the year of birth, month of birth year x genotype interaction and the herd of origin of the dam. Feedlot average daily gain was affected by year of birth and dam age, whereas feed conversion ratio was only affected by dam age.

The fact that herd of origin of the cow affects the weaning weights of her calves led to interest in the concept of epigenetics and a literature study was conducted. All alterations

in DNA function without alterations in DNA sequence are referred to as epigenetics. It is associated with gene expression and the expression of different phenotypes (appearance). These modifications are influenced by environmental factors and can be transferred to the progeny of complex organisms, including livestock. Epigenetic mechanisms play a major role in phenotypic diversity in response to environmental conditions. This warrants further investigation.

Studies on the carcass and meat quality traits of the Nguni x Angus indicated high marbling, low drip loss and a good water holding capacity (lower value, means better water holding), most tender meat at 2 and 21 days post mortem as measured with Warner Bratzler shear force (WBSF) and low calpastatin (the proteolytic enzyme inhibitor) levels, which is in agreement with the lower WBSF. Taking into consideration all measurements contributing to tenderness, both amount and quality of collagen as well as aging ability contributed to differences in tenderness among the 4 groups. Using benchmarks from the USA, it should however be noted that all 3 groups produced meat of acceptable tenderness at 21 days.

The development of a simulation program to compare economic efficiencies of the different communal cattle production systems was added to this project. It was found that the most viable and profitable production system for the South African communal and emerging cattle farmers may be the improved ox production system without purchasing feed. In this system, farmers would need to keep fewer cows and manage breeding to ensure that adequate feed is available all year round. Depending on the financial needs of communal and emerging farmers, a minimum cow herd of between 30 and 50 cows should be a viable enterprise. National and provincial governments, policy makers, scientists, development practitioners and agricultural extension officers can use this information to guide communal and emerging farmers on the most optimal production system they need to follow.

This study endeavored to supply information to assist commercial, emerging and communal beef producers to make better use of available beef breed resources and to capitalize on the favourable effects of heterosis. Livestock production is an important agricultural activity in the Northern Cape and many other parts of South Africa. Continuous

deterioration in beef cattle production environments and climate change, as well as alternative grass-fed production systems necessitates the reviewing and evaluation of current production and breeding strategies.

Recommendations

1. The crossbreeding effects with specialized British and European sire lines crossed with our landrace breeds (Afrikaner, Bonsmara, Nguni and possibly Drakensberger) and tropical adapted breeds (e. g. Brahman) should be evaluated. The results from such a study can be used to quantify heterosis effects for economically important traits in landrace and tropical adapted crossbred cattle for beef production in the era of climate change.

2. If the effect of non-genetic factors on performance, as identified in this study can be confirmed with other studies, adjustments should be made for them when estimating genetic parameters.

3. The indication of the possible existence of epigenetics by this study should be investigated. Knowledge of epigenetic controls in diverse environments should allow for more effective control and management of such effects. Taking control of genetics, independent of Mendelian inheritance, can move future breeding beyond simple breeding programs and provides new management and nutritional tools to enhance productivity. This can be done by using the environment and management to define epigenetic controls, as well as nutritional interactions.

4. A simulation software program should be developed for the correct estimation of grazing capacity and stocking rates. Such a program will improve the competitiveness of the emerging beef cattle sector, and enhance equitable access and participation in the beef cattle industry.

- Technology Transfer Occasions

1. Workshop in Northern Cape on Angus x Nguni during IDC Limpopo visit to Vaalharts, 10 November 2010, by Dr M M Scholtz
2. Meeting with Limpopo IDC Nguni Cattle Development Trust and presentation on "the Angus x Nguni performance and other related issues", 29 November 2010, by Dr M M Scholtz.
3. Vaalharts Cattle Working Group. 26 October 2011. Vaalharts Research Station, by Dr. M M Scholtz
4. The value of indigenous cattle breeds in commercial beef cattle production". Northern Nguni Club, Bela Bela, 4 November 2011, by Dr. M M Scholtz
5. The principles of terminal crossbreeding using indigenous breeds. CAPACITY BUILDING FOR BENEFICIARIES OF THE LIMPOPO IDC ANGUS X NGUNI PROJECT, Bela Bela, 29 and 30 November 2011, by Dr. M M Scholtz
6. The role of indigenous breeds in commercial beef production: The Nguni example. Eastern Cape Nguni Club Information Day, Döhne Agricultural Development Institute, Stutterheim, 22 February 2012, by M M Scholtz

- Reports to Industry

1. SCHOLTZ, M.M., THEUNNISEN, A. & FERREIRA, M. 2011. Progress Report: 2010 – 2011 - Nguni x Angus project at Vaalharts. Submitted to Nguni and Angus Cattle Breeder's Societies, August 2011.
2. SCHOLTZ, M.M., THEUNNISEN, A. & FERREIRA, M. 2012. Progress report on the Angus x Nguni project at the Vaalharts Research Station. Submitted to Nguni and Angus Cattle Breeder's Societies

- Popular articles and media

1. SCHOLTZ M M, THEUNISSEN, A & NKOSI D, 2010. Die Nguni in terminal kruisteelt. Nguni Journal, 69 – 71.
2. SCHOLTZ M M, 2011. The use of the Angus in cross breeding. / Die gebruik van die angus in kruisteling. Certified SA Angus Beef Handleiding/ Manual 2011,21 – 26.
3. SCHOLTZ, M. M, 2011. Principles of genetic improvement in the Angus. Angus Journal, 18 - 19.
4. SCHOLTZ, M M, 2012. Challenges for beef production in developing countries of the southern Africa. Nguni Newsletter, 81 – 85.
5. MPAYIPHELI, M and SCHOLTZ, M M, 2014. Evaluation of communal beef production systems at different production levels and systems. Nguni Journal, 51

- Scientific articles

1. SCHOLTZ M M & THEUNISSEN A, 2010. The use of indigenous cattle in terminal cross-breeding to improve beef cattle production in Sub-Saharan Africa. Animal Genetic Resources 46, 33 – 39.

2. SCHOLTZ, M M, 2011. Future prospects for the Nguni breed in South Africa. In: The Nguni breed of cattle – past, present and future. Eds Scholtz, M M, Gertenbach, W D & Hallowell, G J, Nguni Cattle Breeders' Society Bloemfontein (ISBN-13: 978-0-620-51723-2): 57 - 61.
3. SCHOLTZ, M M, MAIWASHE, A, NESER, F W C, THEUNISSEN, A, OLIVIER, W J, MOKOLOBATE, M, C & HENDRIKS, J, 2013. Livestock breeding for sustainability to mitigate global warming, with the emphasis on developing countries. South African Journal of Animal Science, 43, 269-281.

- Conferences, symposia

1. FERREIRA, M N, THEUNISSEN, A & SCHOLTZ, M M, 2011. Angus X Nguni terminal crossbreeding for optimal beef production: Grass-fed performance. Congress of the Society of Agricultural Technologists, Phantom View River Resort by Knysna, 6 - 9 Sept 2011. (Poster)
2. FERREIRA, M N, THEUNISSEN, A & SCHOLTZ, M M, 2012. Crossbreeding Angus sires with Nguni cows. Congress S Afr. Soc. Agric. Tech., 18 - 21 September 2012, Salt Rock, Kwa-Zulu Natal, South Africa.
3. MPAYIPHELI, M, SCHOLTZ, M M, THEUNISSEN, A & FERREIRA M, 2013. Some factors influencing preweaning and feedlot performance of Angus and Nguni calves. 46th SASAS Congress, June 2013, Bloemfontein, South Africa (Poster)

- Literature reviews

1. SCHOLTZ, M M & VAN ZYL, J P. An overview of the effect of epigenetic changes on animal production.