Phenotypic, Genetic and Environmental Trends of Milk Production Traits in Karan Fries Cattle

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First lactation records of 643 Karan Fries (KF) cattle sired by 77 bulls maintained at the NDRI herd during 1992-2009 were used to estimate phenotypic and genetic trends of first lactation traits viz. 305 days milk yield (FL305MY), total milk yield (FLTMY) and lactation length (FLL). The phenotypic trends were estimated as 20.74 ± 6.08 kg (0.64 percent of herd average), 34.04 ± 8.62 kg (0.90 percent of herd average) and 1.02 ± 0.65 days (0.28 percent of herd average) for FL305MY, FLTMY and FLL respectively. The estimated genetic trends were using BLUP 4.85 ± 5.62 kg (0.15 percent of herd average), 3.44 ± 2.60 kg (0.09 percent of herd average) and 0.58 ± 0.24 days (0.16 percent of herd average) for FL305MY, FLTMY and FLL respectively. The estimated environmental trends were 15.89 ± 8.27 kg, 30.6 ± 9.00 kg and 0.44 ± 0.69 days FL305MY, FLTMY and FLL respectively. It was inferred that there has been genetic improvement in the milk production traits in the desirable direction over the years.

Keywords: Karan Fries cattle, phenotypic trends, Genetic trends, Environmental trends Production traits

INTRODUCTION

A aim of breeding research is to maximize genetic gain per unit of time for various traits (production traits) of economic importance in a breed improvement programme i.e maximizing genetic gain for milk production traits. This calls for evaluation of a breeding programme in terms of assessing change in the genetic constitution as well as environmental (managemental) conditions over time in organized herds. Magnitude and direction of production trends in a herd indicate effectiveness of breeding programme and help in developing or modifying appropriate strategies for bringing further improvement. Therefore, the genetic trends in production traits are important in that they allow for the evaluation of the efficacy of selection and management schemes. Studies have examined genetic trend by regression of estimated breeding values on time (Powell et al., 1985; Lee et al., 1985) or regression of production on time for estimation of phenotypic trends (Burnside and Legate, 1967; Powell and Freeman, 1974). In these studies, genetic gain was considerably less than what is possible under ideal circumstances. In India, Mukherjee (2005) in Frieswal, Raja (2004) in Sahiwal and Singh and Gurnani (2004) in Karan Fries cattle estimated the annual phenotypic, genetic and environment trends in first lactation 305-day milk yield.

The performance trends in Karan Fries cattle were estimated by Singh (1995) utilizing data from NDRI herd during 1982-1992 and thereafter, scanty attempts were made to determine the genetic and environmental trends during the last one and half decade. Accordingly, an attempt was made in the present study to estimate the phenotypic and genetic trends of first lactation traits viz. first lactation traits viz. 305 days milk yield, total milk yield and lactation length during 1992 -2009.

MATERIALS AND METHODS

The records of 643 Karan Fries cows on production traits were collected from history-cum-pedigree sheets maintained at NDRI, Karnal during the period of 18 years from 1992 to 2009. The cows with lactation length less than 100 days and abnormal calvings like still birth, abortion were excluded from the study. The data were classified

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in four seasons viz. Winter (December to March), Summer (April to June), Rainy (July to September) and Autumn (October to November) based on meteorological data of Karnal for the last two decades, six periods viz. period-1 (1992-1994), period-2 (1995-1997), period-3 (1998-2000), period-4 (2001-2003), period-5 (2004-2006), period-6 (2007-2009) keeping in view the use of sires, and six age groups viz. age group-1 (<875 days), group-2 (876-950 days), group-3 (951-1025 days), group-4 (1026-1100 days), group-5 (1101-1175 days) and group-6 (>1176 days) using Sturges rule of choice of class interval.

Phenotypic trends
The phenotypic trends for each trait were estimated by taking regression of performance of the population on the year as b (P.T). (Smith, 1962)

\[ \Delta P = b_{PT} = \sum \frac{P_t}{\sum t^2} \]

where,
\( b_{PT} \) = Linear regression of population performance (P) on time (year) of calving (T),
\( \Sigma P_t \) = Corrected sum of products for trait (P) and time (T),
\( \Sigma t^2 \) = Corrected sum of squares for time taken as deviation from its mean.

Genetic trends
The genetic trends estimated by calculating the transmitting ability (ETA) of sires. The transmitting ability of sire is half of additive genetic value and therefore genetic trends was obtained as 2 X regression of weighted average of sire’s transmitting abilities (WAETA) for each year on year as:

\[ \text{WAETA} = \sum n_{ik} \hat{S}_i / n.k \] (Hintz et al., 1978)

where,
\( n_{ik} \) = Number of daughter of sire i (i= 1, 2, ...,m) in kth year
\( \hat{S}_i \) = Estimated Transmitting ability (ETA) of sire ith
\( n.k \) = Number of daughters of m sires in the kth year

Transmitting ability is half of the breeding value and breeding value calculated by BLUP (best linear unbiased prediction) method as:

\[ Y = Xb + Zu + e \]

where,
\( Y \) is the vector of observations for ith trait (i = 1, 2, 3).
\( b \) is the vector of observations of unknown ith fixed effects (Season, period and age group)
\( U \) is a vector of observations of unknown ith random effect (Sire)
\( X \) and \( Z \) are the incidence matrices pertaining for fixed and random animal effect respectively

In BLUP method, the sire effect was taken as random effect and season, period and age groups effects were taken as fixed effects.

Environmental trends
Environmental trend (\( \Delta E \)) was obtained by subtracting the genetic trend (\( \Delta G \)) from the overall phenotype trend (\( \Delta P \)).

\[ \Delta E = \Delta P - \Delta G \] (Smith, 1962)

The standard error of environmental trend S.E. (\( \Delta E \)) was estimated as:

\[ SE(\Delta E) = \sqrt{SE(\Delta P)^2 + SE(\Delta G)^2} \]

RESULTS AND DISCUSSION
Phenotypic, genetic and environmental trends in first lactation 305 day or less milk yield
The phenotypic trend for FL305MY was 20.74 ± 6.01 kg per year (0.64% of herd average) and was statistically significant (P < 0.05). The overall average FL305MY of Karan Fries cow was estimated as 3243.59±47 kg. The average FL305MY did not exhibit a definite trend over the years (Fig.1) but the phenotypic trend was in the desirable direction exhibiting an increase of 20.74 kg per year.

The genetic trend was estimated to be 4.85 ± 5.62 kg per year (0.15% of herd average) (Table 1). The genetic trend in FL305MY was positive and in desirable direction but non-significant (P < 0.05). The positive phenotypic and genetic trend in FL305MY also reported by Herbert (1987) and Singh (1995) in Karan Swiss cattle at the NDRI farm and Mukherjee (2005) in Frieswal cattle at military dairy farms.

Environmental trend (Table 1) was also found to be positive and high in magnitude in FL305MY which could be due to good management and environmental conditions in herd during the study period.

Phenotypic, genetic and environmental trends in first lactation total milk yield
The phenotypic trend of FLTMY was 34.04 ± 8.62 kg per year (0.61% of herd average) (Table 1). The genetic trend in FLTMY was 5.94 ± 5.84 kg per year (0.18% of herd average) and positive but non-significant (P < 0.05). The positive phenotypic and genetic trend in FLTMY also reported by Herbert (1987) and Singh (1995) in Karan Swiss cattle at the NDRI farm and Mukherjee (2005) in Frieswal cattle at military dairy farms.