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# THE INHERITANCE OF BREED CHARACTERISTICS OF THE AFRIKANER CATTLE BREED

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*OPSOMMING:* DIE ERFBAARHEID VAN RASEIENSKAPPE VAN DIE AFRIKANERBEESRAS

'n Studie oor die erfbaarheid en die onderlinge verhouding van die raseienskappe van 383 Afrikanerbeeste is uitgevoer. Die beraming van oorerflikheid van die verskillende raseienskappe was as volg: 0,187 vir kwaliteit; 0,203 vir middelstuk; 0,281 vir voorlyf; 0,440 vir kop en horings; 0,489 vir algemene voorkoms; 0,572 vir agterkwart; 0,576 vir karakter. Die genetiese-, fenotipiese en omgewingskorrelasies tussen die raseienskappe is oor die algemeen statisties betekenisvol.

*SUMMARY:*

The inheritance and interassociation of the breed characteristics of 383 Afrikaner cattle were studied. The estimates of heritabilities of the different breed characteristics were as follows: 0,187 for quality; 0,203 for middle quarters; 0,281 for front quarters; 0,440 for head and horns; 0,489 for general appearance; 0,572 for hind quarters; 0,576 for character. The genetic, phenotypic and environmental correlations between the breed characteristics are generally statistically significant.

Registered breeds of cattle have standards of excellence to compare animals with the ideal of their respective breeds. These standards relate to phenotypically observable characteristics such as colour, horns, type and general conformation.

Considerable attention is directed at breed characteristics by both breeders and breed societies for the purpose of improving the general appearance of their cattle, promoting greater uniformity within breeds and as a measure of breed purity.

Despite the importance attached to breed characteristics by cattle breeders, information on the mode of inheritance of these traits and their genetic, phenotypic and environmental interrelaionships is relative sparse. Such information will be of inestimable value to breeders if a rapid change in type or certain breed characteristics are required. More reliable estimates of genetic parameters for breed characteristics will also enable the breeder to develop more effective selection programmes.

The objective of the present study was to obtain reliable estimates of the heritability of the breed characteristics of the Afrikaner breed as well as the genetic, phenotypic and environmental association between these traits.

## Procedure

Data from 383 animals born between 1935 and 1966 in the registered Afrikaner herd at the Glen Agricultural Research Institute and the progeny of 20 sires were used in the present study.

Due to unequal numbers in the subclasses, the least-squares method of analysis of variance of Harvey (1960) was used.

A computer programme compiled by the Department of Agriculture of the U.S.A., Beltsville, Maryland was adapted to the data. The estimates of heritability were computed according to the standard procedures for half-sib analysis and the genetic, phenotypic and environmental correlations using the subsequent variance and co-variance of the sire and half-sib components.

Cattle eligible for registration were scored annually by an official of the Afrikaner Cattle Breeders Society (A.C.B.S.).

## Results and discussion

The arithmetic mean with standard deviations of the score for standard of excellence of the different breed characteristics of 383 Afrikaner cattle were calculated and are given in Table 1. The average score for character, quality, front and middle quarters is above the seven points out of ten while the general appearance had the lowest score in the herd namely 6,79 points out of ten.

**Table 1**

*The average score with standard deviations of the breed characteristics*

| Characteristic | Score: Points out of 10 | Standard deviation |
|---|---|---|
| General appearance | 6,79 | ± 1,41 |
| Character | 7,40 | ± 1,50 |
| Quality | 7,44 | ± 1,43 |
| Head and horns | 6,81 | ± 1,42 |
| Front quarter | 7,23 | ± 1,48 |
| Middle quarter | 7,47 | ± 1,41 |
| Hind quarter | 6,92 | ± 1,54 |

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**Table 2**

*The effect of sires on breed characteristics*

| Source | Df | F-values | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | General appearance | Character | Quality | Head and horns | Front quarter | Middle quarter | Hind quarter |
| Sire | 19 | 3,553** | 4,080** | 1,898** | 3,261** | 2,383** | 1,980** | 4,060** |
| Error | 363 | | | | | | | |
| Total | 383 | | | | | | | |

**P < 0,01

**Table 3**

*The heritability of and the genetic, phenotypic and environmental correlations between breed characteristics*

| | | General appearance | Character | Quality | Head and horns | Front quarter | Middle quarter | Hind quarter |
|---|---|---|---|---|---|---|---|---|
| General appearance | $h^2$ | 0,489 ±0,195 | | | | | | |
| | rg | | 0,865 ±0,106 | 0,346 ±0,341 | 0,882 ±0,110 | 0,794 ±0,159 | 0,970 ± 0,143 | 0,197 ±0,296 |
| | rp | | 0,674 | 0,456 | 0,553 | 0,587 | 0,491 | 0,461 |
| | re | | 0,247 | 0,545 | 0,270 | 0,483 | 0,291 | 0,764 |
| Character | $h^2$ | | 0,576 ±0,213 | | | | | |
| | rg | | | 0,787 ±0,196 | 0,809 ±0,135 | 0,741 ±0,193 | 0,920 ±0,204 | 0,368 ±0,284 |
| | rp | | | 0,538 | 0,534 | 0,439 | 0,237 | 0,197 |
| | re | | | 0,476 | 0,260 | 0,256 | −0,134 | 0,102 |
| Quality | $h^2$ | | | 0,187 ±0,123 | | | | |
| | rg | | | | 0,616 ±0,272 | 0,172 ±0,420 | 0,656 ±0,346 | 0,168 ±0,370 |
| | rp | | | | 0,458 | 0,376 | 0,286 | 0,310 |
| | re | | | | 0,416 | 0,440 | 0,197 | 0,432 |
| Head and horns | $h^2$ | | | | 0,440 ±0,184 | | | |
| | rg | | | | | 0,701 ±0,184 | 0,930 ±0,228 | 0,359 ±0,281 |
| | rp | | | | | 0,412 | 0,172 | 0,244 |
| | re | | | | | 0,262 | −0,159 | 0,131 |
| Front quarter | $h^2$ | | | | | 0,281 ±0,146 | | |
| | rg | | | | | | 0,708 ±0,272 | 0,446 ±0,287 |
| | rp | | | | | | 0,384 | 0,308 |
| | re | | | | | | 0,283 | 0,233 |
| Middle quarter | $h^2$ | | | | | | 0,203 ±0,127 | |
| | rg | | | | | | | 0,234 ±0,349 |
| | rp | | | | | | | 0,445 |
| | re | | | | | | | 0,626 |
| Hind quarter | $h^2$ | | | | | | | 0,572 ±0,212 |
| | rg | | | | | | | |
| | rp | | | | | | | |
| | re | | | | | | | |

The average effect of sires on the breed characteristics of the cattle was tested by means of an analysis of variance (Table 2). It was clear that sires had a statistically highly significant ($P < 0,01$) effect on all the breed characteristics studied.

Estimates of heritabilities with standard errors of the breed characteristics were calculated as well as the genetic, phenotypic and environmental correlations between these breed characteristics and given in Table 3. The estimates for heritabilities varied mostly from medium to high (0,281 ± 0,146 to 0,576 ± 0,213) with quality being the lowest (0,187 ± 0,123). Together with the significant effect of sires on the breed characteristics and the medium to high estimates of heritability, a rapid progress in the improvement of these breed characteristics can be brought about by the use of sires and dams which are outstanding for the desired characteristics and by strict selection. It is especially applicable in the cases of the general appearance, character, head and horns and hind quarters of which the heritabilities ran from medium to high.

The estimate of heritability for quality is not reliable due to a high standard error. The quality of an animal is determined by many factors and may often lead to variable interpretations and less consistent evaluations. This probably results in not only a lower estimate of heritability but also a less reliable estimate.

The estimates of heritabilities in Table 3 are more or less in line with those reported by Willham (1970) who worked on Aberdeen Angus cattle and gave estimates of heritabilities ranging from 0,27 for shoulder and front ribs to 0,64 for head and breed character and those of Nielsen & Willham (1974) ranging from 0,26 for shoulder and front ribs to 0,62 for rear quarters.

Willham (1970) concluded that the estimates of heritability for parts of the animal upon which fat are deposited, tend to be lower. This may be true in the present study in the case of the front and middle quarters but not for the hind quarters where the estimate of heritability is one of the highest namely 0,572 which is very close to the estimate of 0,62 for hind quarters of Nielsen & Willham (1974). Characteristics such as character, general appearance and head and horns which are supposed not to be influenced by the condition of the animal did, however, have the highest estimates of heritability ranging from 0,440 to 0,576. Frey, Frahm, Whiteman, Tanner & Stephens (1972), found that condition of an animal can influence the score for breed characteristics.

According to Krehbiel, Brown, Gifford & Mabry (1958) the heritability of type in an Aberdeen Angus herd is 0,54 and concluded that for any genetic improvement, efficient selection can be practised for type from its score card.

The genetic correlations between the breed characteristics in Table 3 is statistically significant with generally small standard errors, signifying a general interassociation. The genetic correlations between hind quarters and the rest of the breed characteristics are not reliable due to large standard errors. It can be suggested that in spite of the high phenotypic correlations that exist between the hind quarters and the rest of the breed characteristics, separate selection should be practised for each.

It is evident from the environmental correlations listed in Table 3 that the breed characteristics are not all influenced by the same environmental factors. Of considerable interest is the low or negative association between middle quarter and hind quarter with character and head and horns. While the middle quarter and hind quarter are influenced by the condition of the animal, this is not the case with character or head and horns which remain unaffected by condition. It can be concluded that selection will be more effective for those traits that are not affected by condition of the animal and hence more rapid genetic improvements can be expected in these traits.

## References


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