Phenotypic, genetic and environmental trends for first lactation traits of Sahiwal cattle

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ABSTRACT

Various methods have been developed to measure the genetic change in breeding stocks under selection. However, problem remains in accumulated data or in populations where no control comparisons are available. Phenotypic trend is the change in yearly mean phenotypic effect over the years, which includes the genetic and environmental components. This partitioning would reflect the effectiveness of selection programme undertaken over the years and will be helpful in suggesting corrective measures for further improvement of various economic traits. Production performance for a period of twenty-four years (1980-2004) of 272 Sahiwal cattle maintained at NDRI, Karnal were analyzed for the genetic change which revealed negative phenotypic trend for first lactation milk yield, 305 days milk yield, lactation length, lactation milk yield per day of lactation length and lactation milk yield per day of calving interval, while the genetic trends were positive for most of the traits. Based on the standard errors, the different methods were compared and it is concluded that method - IV (Powell and Freeman) is the most precise method for estimation of genetic trends for economic traits.

Key words: Genetic & phenotypic trends, First lactation milk yield, Sahiwal cattle

INTRODUCTION

Estimating the phenotypic and genetic trends for production and reproduction performance of dairy cattle from year to year can assess effectiveness of selection programme and management over time. Annual genetic gain resulting from selection for a particular trait can be predicted with the help of estimates of heritability, selection differential and generation interval. But the predicted gain may not be actually realized because of many reasons like small herd size of breeding population resulting in sampling variance, female progenies of culled animals or low ranked progeny tested bulls remaining in the breeding stock, complex nature of the selection schemes, changes in the managemental practices over the time etc. Even when data are adjusted for yearly changes effects still remain intermingled with environmental changes. Phenotypic trend is the changes in yearly mean phenotypic effect over the years, which includes genetic and environmental components. Therefore, it is imperative to separate genetic change from environmental ones as accurately as possible. This partitioning would reflect the effectiveness of selection programme undertaken over the years and will be helpful to suggest corrective measures for further improvement of various economic traits.

MATERIALS AND METHODS

The data on production and reproduction records were collected from history-cum-pedigree sheets of Sahiwal cattle maintained at NDRI, Karnal. The data of animals were spread over of a period of twenty-four years (1980-2004). The traits included in the study were first lactation milk yield, first lactation 305 days milk yield, first lactation length, first lactation milk yield per day of lactation length, first lactation milk yield per day of calving interval. Phenotypic trends for each trait were calculated as regression of performance of the population on year (b (P.T)).

The methods of estimating genetic trends were obtained by procedure suggested by Smith (1962) i.e. method I and method II and its modification by Powell and Freeman (1974) i.e. method III and method IV.

Method I $\hat{g}=2(b_{P.T}.b_{P.T/S})$

Method II $\hat{g}= -2(b_{(P-P).T/S})$

Method III $\hat{g}=2(b_{P.T}.b_{P.T/S}) + \blacktriangle D_1 / 2 / (1+ b_{DA.T/S} - b_{DA.T})$

Method IV $\hat{g}=-2(b_{(P-P).T/S}) - \blacktriangle D_2 /2 / (1+ b_{DA.T/S} - b_{DA.T})$

$b_{P.T}$=is regression of population performance on time

$b_{P.T/S}$ =is within sire regression of progeny performance on time.

$b_{(P-P).T/S}$ =is with in sire regression of progeny performance on time record being deviated from population mean.

$b_{DA.T}$=is regression of dam's age on period

$b_{DA.T/S}$=is within sire regression of dam's age on period

$\blacktriangle D_1 = h^2(b_{DP.T/S} - b_{DP.T}) = b_{DP.T}$ is regression of dam's performance on time.

$b_{DP.T/S}$ is within sire regression of dam's performance on time.

Similarly,

$\blacktriangle D_2 = h^2 b_{(DP-P).T/S}$; Where,

$b_{(DP-P).T/S}$ is within sire regression of dam's performance on time records being deviated from population mean.

Environmental trends were calculated by subtracting genetic trends obtained by methods - I, II, III and IV from phenotypic trend, for every economic trait. Estimates of genetic trends obtained by the four methods were compared by their standard errors.

RESULTS AND DISCUSSION

The estimates of phenotypic, genetic and environmental trends with standard error have been presented in Table[1] and [2]

First Lactation Milk Yield: The phenotypic trend obtained for this trait was -31.361±9.408 Kg. The genetic trend estimates are 14.338 ± 10.837, 77.055 ± 10.532, 12.104 ± 9.324, 65.047± 11.069 Kg by the four methods respectively. Corresponding environmental trends were -45.699 ± 36.587, -108.416 ±44.338, -43.467 ± 21.058 and -96.408 ± 33.092Kg. The estimate of phenotypic trend was negative for this trait (highly significant). Singal (1993) had given similar reports in Sahiwal cattle. Singh *et*

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al. (2002) reported similar trend for this trait in Hariana cattle. The genetic trends obtained by the first two methods are comparable to the estimates given by Acharya and Lush (1968) and Singal (1993) in Hariana and Sahiwal cattle, respectively. Gurnani and Nagarcenkar (1974) reported very less value of the trend for this trait in Tharparkar cattle.

Estimates of genetic trends by the method of Powell and Freeman (1974) were positive. Kumar and Narain (1979) and Hingane (1980) reported very low trends in Hariana cattle for this trait. Singh and Nagarcenkar (2000) also reported similar trends. The estimates indicated an overall decrease in milk yield. Even though the animals were genetically superior negative trend may be due to environmental effects on the phenotypic expression of this trait. Hence, more efforts may be directed for bringing about improvement in the productivity of the herd through desired changes in the management of the herd

First Lactation 305-Day Milk Yield: The estimate of phenotypic trend for this trait was -26.900±7.451 Kg (highly significant), the genetic trends were positive by Smith Method (1962) and Powell and Freeman (1974) method. There is decrease in FL305DMY. This may be due to environmental effects. So managemental practices should be improved.

First Lactation Length: Estimates of phenotypic trend for the trait was negative but it was not significant which was similar to the reports of Singal (1993) in Sahiwal and Singh et al. (2002) in Hariana cattle. The genetic trends for this trait were negative by different methods. The estimates are comparable with the reports of Narain and Garg (1972), Tomar and Singh (1981), Hingane (1980), Herbert and Bhatnagar (1988) and Singal (1993) in various indigenous cattle. Non-significant negative trend was reported by Singh and Nagarcenkar (2000) in Sahiwal cattle. The negative trend in lactation length indicated the shorter first lactation length and thereby reduction in the first lactation milk yield.

First Lactation Milk Yield per day of Calving Interval: The phenotypic trend estimate was negative ($p<0.01$) and the genetic trends by Smith (1962) method and by the Powell and Freeman (1972) were positive. Singal (1993) in Sahiwal cattle also reported similar estimates. The estimates obtained by Smith Method (1962) are in agreement with the reports of Hingane (1980) in Hariana cattle. The negative trend in the trait may be due to longer calving interval. To improve the deteriorating trait of high economic importance for dairy cattle, breeding and managementalpractices should be improved.

First Lactation Milk Yield per day of Lactation Length: The estimate of phenotypic trend for this trait was negative ($p<0.01$) in accordance with the report of Singal (1993). The estimate of genetic trend by Smith (1962) Method I & II was positive, similar reports were given by Narain and Garg (1972) by their own method, Hingane (1980) and Singal, D.K. (1993), by Smith Method. The results were in accordance with the reports given by Hingane (1980), Singh *et al.* (2002) in Hariana cattle and Singal (1993) in Sahiwal cattle. Since, there is a deterioration of the trait it may be improved by increasing milk yield and decreasing lactation length by suitable breeding and managemental practices.

Table 1 Phenotypic trend for First Lactation Traits of Sahiwal Cattle.

Trait	Phenotypic trend
FLMY	-31.3610 ± 9.408
FL305DMY	-26.900 ± 7.451
First Lactation Length	-1.772 ± 0.947
FLMY/CI	-0.091 ± 0.021
FLMY/LL	-0.084 ± 0.022

Table 2. Genetic and Environmental trends for First Lactation traits of Sahiwal Cattle by different methods

Trait	Trend	Smith methods		Powell and Freeman methods	
		Method I	Method II	Method III	Method IV
First Lactation milk yield (kg)	g	14.34±10.84	77.06±10.53	12.10±9.32	65.05±11.07
	t	_45.70±36.59	_108.42±44.33	_43.47±21.05	_96.41±33.09
First Lactation 305 DMY (kg)	g	13.72±9.24	67.51±39.29	11.58±8.32	56.99±22.43
	t	_40.62±8.93	_94.41±39.93	_38.48±16.93	_83.89±23.62
First Lactation Length (days)	g	-4.67±0.84	-1.12±0.83	-3.94±0.24	-0.95±0.10
	t	2.89±0.920	_0.65±0.99	2.17±0.10	_0.83±0.32
First Lactation Milk Yield/CI(kg)	g	0.079±0.10	0.207±0.53	0.07±0.27	0.19±0.09
	t	-0.17±1.40	-0.36±0.69	-0.16±0.02	-0.28±0.12
First Lactation Milk Yield/LL(kg)	g	0.11±0.03	0.21±0.54	0.10±0.02	0.18±0.020
	t	-0.20±0.22	-0.36±0.89	-0.18±0.01	-0.26±0.10

g- Genetic trend; t - Environmental trend

Comparison of the estimates of genetic trends by different methods: The estimates of the genetic trends obtained by four methods were compared by comparing their standard errors. The estimates of the genetic trends by the method of Powell and Freeman-IV have smaller standard errors than other methods for all traits except for FLMY/CI. Hence, estimation of genetic trends from Powell and Freeman methods is better than Smith methods. Because methods of Powell and Freeman showed less standard error than methods of Smith. Method - III showed less standard error than method- I. Method-IV showed less standard error than method-II in all most all traits. Hence adjustment for biases due to non-random allotment of dams with respect to their age were useful in increasing precision of genetic trends. It can be concluded that method - IV (Powell and Freeman, 1974) is most precise for

estimation of genetic trends for economic traits.

Conclusion: Highly significant negative phenotypic trend for FLMY, FL305DMY, FLMY/CI and FLMY/LL were observed. The phenotypic trends indicate that there is decline in the first lactation traits of economic importance. But the genetic trends for the traits were positive. So, there is need to put more efforts in bringing about the improvement in productivity through improvement in management of the herd. From the comparison of the methods based on the standard errors it may be concluded that method-IV (Powell and Freeman, 1974) is most precise for estimation of genetic trends for economic traits.

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