ESTIMATED BREEDING VALUES AND GENETIC TREND FOR MILK YIELD IN JERSEY COWS

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ABSTRACT

Data on 1260 pedigree, breeding and performance records of 649 Jersey cattle maintained at Livestock Experiment Station Bhunikey (Pattoki) Distt. Kasur during the period 1982-2001 were utilized for the present study. The data were analyzed through Best Linear Unbiased Predictions (BLUP) procedure. The breeding values for milk yield considering all lactations were estimated by using Restricted Maximum Likelihood (REML) procedure fitting Individual Animal Model. The estimated breeding values for milk yield from animal model evaluations ranged from -1034 to 1641 Kg for all the cows. The corresponding values for the standing herd ranged from -613 to 521 Kg. The genetic trend for milk yield depicted a deteriorating trend indicating that breeding strategy proved to be inefficient during the last 20 years. Present herd comprise of 15, 34, 15 and 1 animals of second; third, fourth and fifth generations, respectively. None of the zero (imported) generation or their offsprings is present in the standing herd.

Key words: Animal model, estimated breeding value, genetic trend, Jersey cattle.

INTRODUCTION

Out of 22.4 million heads of cattle population (Anon. 2001), about 72% are of nondescript type. These animals are late maturing and poor milk yielders. To upgrade their production potential, a crossbreeding programme with exotic temperate dairy breeds was initiated in early seventies by importing frozen semen of Jersey and Friesian cattle. To cope with the demand of exotic cattle semen, during 1985 a herd of 100 adult pregnant Jersey cows was imported for the production of genetically superior bulls to ensure the regular and adequate supply of semen for crossbreeding in barani and hilly areas of Punjab and other provinces. These cows have been maintained at the Livestock Experiment Station, Bhunikey (Pattoki), district Kasur. About 4-5 generations of these imported cows have been produced in the sub-tropical environment of central Punjab. However, little information is available on breeding values and genetic trend for milk yield in these cows.

The ultimate goal in animal breeding is to rank breeding animals according to their genetic merit for the desired characters and to use them efficiently in breeding. The genetic evaluation of animals is, therefore, a key issue. The accuracy of identifying genetically superior animals is the basic requirement for genetic improvement through selection. Assessment of the true breeding value of an animal is not possible, instead, estimated breeding values (EBVs) are calculated which are estimates of the true breeding value of an animal. Best Linear Unbiased Predictions (BLUP) procedure using the Individual Animal Model (IAM) has become the world wide standard for the prediction of breeding values of farm animals (Hill and Meyer 1988).

The present investigation was aimed to estimate the breeding values of the animals for comparative ranking and genetic trend for milk yield in a pure-bred herd of Jersey cattle in Pakistan using BLUP procedure. The information so generated will be useful in formulating the future breeding programme and selection of breeding bulls for genetic improvement of our local non-descript cattle through crossbreeding in barani and hilly areas.

MATERIALS AND METHODS

Data on 1260 pedigree, breeding and performance records of a purebred Jersey herd maintained at Livestock Experiment Station Bhunikey (Pattoki) Distt. Kasur during the period 1982-2001 were utilized for the present study. The data on milk yield and lactation length were analyzed to estimate the breeding values and genetic trends in milk yield. Incomplete lactations for any recorded reason or lactations showing any abnormality were not utilized in the analysis. In addition to the basic edits of consistency for dates and animal identities, the following edits were conducted on the data set by eliminating the out layer records having $+3\ \sigma_p$ from the mean values of the corresponding traits (233), lactations having less than 100 days (89) were also removed. All these edits compelled to remove 322 records from the data for analysis. All of the available pedigree information was included in the analysis to minimize the bias due to selection and non-random mating.

Breeding values of animals for milk yield were estimated by Best Linear Unbiased Prediction (BLUP) procedure, as outlined by Henderson (1973). Model used for this purpose was an animal model. The genetic parameters used were the same for genetic evaluations. The fixed effects, year of calving (18 years), season of calving (5 seasons), lactation length (1260 records) and lactation number (No. 10) found significant (reported elsewhere, Javed and Ahmad, 2002) were fitted in the model. In matrix notation, model assumed can be written as under:

$$\mathbf{y} = \mathbf{X}\beta + \mathbf{Z}\mu + \mathbf{e}$$

where,

y is the vector of observations of the animal for a trait (No. of records x 1)

X is the known design matrix relating fixed effects to **y** (No. of records x total No. of fixed effect levels)

β is the vector of unknown fixed effects including the co-variables (total No. fixed effect levels)

Z is the known design matrix relating animals direct additive genetic effects to Y (total No. of records x total No. of animals)

μ is the vector of random animal solutions i. e. breeding values (total No. of animals x 1)

e is the vector of unknown random residual effects (total No. of records x 1)

The random effects were assumed to be normally distributed with mean zero and (Co) variances:

$$V(\mu) = \mathbf{A}\,\sigma^2_A \quad V(e) = \mathbf{I}\,\sigma^2_E \quad \text{and } Cov(\mu, e) = 0$$

$$V(y) = Z\,\mathbf{A}\,Z\,\sigma^2_A + \mathbf{I}\,\sigma^2_E$$

Where,

A is the numerator relationship matrix (total No. of animals x total No. of animals)

I is the identity matrix (total No. of records x total No. of records)

σ^2_A is the estimate of direct additive genetic variance

σ^2_E is the estimate of residual variance.

BLUP equations (Henderson's mixed model equations) for the above mixed model can be represented as follows:

$$\begin{bmatrix} XX & XZ \\ ZX & ZZ+A^{-1}\lambda \end{bmatrix} \begin{bmatrix} b \\ \mu \end{bmatrix} = \begin{bmatrix} Xy \\ Zy \end{bmatrix}$$

Where,

A^{-1} is the inverse of the numerator relationship matrix and

$$\lambda = \sigma^2_E / \sigma^2_A$$

The estimates of σ^2_A and σ^2_E used here were from the same analysis.

The derivative free restricted maximum likelihood (DFREML) Set of Computer programmes (Meyer, 1997) was used which also generated Estimated Breeding Values (EBVs) as a by-product. Breeding values thus estimated were fitted in a fixed effect model (Harvey, 1990) having year of birth as the only fixed effect. The least squares solutions of breeding values were drawn against year of birth to depict the genetic trend. Phenotypic values of milk yield were plotted against the year of birth to determine phenotypic trend.

RESULTS AND DISCUSSION

The estimated breeding values for milk yield from animal model evaluations ranged from -1034 to 1641 Kg for all the cows of Jersey breed maintained under the period of study. The corresponding values for the standing herd ranged from –613 to 521 Kg. The genetic and phenotypic trend for milk yield depicted a deteriorating trend (Figure 1) indicating that breeding strategy proved to be inefficient during the last 20 years. It also indicated that the selection of animals could not be practiced in the proper direction and some sort of random mating had been practiced. The young bulls were selected on the basis of milk yield of their dams with no consideration of their breeding values. In the absence of broader genetic base and smaller herd, much improvement in milk yield could not be expected to occur through selection.

The genetic difference among the individuals is another factor, which determines the rate of genetic improvement that can be accomplished through selection. With low estimate of heritability, the improvement in milk yield is much less through selection as compared to what could be attained by other environmental changes (Javed *et al.*, 2002). The culling in the herd under investigation was not according to the recommended level and mostly animals unfit for breeding, repeaters or sick were disposed off. The culling on the basis of low production was rarely practised. It could be inferred from the present study that in the presence of various factors, the selection remained ineffective to bring about the desired changes over 20 years. It further indicated that roughly similar genetic trend could be expected from random use of breeding animals. The possible reasons for ineffective selection could be unavailability of efficient techniques for the evaluation of animals and incorrect performance recording etc.

Phenotypic reduction in milk yield was noticed (Fig. 1) in the present herd during the period under study. The deterioration in this trait may largely be attributable to environmental factors. The major reason for this deterioration may be the fact that attacks of different diseases like foot and mouth and other hazards occurred during different years. Another factor may be that these animals could not adapt to the subtropical environment. The herd under study was imported from temperate zone and was kept in the subtropical environment of central Punjab where ambient temperature often rises up to 45°C in summer months. Genotype X environment interaction

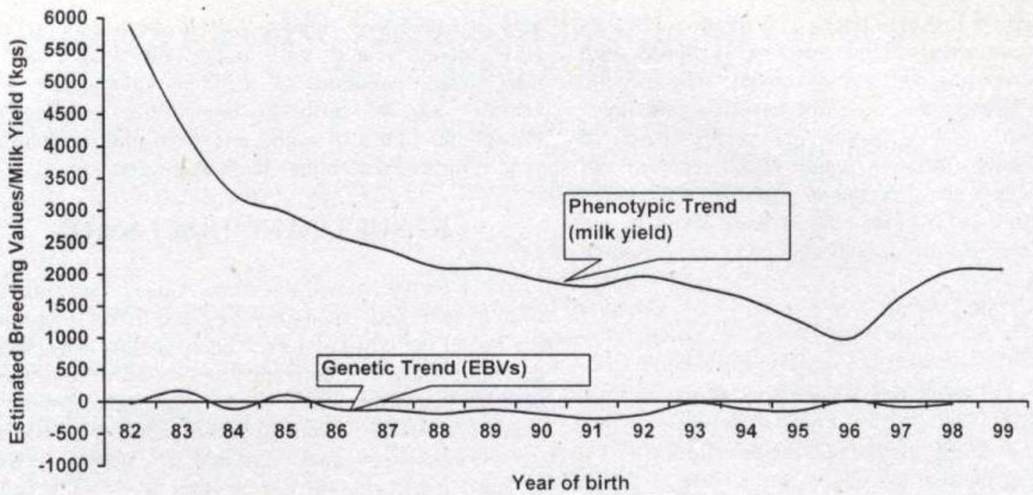

Fig. 1: Genetic and phenotypic trend for milk yield in Jersey cows

is potentially extremely important in cattle breeding in the tropics. The animals of temperate regions maintained in tropical conditions cannot behave similar in both the environments (Javed and Ahmad, 2002). The importation of temperate breeds to tropical environments is often trouble making. Payne and Hodges (1997) have reported that in temperate type nucleus units of cattle established by Governments where improved management was not given, the pure imported cattle were often dying.

Table 1 revealed that average milk yield was maximum (3404 Kg) among the cows of zero generation (imported herd). The condition gradually deteriorated in the subsequent generations indicating that the animals could not adapt to the subtropical environment. However, the animals of the fourth generation performed comparatively better. It might be due to the better managemental practices. Present herd comprise of 15, 34, 15 and 1 animals of second, third, fourth and fifth generations, respectively. None of the zero (imported) generation or their offsprings is present in the standing herd. They have either died or have been auctioned.

Table 1: Average milk yield in cows of different generations

Generation No.	No. of cows	No. of lactations	Average milk yield (kg)
0	99	5	3404
1	143	3	1708
2	118	2	1338
3	44	1	1360
4	9	1	1824

REFERENCES

Anonymous, 2001. Economic survey of Pakistan (2000-2001). Government of Pakistan, Islamabad.

Harvey, W. R., 1990. User's Guide for LSMLMW (PC version) Mixed Model Least Squares and Maximum Likelihood Computer Program, The Ohio State University, Ohio, USA.

Henderson, C. R., 1973. Sire evaluation and genetic trends. In Anim. Breed. Genetics. Am. Soc. Anim. Sci./Am. Dairy Sci., Assoc., Champaign, Illinois.

Hill, W. G. and K. Meyer, 1988. Developments in methods for breeding values and parameter estimation in livestock. In Animal Breeding Oppertunities. BSAP Occasional publication No. 12 pp 81-98.

Javed, K. and I. Ahmad, 2002. Environmental effects on lactation milk yield of Jersey cattle maintained at Livestock Experiment Stasion, Bhunikey (Pattoki) Distt. Kasur. Annual Report (2001-02), Research Institute for Physiology of Animal Reproduction, Bhunikey (Pattoki). Distt. Kasur

Javed, K., M. Abdullah and M. A. Khan, 2002. Estimation of breeding values and genetic trends in Sahiwal cattle in Pakistan. J. Anim. Plant Sci., 12 (1) : 1-6.

Meyer, K., 1997. User's notes of DFREML Set of Computer Programmes Version 3.0.00α.

Payne, W. J. A. and J. Hodges, 1997. Tropical Cattle Breeding, Origines, Breeds and Breeding Policies. Blackwell Science Ltd. London.

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