Research Application Summary

Genetic and phenotypic evaluation of Zimbabwean Jersey cattle towards the development of a selection index

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Abstract

A multitrait selection index for Zimbabwean Jersey cattle was constructed using 10 986 records (305-day) from 25 herds with calving period from 1996 to 2008 using data from the Livestock Identification Trust. Genetic and phenotypic parameters were estimated using an Animal Model in ASREML. Genetic trends were also computed. The index was: I = 0.0004MY + 0.0109FY + 0.0313PY + 1.0004F% + 2.4491P% - 0.1905SCC; with an accuracy of 91.10 % and the correlation between the index and the aggregate breeding objective was 0.954. Incorporation of conformation and other functional traits is important but the current index can be used to improve Zimbabwe's Jersey herd.

Key words: Dairy herd improvement, dairy production, genetic parameters, heritability, milk composition

Résumé

Un index à plusieurs traits de sélection pour les bétails Jersey de Zimbabwe a été construit en utilisant 10 986 dossiers (305 jours) à partir de 25 troupeaux avec une période de vêlage de 1996 à 2008 en utilisant des données provenant de « Livestock Indentification Trust ». Les paramètres génétiques et phénotypiques ont été estimés en utilisant un modèle animal de ASREML. Les tendances génétiques ont également été calculées. L'indice a été: I =% 0.0004MY + 0.0109FY + + 0.0313PY 1.0004F% + 2.4491P - 0.1905SCC; avec une précision de 91,10% et la corrélation entre l'indice et l'objectif global de reproduction s'est élevée à 0,954. L'incorporation de configuration et d'autres caractères fonctionnels sont importants, mais l'index actuel peut être utilisé pour améliorer les troupeaux du Jersey au Zimbabwe.

Mots clés: Amélioration des troupeaux laitiers, la production laitière, les paramètres génétiques, héritabilité, la composition du lait

Background

Zimbabwe is divided into five agro-ecological regions according to climate, altitude and agriculture. It is characterised by a sub-tropical savanna type of climate. Most of the conditions in these regions are conducive for cultivated pastures that are vital for dairy cattle farming. As a result of these, there is a well developed dairy industry, which is composed of the smallholder and the commercial sectors.

The Jersey is one of the dairy breeds found in Zimbabwe. It is the third most important breed of dairy after Holstein and Holstein-Friesian. The breed is popular for the high butterfat content of its milk and the lower maintenance costs incurred due to its lower bodyweight. However, there is paucity of information on production traits of this breed. Most research has been done on Holstein-Friesian breed's production traits.

Therefore, the study focused on the genetic and phenotypic evaluation of milk, fat and protein yields for Jersey cattle in Zimbabwe. The information generated led to the development of a multitrait selection index and will also be useful in the development of sound and effective breed improvement programmes.

Literature Summary

Various environmental factors have been reported to cause variation in individual cow milk yield. These include herd, age at calving, lactation number, stage of lactation, year and season of calving (Guler *et al*., 2009). As a result milk production varies according to the cow's genetic constitution and host environmental effects.

Genetic parameters are a very useful tool for shaping the future of breed improvement (Panteliæ *et al.,* 2008). To understand how to achieve future goals, genetic information (heritabilities, genetic correlations and genetic trends) from the past should be determined (CDN, 2010).

The use of selection index which includes several traits increases the selection index efficiency. According to Van der Westhuizen and Van der Westhuizen (2009), every country needs its own selection index because the success of selection index from different countries cannot be compared, even though breeding goals may be very similar.

Study Description

A total of 10 986 standard 305-day milk production records were obtained from Zimbabwe Livestock Identification Trust.

There were from 25 herds, with cows calving in the period 1996 to 2008. The records were edited using Statistical Analysis of Systems version 9.1.3 and Pedigree Viewer version 6.4b. After the data editing 6 725 records in 21 herds remained.

The General Linear Model of Henderson Type III sum of squares in Statistical Analysis Systems version 9.1.3 was used to determine the environmental factors with a fixed effects model containing herd-year-season, calving interval, days dry and both the linear and quadratic effects of age at calving fitted as covariates.

The genetic and phenotypic parameters and genetic trends were estimated using ASReml program and the animal model described above with random effects of animal and residual.

A selection index was developed using genetic and phenotypic parameters estimated. The breeding objective of the index was defined in terms of production and functional traits. The production component of the index included milk yield (MY), butterfat yield (FY), protein yield (PY), butterfat percent (F%) and protein percent (P%), while the functional component included the somatic cell count (SCC).

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Herd-year-season, calving interval, days dry, linear and quadratic effects of age at calving significantly ($P<0.0001$) affected MY, FY and PY. The HYS contributed 36% to the total variation in the production traits. MY, FY and PY increased with an increase in calving interval. The average calving interval for cows was 383 days. The optimum dry period for the production trait was 60 -75 days dry. The relationship between the production traits and age at calving is both linear and quadratic, implying that MY, FY and PY increase with the age of the animal.

Variance components and genetic parameter estimates are presented in Table1.The heritability estimates obtained in this study are comparable to those reported elsewhere. Therefore, there is adequate additive variance for an effective selection program for MY and composition of Jerseys in Zimbabwe.

The rates of genetic improvement for MY, FY and PY were positive (Table 1). This shows that these traits improved in recent decades, but with fluctuation between years. However, F%, P% and $Log_{10}SCC$ have been declining (Table 1). This is

Table 1. Variance components, genetic parameter estimates and genetic trends and their standard errors (±SE) for production and Log_{10}SCC traits.

Trait	σ^2_a	σ^2_{pe}	σ^2_e	σ^2_p	h^2	c^2	Genetic trend
Milk yield (kg)	86 263	25 532	173 158	284 953	0.30 (0.10)	0.09 (0.10)	1.4200 (0.72)
Butterfat yield (kg)	428	78	822	1 328	0.32 (0.10)	0.06 (0.10)	0.1600 (0.01)
Protein yield (kg)	201	36	371	608	0.33 (0.10)	0.06 (0.10)	0.1600 (0.03)
%Butterfat	0.0587	0.00951	0.0710	0.1392	0.42 (0.11)	0.07 (0.11)	-0.0210 (0.01)
%Protein	0.0105	0.00161	0.0117	0.0238	0.44 (0.12)	0.07 (0.12)	-0.0150 (0.01)
Log_{10}SCC	0.0252	0.02241	0.2500	0.2976	0.08 (0.07)	0.08 (0.07)	-0.0002 (0.00)

Key: σ^2_a = additive genetic variance; σ^2_{pe} = permanent environmental variance; σ^2_e = residual variance; σ^2_p = total phenotypic variance; h^2 = heritability; c^2 = permanent environment.

because of the negative genetic correlation between milk composition and MY.

A selection index developed was: I_T = 0.0004MY + 0.0109FY + 0.0313PY + 1.0004F% + 2.4491P% - 0.1905SCC. These means that animals can then be ranked according to these index values and selection based on these rankings. The accuracy of the index was 91.1% and the correlation between this index and the aggregate breeding objective was 0.954.

Recommendation

It is recommended that Zimbabwe should start to use the selection index for Jersey cattle that has been developed in order to increase the accuracy and precision of national sire and cow evaluation. Further studies are needed to develop a selection index that would incorporate some conformation traits if more genetic progress is to be made. Further studies should also be made to develop selection indexes for other breeds.

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