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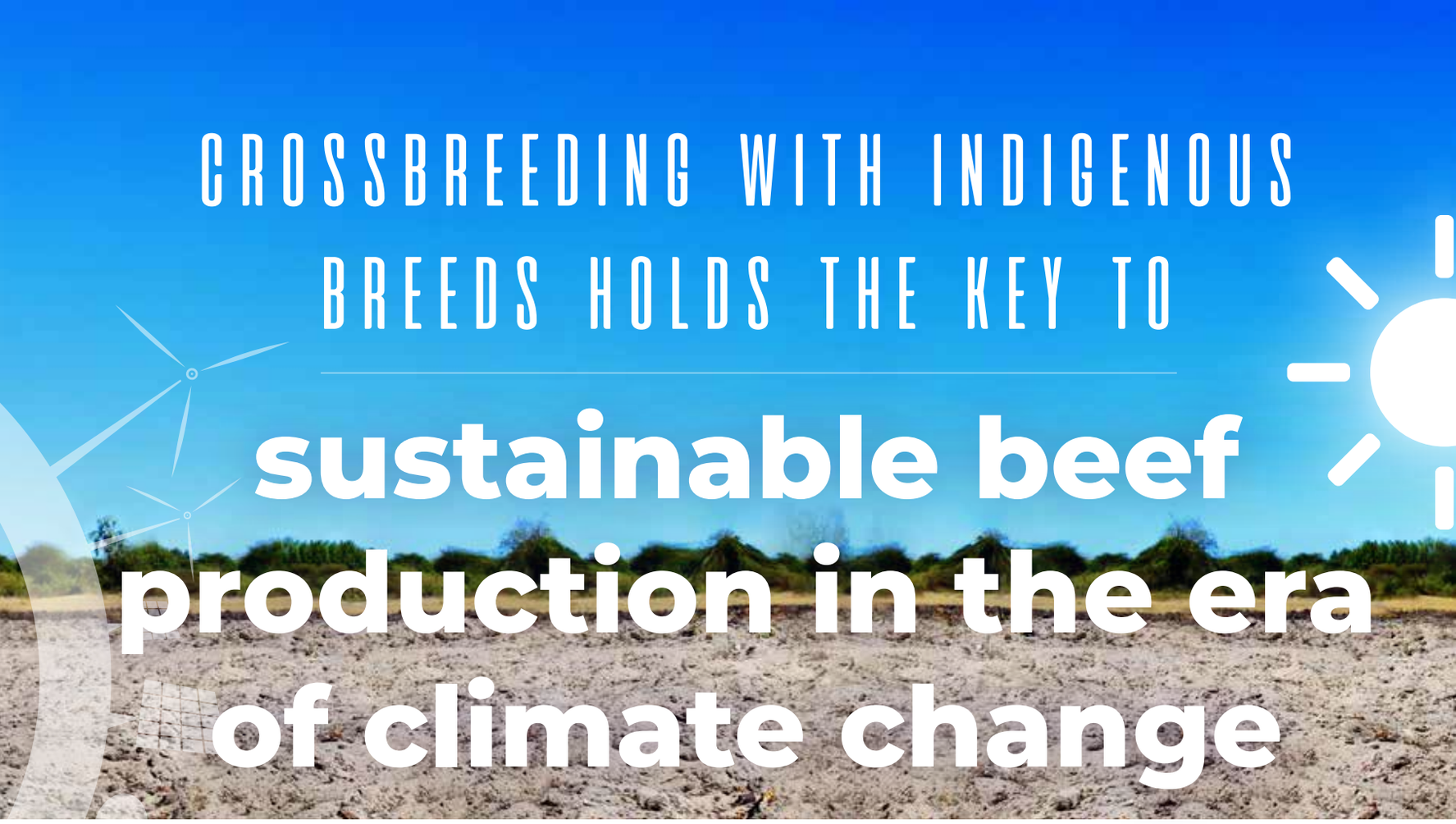
BACKGROUND

The type of production strategy to be followed in southern Africa will depend primarily on the environment and level of management. In harsh and undeveloped communal areas or pastoralist systems, pure breeding with indigenous (or adapted) breeds is the only production strategy that can be followed. The level of nutrition in most of these areas is not sufficient for the higher demands of exotic breeds or their crossbreds, but there are situations where the higher demands of crossbreds could be met, and allow them to produce at an acceptable level, especially in the case of beef cattle.



CROSSBREEDING WITH INDIGENOUS BREEDS HOLDS THE KEY TO sustainable beef production in the era of climate change

In the case of beef cattle, the effective use of crossbreeding may have specific advantages. Under commercial farming practices with fair managerial skills, but where conditions are still harsh with relatively low levels of nutrition, terminal crossbreeding with small indigenous cows may succeed in improving the output of beef cattle farming. This is going to become more important due to global warming. The advantage follows since any system with large feeders from small breeding cows must be more efficient than one with feeders and breeders of equivalent size, simply because small cows eat less than large cows.

This higher efficiency arises from a potential increase in weaning weight of up to 46% per cow exposed to mating, while the feed energy requirement only increases by 1%. In addition, and of particular importance for local food security, is the use of locally adapted, low-input maternal breeds, such as the Nguni, and the improvement of the production potential of the progeny by using terminal sire breeds. However, such a system will only be viable if the natural environment can support the higher production, and the managerial demands can be met.

Examples from previous crossbreeding projects at the Vaalharts Research Station indicate that cow productivity (defined as kilogram calf weaned per Large Stock Unit mated, which can also be converted to kg calf produced per ha) increased by 15% with Simmentaler x Afrikaner crosses. When a F1 Afrikaner cow was used, the cow productivity increased by up to 49%. In the case of the Charolais x Afrikaner cross, there was a 27% increase in value of meat and 27% less feed was consumed from weaning to slaughter.

Such systems of terminal crossbreeding may be valuable for the commercialisation of identified individuals within the emerging beef sector and commercial farmers. In this case, the system will rely heavily on adapted or indigenous breeds as dam lines. Recent research in South Africa indicates that a criss-

cross mating system with indigenous breeds (Afrikaner, Bonsmara, Nguni) may be viable within the emerging and communal beef sectors. If such a system has advantages for these farmers, resource farms will have to be established to supply purebred breeding bulls for a criss-cross mating system.

PREVIOUS ANGUS X NGUNI PROJECT AT VAALHARTS

The research was carried out at the Vaalharts Research Station of the Northern Cape Department of Agricultural, Land Reform and Rural Development near Jan Kempdorp over a period of four years, with calves weaned from 2009 until 2012. The Nguni cows used in this trial were purchased at sales under the auspices of the Nguni Cattle Breeders' Society.

The number of observations, mean plus standard deviations (Std dev), minimum and maximum values for 205-day weight, cow weight at weaning of the calf and kilogram calf weaned per Large Stock Unit is presented in Table 1.

TABLE 1

Trait / genotype	N	Mean (Std dev)	Min.	Max.
205-day weight				
Nguni	167	145 ± 35.4	56	230
Angus x Nguni	81	77 ± 36.8	105	303
Cow weight				
Nguni	167	365 ± 65.4	222	566
Angus x Nguni	81	355 ± 53.2	250	492
Kg calf / LSU				
Nguni	167	116 ± 29.5	45	181
Angus x Nguni	81	142 ± 30.1	84	249

TABLE 1: Summary statistics of 205-day weight, cow weight at weaning of the calf and kilogram calf weaned per Large Stock Unit LSU for the pure Nguni and Angus x Nguni calves

The 205-day weaning weight of the Angus x Nguni calves were 177 kg and that of the pure Nguni calves 145 kg. Although the adjusted weaning weight of the Angus x Nguni calves was 32 kg higher than that of pure Nguni calves, the difference was not significant. 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. If cow efficiency is expressed as kilogram calf weaned per Large Stock Unit, the cow efficiency of cows with Angus x Nguni calves improved by 22%. The results showed that crossbreeding can increase the weaning weights of crossbred calves from Nguni cows.

Although all the cows were purchased at sales under the auspices of the Nguni Cattle Breeders' Society, there was a large difference in the genetic merit between the cows (Estimated Breeding Values). This big variation may partly explain the variation in actual weaning weights and cow weights. Furthermore, the herd of origin of the cow had a significant effect on the weaning weights of her calves, which may be due to differences in genetic merit between herds.

CURRENT CROSSBREEDING PROJECT AT VAALHARTS

The current crossbreeding project at Vaalharts started in 2014 and the first calves were weaned in 2015. The results of the first three years are reported here. In this project Afrikaner, Bonsmara and Nguni cows were mated to Afrikaner, Bonsmara, Nguni, Angus and

Simmentaler bulls in all possible combinations. Fifteen different genotypes of calves were produced (12 crossbred and 3 purebreds).

TABLE 2

Breed	Birth weight, kg	ADG, g/d	Weaning age, days	Actual weaning weight	205-day weight, kg	Cow weight, kg
Bonsmara	37.3 ± 0.7	884 ± 62	198 ± 11	212 ± 13	218 ± 13	454 ± 10
Nguni	32.9 ± 0.6	742 ± 31	210 ± 6	189 ± 6	185 ± 6	365 ± 7
Afrikaner	36.0 ± 0.9	763 ± 31	202 ± 8	194 ± 9	192 ± 9	446 ± 10

The means of Bonsmara, Nguni, and Afrikaner calves for pre-weaning traits, and for weight at weaning are presented in Table 2. The calves from Nguni dams were older at weaning than those from Bonsmara dams (210 days versus 198 days). The reason for this is not clear, but it is speculated that the gestation length of the Nguni cow is shorter than that of the Bonsmara cow, or that Nguni cows come on heat earlier in the breeding season.

TABLE 2: The means of Bonsmara, Nguni, and Afrikaner calves for preweaning traits, and weight at weaning

The Nguni cows were much lighter than the cows from the other breeds. Cow efficiency was thus investigated, where it was defined as kg calf weaned per Large Stock Unit (LSU). An LSU is defined as the equivalent of an ox requiring 75 MJ of metabolizable energy to maintain a live weight of 450kg and gain 500g per day on a grass pasture that has a mean digestible energy of 55%. The cow efficiency is presented in Table 3.

TABLE 3: Estimation of cow efficiency for Afrikaner, Bonsmara, Nguni, Angus and Simmental sired calves from the Afrikaner, Bonsmara and Nguni dams of a constant age

From Table 3 it can be seen that the Nguni cows are more efficient than the other two breeds. The two most efficient crosses are Afrikaner and Angus bulls mated to Nguni cows. The fact that the Afrikaner x Nguni seems to be very efficient, may be linked to climate and the effect of the weather was thus investigated and is presented in Table 4. The 2015/16 summer was the warmest and driest year ever recorded in South Africa. In the preceding 9 summers there were on average 1.9 heatwaves per summer with 6.5 heatwave days. In the 2015/16 summer, there were 12 heatwaves totalling 71 heatwave days.

The Sanga sired calves (Afrikaner, Bonsmara, and Nguni) and Angus/Simmentaler sired calves had the same 205-day corrected weaning weight (171 kg) in 2015/16. In contrast, the 2016/17 summer season was cooler and wetter, resulting in the weaning weight of the Angus/Simmentaler sired calves being 27 kg heavier than the Sanga sired calves (210 kg versus 183 kg). From Table 4 it seems that the Afrikaner and Nguni sired calves were less affected by the severe weather of the summer of 2015/2016, which was the hottest and driest year recorded in South Africa, relative to calves from the other breeds of sire. This may explain the good performance of the Afrikaner x Nguni.

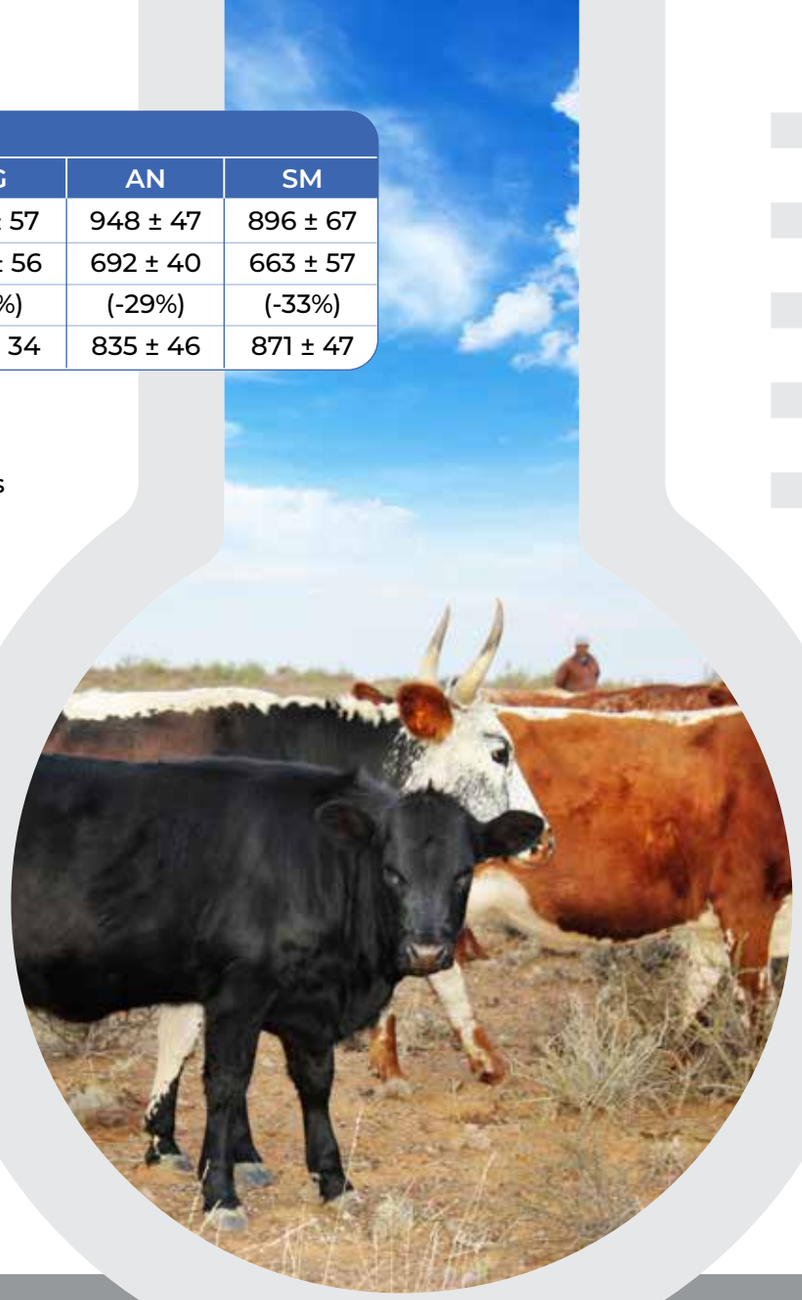
Dam Breed	Average (kg calf/LSU)	AF	BN	Sire Breed NG	AN	SM
AF	154	141 ± 6 kg/LSU	160 ± 7 kg/LSU	**155 ± 7 kg/LSU**	159 ± 6 kg/LSU	153 ± 6 kg/LSU
BN	153	148 ± 8 kg/LSU	153 ± 8 kg/LSU	**155 ± 7 kg/LSU**	159 ± 6 kg/LSU	152 ± 8 kg/LSU
NG	**163**	**169 ± 5 kg/LSU**	**157 ± 5 kg/LSU**	**158 ± 5 kg/LSU**	**168 ± 5 kg/LSU**	**161 ± 5 kg/LSU**

AF: Afrikaner, BN: Bonsmara, NG: Nguni, AN: Angus, SM: Simmentaler

Year	AF	Breed of sire			
		BN	NG	AN	SM
2014/2015	773 ± 59	1128 ± 56	855 ± 57	948 ± 47	896 ± 67
2015/2016	711 ± 35	643 ± 40	684 ± 56	692 ± 40	663 ± 57
Difference	(-5%)	(-46%)	(-17%)	(-29%)	(-33%)
2016/2017	714 ± 32	748 ± 34	743 ± 34	835 ± 46	871 ± 47

TABLE 4: Estimates of year effects on average daily gain (g/d) from birth to weaning of calves sired by Afrikaner (AF), Bonsmara (BN), Nguni (NG), Angus (AN) and Simmentaler (SM) bulls with the percentage reduction in performance during the summer of 2015/2016 relative to the average of the preceding summer shown in parentheses.

Post-weaning growth (average daily gain) of weaner bull calves were recorded under feedlot conditions during the 2015/16 summer season. The average daily gain of the Angus and Simmentaler types decreased by 17%, whereas that of the Sanga types decreased by 9%, as a result of the heatwaves experienced.



DISCUSSION

Inclinations may deem crossbreeding in beef cattle to become more popular and achieve more recognition amongst the developing countries, especially in the Southern Hemisphere, where climate change is more adverse. At present, a joint collaboration between the ARC-Animal Production, the Northern Cape Department of Agriculture, Land Reform and Rural Development, and the University of the Free State exists. More research will become available regarding the performance of these different breeds and their crossbred progeny, especially under adverse environmental conditions.

The effect of climate (temperature and humidity) on the performance and the behaviour of different crossbred genotypes should also be studied. The ARC-Animal Production has installed a GrowSafe® feed and water intake system from Canada, that allows real-time recording of body weight, feed and water intake, which will allow statistical quantification of the effect of climatic factors on the performance of different animals and genotypes.