

## A comparison of the performance of Holstein and Friesian bulls in the South African Progeny Testing Scheme

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The performance of 92 Holstein-Friesian bulls, which were accepted for progeny testing under the South African National Dairy Animal Performance and Progeny Testing Scheme during 1982, 1983 and 1984, was compared. Bulls which were locally bred for more than one generation were not entered under the Scheme. Only 36% of bulls with local sires were accepted and the majority of Dutch Friesian type bulls were rejected as potential AI bulls. The RBVs (relative breeding values) for milk, butterfat and protein yields of the test bulls were used in the analysis. The factors that were included were GROUP (in which the bull was tested), IMP (the proportion of imported genes), %HOLSTEIN and BREEDER. The factor %HOLSTEIN was found to be significantly related to RBV.milk, RBV.butterfat and RBV.protein ( $P < 0.05$ ). IMP ( $P < 0.05$ ) was also found to be significantly related to RBV.butterfat. The Holstein type bulls were more successful than the Dutch Friesian type bulls, as an increasing number of Holstein genes leads to higher breeding values for milk, protein and butterfat yields. Bulls with a high percentage Holstein genes are thus more readily accepted as AI bulls. The Holstein will probably gain in popularity and replace the Dutch Friesian type in South Africa.

'n Vergelyking is getref tussen die prestasies van 92 Holstein-Friestipe bulle wat gedurende 1982, 1983 en 1984 aanvaar is vir prestasietoetsing onder die Suid-Afrikaanse Nasionale Melkbeesprestasie en Nageslagtoetsingskema. Bulle wat plaaslik vir meer as een generasie geteel is, is nie getoets nie en slegs 36% van die bulle met plaaslike vaars is aanvaar as potensiële KI-bulle. Min Hollandse Friestipe bulle is aanvaar as potensiële KI-bulle. Die RTWs (relatiewe teelwaardes) vir melk-, bottervet- en proteïenproduksie is in die ontledings gebruik. Die volgende faktore is ingesluit: GROEP (waarin die bul getoets is), IMP (toegeken op grond van die proporsie ingevoerde gene), %HOLSTEIN en TELER. Die faktor %HOLSTEIN het 'n betekenisvolle verwantskap getoon met RTW.melk, RTW.bottervet en RTW.proteïen ( $P < 0.05$ ). IMP ( $P < 0.05$ ) het ook 'n betekenisvolle verwantskap getoon met RTW.bottervet. Die Holsteintipe bulle was meer suksesvol as Hollandse Friestipe bulle aangesien 'n toenemende aantal Holsteingene tot hoër relatiewe teelwaardes vir melk-, proteïen- en bottervetproduksie lei. Bulle met 'n hoër persentasie Holsteingene staan gevolglik 'n beter kans om aanvaar te word as KI-bulle. Die Holstein sal dus waarskynlik verder in gewildheid toeneem en uiteindelik die Hollandse Friestipe in Suid-Afrika grootliks verplaas.

**Keywords:** Dairy cattle, Holstein-Friesian, relative breeding values.

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### Introduction

As the influence of the North American Holstein is spreading rapidly throughout the world, the Friesian populations of Europe and many other countries have essentially been replaced by the Holstein (Maijala *et al.*, 1984; Hansen *et al.*, 1990). In Europe, AI stations tend to use mainly Holstein bulls, because of the better performance by Holstein sires compared with their local sires in bull testing programmes (Schwarz, 1974).

The South African Friesland Association was formed in 1907, and the breed was dominated by imported Dutch Friesian bulls until the 1970s (Cilliers, 1964; 1978; Bekker, 1988). Since then, the Holstein has gained in popularity and, during 1988, 98.1% of the Holstein-Friesian semen imported was Holstein or part-Holstein compared to only 47.6% in 1979 (Theron *et al.*, 1992). Semen from mainly two bloodlines, viz. Ivanhoe and Chief, was imported between 1979 and 1989 (Theron *et al.*, 1992). About 85% of all registered Holstein-Friesian calves in South Africa result from AI and 14.2% result from AI with imported semen (Du Preez, 1990). A

significantly better performance by Holstein type bulls in the South African Progeny Testing Scheme would lead to a majority of Holstein type bulls becoming local AI sires. Imported Holstein semen could thus have a widespread influence on the local Holstein-Friesian breed.

In this study the performance by (i) locally bred vs. imported, and (ii) Holstein type vs. the Dutch Friesland type bulls in the South African National Dairy Animal Performance and Progeny Testing Scheme was compared. Since semen imports showed that certain Holstein lines were more popular among importers (Theron *et al.*, 1992), the performance by bulls related to these lines was also included in this investigation.

### Materials and Methods

The performance of Holstein-Friesian bulls, which were accepted for progeny testing during 1982, 1983 and 1984 and which had completed the test, was compared. A young bull was selected for participation in the Progeny Testing Scheme according to his pedigree and the performance of his relatives,

e.g. his dam and sisters. Only bulls with a high expected genetic merit were thus selected for participation in the Scheme.

The RBVs (relative breeding values) for milk, butterfat and protein yields of 92 test bulls, all with a reliability of more than 50%, were available. The RBV of a bull is an index of his expected progeny difference value calculated in relation to the first lactation averages of the herds in which his daughters were recorded. The expected progeny difference is the weighted difference between the average of a bull's daughters and the average in the population.

The following effects were used in the analysis:

**GROUP:** The bulls were tested in eight groups of 10–12 bulls each during the three-year period of the investigation.

**IMP:** A code was assigned to each bull according to the number of imported male ancestors in the previous two generations, irrespective of country of origin, thus comparing imported and locally bred stock. The proportion of imported genes was also calculated. The codes awarded were as follows:

IMP 1: Locally bred bull for at least two generations.

IMP 2: Bull's paternal grandsire imported – 25% imported genes.

IMP 3: Bull's maternal grandsire imported – 25% imported genes.

IMP 4: Paternal and maternal grandsires imported – 50% imported genes.

IMP 5: Sire imported – 50% imported genes.

IMP 6: Sire and maternal grandsire imported – 75% imported genes.

IMP 7: Imported bull or embryo – 100% imported genes.

In the final analysis 0, 3, 1, 7, 27, 54 and 0 bulls were available for IMP 1 to 7 respectively. The one bull which was available for IMP 3 was excluded from further analyses.

**%HOLSTEIN:** The number of Holstein sires or grandsires in the bull's pedigree was used to estimate the percentage of Holstein genes. There were 15, 8, 36 and 32 bulls with 0%, 25%, 50% and 75% Holstein genes respectively.

**BREEDER:** Twenty-seven breeders contributed between one and 12 bulls each. Ten breeders who contributed only one bull each were included in the analyses.

Model 1 of Harvey's LSMLMW program (Harvey, 1988) was used to analyse the RBVs, and all effects were considered fixed. The following model was used:

$$Y_{ijkl} = \mu + a_i + b_j + c_k + d_l + e_{ijkl}$$

where

$Y_{ijkl}$  = the observed value of a given dependent variable,

$\mu$  = the overall mean,

$a_i$  = the fixed effect of the  $i^{\text{th}}$  GROUP,

$b_j$  = the fixed effect of the  $j^{\text{th}}$  IMP,

$c_k$  = the fixed effect of the  $k^{\text{th}}$  %HOLSTEIN,

$d_l$  = the fixed effect of the  $l^{\text{th}}$  BREEDER, and

$e_{ijkl}$  = the random error.

All first-order interactions were included in the initial model. All bulls were used in the analysis, whether or not they had passed the test as proven sires.

## Results

None of the bulls which entered the progeny tests during 1982–1984 were locally bred for more than one generation.

Eighty-one bulls (88%) had imported sires, of which 54 (57%) also had imported maternal grandsires. Only four of the 11 bulls (36%) with local sires were accepted as potential AI bulls.

Bulls were grouped according to the imported sires and/or grandsires in their pedigrees as Friesian (European origin), Holstein (North American origin) or Holstein–Friesian (combination of European and North American origin). Thirty-five per cent of Holstein and Holstein–Friesian bulls and 73% per cent of Friesian bulls were rejected as potential AI bulls. Fifty per cent of the bulls which entered the Progeny Testing Scheme were bulls of the Elevation (28 bulls) or Chief (18 bulls) bloodlines, while 32% of the test bulls accepted were of these two lines. Included in the Chief line were eight bulls of Chief's son, Valiant, of which seven were accepted.

The least square means of RBV.milk, RBV.fat and RBV.protein, as calculated by Harvey's LSMLMW program (Harvey, 1988) for the bulls with different numbers of Holstein genes, are summarized in Table 1. The factor %HOLSTEIN had a significant relationship with RBV.milk, RBV.butterfat and RBV.protein ( $P < 0.05$ ). With an increasing number of Holstein genes, the RBV.milk, RBV.fat and RBV.protein tended to increase.

**Table 1** Least square means ( $\pm$  SE) of the relative breeding values for milk, fat and protein yields and the Rand value indices of Holstein bulls

%Holstein	RBV.milk	RBV.fat	RBV.protein	RVI	No. of bulls
0%	94.4 $\pm$ 3.5	95.5 $\pm$ 2.9	93.0 $\pm$ 3.3	94	15
25%	95.0 $\pm$ 3.9	95.2 $\pm$ 3.2	94.3 $\pm$ 3.6	95	8
50%	102.9 $\pm$ 2.8	99.3 $\pm$ 2.3	100.9 $\pm$ 2.6	100	36
75%	106.5 $\pm$ 3.7	105.6 $\pm$ 3.0	105.7 $\pm$ 3.4	106	32

A Rand Value Index (RVI), calculated as [(60%  $\times$  RBV.protein) + (40%  $\times$  RBV.fat)] according to the Taurus Dairy Bull Directory, is listed in Table 1 and ranked according to the number of Holstein genes. These indices show that an increasing number of Holstein genes increases the monetary value of the product, as South African producers are rewarded according to protein and fat production and not the volume of milk.

In Table 2 the least square means of the relative breeding values of the proportion of imported genes in the previous two generations are listed. IMP also had a significant relationship with RBV.butterfat ( $P < 0.05$ ), but not with RBV.milk or RBV.protein. From these results it appears that bulls with 50% imported genes, irrespective of the country of origin, produce a higher RBV.fat than bulls with 75% imported genes.

Neither the factors GROUP and BREEDER or any first-order interactions had significant relationships with the relative breeding values (RBV).

## Discussion

Bulls which were locally bred for more than one generation were not entered and only 36% of bulls with local sires were accepted as potential AI bulls. This suggests that the South African Holstein–Friesian breed acts merely as a duplicator of

**Table 2** Least square means ( $\pm$  SE) of the relative breeding values of bulls with imported ancestors

IMP	Imported ancestor	% Imported genes	RBV .milk	RBV .fat	RBV .protein	No. of bulls
1	None	0%	—	—	—	0
2	Paternal grandsire	25%	94.8 $\pm$ 6.1	91.7 $\pm$ 5.0	93.0 $\pm$ 5.6	3
3	Maternal grandsire	25%	—	—	—	1
4	Both grandsires	50%	104.0 $\pm$ 4.5	103.7 $\pm$ 3.7	101.1 $\pm$ 4.2	7
5	Sire	50%	101.6 $\pm$ 2.8	103.1 $\pm$ 2.3	101.6 $\pm$ 2.6	27
6	Sire + maternal grandsire	75%	98.4 $\pm$ 1.92	97.2 $\pm$ 1.6	98.2 $\pm$ 1.8	54

overseas genetic material and is not an independent population of the breed. The majority of the Dutch Friesian type bulls which entered the South African Progeny Test during 1982, 1983 and 1984 did not perform well enough to be accepted as potential AI bulls. When compared to the Dutch Friesian type bulls, the Holstein type bulls were significantly more successful and the majority of South African AI bulls are thus presently Holstein or Holstein type.

In the FAO experiment in Poland, in which the genetic values of 10 major Friesian lines were compared, the Holstein cows of the USA ranked first and the strains of the Netherlands ranked among the last for certain lifetime production traits, such as days of productive life, total lifetime production of milk and fat, as well as daily production of milk and fat (kg/d) (Zarnecki *et al.*, 1990). When, however, the total butterfat and protein yield per 100 kg of live weight was calculated for heifers, there was very little difference between heifers from the USA and the Netherlands: 68 and 64 for the F<sub>1</sub> and backcross heifers from the Netherlands vs. 66 and 68 for the USA F<sub>1</sub> and backcross heifers respectively (Jasiorowski *et al.*, 1983; 1988). However, the total butterfat and protein yield per lactation was higher for the USA in F<sub>1</sub> as well as backcross heifers in the Polish experiments (Jasiorowski *et al.*, 1983; 1988).

The literature thus indicates that the use of Holstein types should increase milk production and total butterfat and protein yield. An important question for the dairy industry is to what degree the increase in production is associated with a corresponding increase in feed consumption or a decrease in the efficiency of feed utilization. It is therefore important for the dairy industry to establish the relationship between selection for milk, butterfat and protein production and the correlated change in feed efficiency. It appears that research should be directed towards measuring the feed efficiency of dairy cows rather than production alone.

Oldenbroek (1980) found a significant sire effect for birth weight, percentage of calving difficulties and gestation period when Holstein and Dutch Friesian bulls were used on four subpopulations with 0%, 25%, 50% and 75% Holstein-Friesian genes. The expected change in the South African Holstein-Friesian population from the Dutch Friesian type to a Holstein type may thus initially lead to more calving difficulties and deaths as a result of higher birth weights, as is currently being experienced in two experimental herds at Potchefstroom (Horn-Quass & Cruywagen, 1991) and Irene (Ferreira, 1991, personal communication).

Traditionally, the South African Holstein-Friesian is

closely related to the Dutch Friesian (Cilliers, 1964; 1978), but the Holstein will probably gain in popularity and replace the Dutch Friesian type in South Africa. This shift will be the result of the importation of mostly Holstein semen and also because most of the local AI bulls are of the Holstein type.

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