Marker detection in beef cattle II

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Marker detection in beef cattle Phase II

Industry Sector: Cattle And Small Stock

Research Focus Area: Livestock Production With Global Competitiveness: Breeding, Physiology And Management

Research Institute: Agricultural Research Council – Animal Production Institute

Researcher: Dr A Maiwashe PhD

The Research Team

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Prof	M	MacNeil	PhD
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Dr	NO	Mapholi	PhD

Year Of Completion : 2018

Aims Of The Project

- To establish a beef cattle genetic marker discovery population
- To collect phenotypic data on tolerance to ticks, post-weaning growth and feed efficiency and carcass traits
- To detect Quantitative Trait Loci for tolerance to ticks, post-weaning growth and feed efficiency and carcass traits

Executive Summary

The project aimed to detect genetic markers for traits of economic importance in the Nguni X Angus F2 crossbred population. The specific objectives of the project were to: (1) establish a beef cattle genetic marker discovery population, (2) collect phenotypic data on tolerance to ticks, post-weaning growth and feed efficiency and carcass traits, and (3) detect quantitative trait loci (QTLs) for tolerance to ticks, post-weaning growth and feed efficiency and carcass traits. Accordingly, a number of experiments were conducted to address these objectives.

Briefly, a total of 233 F2 animals were produced since the inception of the project. The following phenotypic data were collected on the 233 F2 crossbred animals: growth rate, feed intake, tick count, skin volatiles compounds, skin thickness and colour, hematology, skin hypersensitivity and carcass traits. Coat color was scored and skin thickness was also done since they are known to be correlated with tolerance to ticks. Artificial tick infestation was conducted using *Amblyomma hebraeum*. Each animal was infested with 100 larvae obtained from ARC-Onderstepoort Veterinary research.

Tick counts were also conducted on 586 Nguni cattle under natural infestation with the aim of developing a protocol for measuring tolerance to ticks using tick count procedure.

The results indicate extensive variability on ticks counts among the animals, ranging from 0 to 100 per animal. Tick counts were higher in the hot months and *Amblyomma hebraeum* was the most dominant tick species. Heritability estimates for tick count ranged from 0 to 0.89. High genetic correlations were observed between whole body count and the anatomical location counts, suggesting that it may not be necessary to conduct whole body counts. Counts from the belly and perineum were most suitable surrogate traits for whole body count.

In another experiment, feed intake and growth performance data were collected at the feedlot on 170 animals at the ARC-Animal Production campus in Irene. Average daily feed intake (ADFI), average daily gain (ADG) and feed conversion ratio (FCR) were computed and analyzed using SAS software. The findings showed a significant effect of genotype on ADFI and ADG ($P < 0.05$), while there were no differences ($P > 0.05$) in FCR among the genotypes. The F2 Nguni-Angus genotype had the best feedlot performance with ADFI, ADG and FCR of 7.9 kg, 1.5 kg and 5.6, respectively. There was also some correlation between ADG and FCR, while ADG and FCR were not correlated with ADFI.

For genomic analyses, hair and blood samples were collected from 233 F2 animals and DNA isolation conducted on 170 animals. Ninety-six (96) F2 samples were genotyped using Bovine SNP150K assay. A genomic analyses was conducted to characterise genetic parameters of tick count and identify genomic regions associated with tick resistance in South African Nguni cattle. A genome-wide association analysis for tick count was performed using GenABEL. Heritability estimates for the tick count traits ranged from 0.04±0.04 to 0.20±0.04. Two genome-wide significant regions on chromosomes 1 and 19 were identified for total tick count on the perineum and for total body count for *A. hebraeum* ticks. Additional regions significant at the suggestive level were identified on most chromosomes for several other tick count traits.

This research provides the first line of evidence of association between tick count and SNP markers in beef cattle under South African condition. The results are consistent with results from similar studies conducted in Brazil. Further research should consider fine-mapping of the genomic regions identified to be harbouring genes for tolerance to ticks.

Popular Article

Marker Detection In Beef Cattle

Nguni cattle are adapted to the harsh conditions of South Africa characterised by, among others, high levels of tick infestation. This adaptation may be due to the natural resistance of the Nguni, which may be attributed to their genetic make-up. On the other hand, the Angus cattle are exotic to South Africa and are susceptible to tick infestations. However, they have excellent growth, feed utilization and meat quality characteristics. Combining the characteristics of these breeds into one breed may be a sustainable of way of improving beef production in the tick-infested production areas of South Africa. The objective of the study was cross the Nguni and Angus cattle to produce a crossbred animal that potentially has characteristics of both breeds.

The project started in 2013 using 84 Nguni cows and five Angus bulls, and has so far produced 233 animals that have been evaluated for several traits related to resistance to ticks, growth performance and meat quality. After weaning the calves were individually fed under feedlot conditions and their performance recorded and analysed. Daily feed intake for each animal was recorded and weekly weights were taken. At the end of the growth test, each animal was artificially infested with ticks so that its level of resistance can be determined by counting the number of ticks that feed and survive on it. Chemicals on the skin produced by the animal that may be responsible for repelling or attracting ticks were collected. In addition, the ability of the animal's immune system to respond to tick bites was measured by measuring the degree of swelling and the time taken for it to subside. The response of blood parameters responsible for the immune system to tick bites was also evaluated. Also measured was the thickness of the skin, which may also related to the ability of the ticks to attach to the skin. Hair samples were collected to

determine the genetic make-up of the animal, which will later be correlated with the level of resistance to ticks, growth performance and meat quality.

After the 120 days in the feedlot, the animals were then slaughtered following the recommended South African Meat Industry Company procedures. Carcass were weighed after dripping free water after 24 hours. Then several meat quality characteristics were evaluated, which included tenderness, water holding capacity, fat content and moisture content.

The results show that there are differences in the level of resistance to ticks in the cross-bred animals. No relationship was observed in the level of resistance to ticks with growth performance and feed utilization. Skin thickness was not found to influence the ability of ticks to attach to the animal. Meat quality results indicate that the crossbred animals produce meat of commendable quality. Male animals produced heavier carcasses than their female counterparts, and were less fat compared to the females. On the other hand, meat from females was more tender than that from males. So far the results show that there is no relationship between meat quality and the level of tick resistance. Therefore, resistance to ticks can improved by combining the Nguni and Angus breeds without compromising growth, feed utilization and meat quality characteristics. More studies on the genetic make-up will be done to relate it to the other characteristics.

Please contact the Primary Researcher if you need a copy of the comprehensive report of this project – Azwihangwisi Maiwashe on norman@arc.agric.za

Breeding, Cattle and Small Stock, Livestock Production

2018, ARC, ARC-API, CSS, Maiwashe, Online

‹ Karoo Predator Project

› Genomic markers in beef tenderness

DEADLINES for RESEARCHERS 2021

Proposals for 2021: TBC
Progress reports: 28 Jan 21
Final reports: 29 Jan 21 Final includes comprehensive report and popular article

COMMITEE MEETINGS for 2021

RMRDSA CSS Planning - TBC
Project Committee - TBC
Pork Planning - TBC

Calendar

<		Apr 2021				>
Sun	Mon	Tue	Wed	Tur	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

PORK Priority Areas

Cattle & Small Stock Programmes

1 Sustainable natural resource utilisation

2 Improvement of Livestock production and forage

3 Management of agricultural risk to create a resilient Red Meat sector

4 Sustainable health and welfare for the Red Meat sector

5 Enhancement of production and processing of Animal Products

6 Consumer and market development of the Red Meat sector

7 Commercialisation of the emerging sector