An overview of crossbreeding in beef cattle with reference to the Southern African situation

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Abstract

An increasing number of commercial beef producers direct themselves to crossbreeding systems in which crossbred animals have higher merit in reproduction, growth and end product. It has been claimed that heterosis in a sound crossbreeding program could increase the productivity in the beef cow herd by as much as 26% over a comparable straight breeding program. The availability of diverse beef cattle breed resources with large adaptive and production differences allow the breed types to be matched to different environments, management levels and markets. By utilizing breed differences the opportunity for high productivity and profitability can be maximized. The improved indigenous (Sanga) and indicus (Zebu) derived beef breed genotypes will probably have the highest potential to produce red meat sustainably in Southern Africa. It is believed that crossbreeding will gain more importance in the region as climate changes stands to affect the African continent substantially. The region is in short supply of across-breed breeding values and the utilization of crossbreeding in beef production is not properly planned and largely ineffective.

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Introduction

The beef cattle industry has moved towards national and international beef cattle evaluation with multiple pure breeds and cross-bred animals (Garrick, 2006; Pollak, 2006), whilst breeding objectives have moved towards economical orientation (Ritchie *et al*., 1996). Breeding programmes mainly focus on weighing beef cattle traits with their economic value and profitability (Barwick & Yeates, 1998; Graham *et al*., 1998) in selection indices with today's sophisticated genetic prediction systems (Green, 2009) in a genome-enabled era. Prediction models use existing breeding values to model total herd productivity. For crossbreeding, information on breed composition and heterosis are incorporated into multi-breed genetic evaluation models to predict phenotypic performance (Cardoso & Tempelman, 2004; Pollak, 2006). This comes as more commercial cattle producers direct themselves to crossbreeding systems in which crossbred animals have higher merit in reproduction, growth and end product (Khombe, 2002; Scholtz *et al*., 2008). Southern African technology development endeavors to follow suit. Currently, a country such as South Africa has multi-trait systems for intra-breed evaluation to evaluate the genetic potential of its many purebred and composite cattle breeds. However, a multi-national (multi-breed) evaluation system will have to be developed which will allow the estimation of heterosis and the development of breed adjustment tables. Experimental results can enhance the development of the multi-breed database. Breeding objectives could then include crossbred animals in order to create an equitable and enabling environment that allows producers to be highly competitive and market responsive.

Currently southern African region is richly endowed with many indigenous beef cattle breeds such as the Afrikaner, Tuli, Tswane, Barotse, Boran, Mashona, Nkone, Angoni and Nguni/Landim (Mozambique), but is threatened by increased uncontrolled crossbreeding with exotic genotypes (Khombe, 2002). For example, in the case of the emerging sector of South Africa non-descript/crossbred cattle make up 66.4% of herds (Scholtz *et al*., 2008).

Discussion

The purpose of crossbreeding in beef cattle is partly to combine breed differences and partly to make use of heterosis to improve production. It has been claimed that heterosis in a sound crossbreeding program could increase productivity in the beef cow herd by as much as 26% over a comparable straight breeding program (Cundiff *et al*., 1974; Koger *et al*., 1975; Gregory & Cundiff, 1980; Lamb *et al*., 1992; MacNeil & Newman, 1991; MacNeil, 2005; MacNeil & Matjuda, 2007).

Many breed utilization strategies suggest that indigenous/tropically adapted breeds (Sanga and Zebu cattle), their derived genotypes and crosses of these breeds with exotic breeds, have the greatest potential for sustainable beef production in the dry areas of Southern Africa (Tawonezvi, 1984, 1993; Schoeman, 1989; Moyo, 1990; Moyo *et al*., 1996; Mpofu, 1996, 2002; Moyo & Mpofu, 1999; Scholtz & Theunissen, 2010). Moyo & Mpofu (2004) summarized studies in the region showing that various indigenous breeds, which are adapted to harsh environments, are more productive compared to exotic types, mainly due to their high survival and calving rates. The Afrikaner breed (Hetzel 1988; Lepen, 1996; Moyo *et al*., 1996; Theunissen, 2012) and the Brahman breed (Scholtz, 1988; Vilakati, 1990) have showed poor fertility in comparison with other breeds, but the latter breed showed high fertility in a study by Moyo *et al*. (1996). However, for the production of slaughter cattle, indigenous/tropically adapted maternal breeds should be crossbred with exotic (paternal) breeds (breeds strong in paternal traits such as rate and efficiency of gain, meat quality and carcass yield) through the use of terminal sires to exploit the crossbreeding effects (Dickerson, 1973; Scholtz, 1988; Scholtz *et al*., 1990; Lepen, 1996; Mpofu, 2002; Scholtz & Theunissen, 2010). Crossbred progeny are mostly heavier at weaning than their purebred cohorts. There is also evidence that feedlot performance and carcass traits are enhanced when *Bos taurus* is crossed with indigenous and tropical adapted cattle breeds (Moyo, 1990; De Bruyn, 1991; Theunissen, 2012).

The type of production strategy to be followed will depend primarily on the environment and management level. In some harsh and undeveloped areas or pastoralist systems in the region maternal breeds with a high genetic potential for milk production can go into a negative energy balance that is sufficient to compromise reproduction (Short & Adams, 1988). Pure breeding with Sanga or Zebu breeds, or crosses between the two breed types, may probably have the highest potential for producing red meat sustainably. However, there are scenarios where the higher demands of exotic breeds or their crossbreds could be met and allow them to produce at an acceptable level (Lepen 1996; Moyo *et al*., 1996; Skrypzeck *et al*., 2000; Theunissen, 2012).

The greatest benefit gained through crossbreeding is by using crossbred cows (Skrypzeck *et al*., 2000; Dadi *et al*., 2002) or composite/crossbred bulls of high genetic merit (Theunissen, 2012). It is also believed that crossbreeding will gain importance in many developing counties of southern Africa, as climatic changes stand to affect the African continent more substantially than the other continents (Anitei, 2006; Appel, 2006; Romanini *et al*., 2008). Small herd size, in particular, puts extra limitations on the suitability of particular mating systems to obtain three-breed genotypes in which composite/crossbred bulls offer an alternative to conventional crossbreeding. While the supply of performance evaluated F1 bulls from selected and proven purebred parents with breeding values are available in the USA, they are limited or non-existent in the southern African region.

Conclusions

It is therefore hoped that this paper will stimulate and draw the attention to the advantages of crossbreeding and that it will to give some direction in respect of crossbreeding in the southern African context. Currently southern African countries are in short supply of across-breed breeding values and the utilization of crossbreeding in beef production is not properly planned and largely ineffective. Contrary to developments elsewhere, and particularly in the USA and Australia, there are few crossbreeding studies currently active in the southern African region which involves several genotypes and/or backcrossing. It is therefore essential that crossbreeding studies be conducted and that previous studies be re-analyzed properly. This holds promise for reducing unit cost of beef production (thereby reducing the carbon footprint), and for increased profitability and sustainability of beef farmers.

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