GENETIC TREND IN MILK PRODUCTION OF THARPARKAR CATTLE

The Tharparkar herd was established at this Institute by purchase of animals during 1923-1930 from the open market. Since then the herd has effectively been closed to outside breeding. The breeding bulls were selected on the basis of their dam's milk production performance and body conformation. The males, except those retained for future breeding at the farm, were raised at the farm until 18 months age and then distributed to various state agencies for upgrading of local cattle. The females were selected on the basis of their growth and reproductive performance, body conformation, and milk production in first lactation.

All the females were normally kept at the farm until completion of their first lactation. The average phenotypic lactation milk production tended to vary from time to time showing a declining trend during the later years. It was, therefore, considered useful to evaluate the effective genetic and environmental change (including managemental) that has occurred in the milk production of this closed herd for the period of first calving from 1936 to 1971. The reason for conducting the study up to 1971 was that in 1971-72 crossbreeding of this herd with three exotic breeds viz., Holstein, Brown Swiss, and Jersey was undertaken as a pilot project.

The first lactation milk records normally completed for the lactation duration of 101 to 305 days were considered as standard 305 days records. No correction for differences in lactation length were made. The three seasons of calving were: Season I: November to February; Season II: March to June and Season III: July to October. The criteria of grouping months of calving into seasons were the climatic considerations and differences in monthly averages which were minimised within seasons.

The unadjusted year means of first lactation milk production (FLP) and the least-square year means of FLP, adjusted for seasonal differences and age at calving for various years indicated increase in FLP from 1936 to 1945 and thereafter fluctuated from year to year with apparent overall decline indicating a negative phenotypic trend. Two methods of estimating phenotypic trend (AP) were employed: (i) AP₁ = simple regression of FLP on year of calving (bP₁), (ii) AP₂ = weighted regression of least-squares year constants on year of calving with weights being inverse of the variance of year constants (wP₁). The linear model consisted of fixed effects of year and season of calving and regression on age at first calving.

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Three methods of estimating genetic trend ($\Delta G$) were employed. These were: (i) $\Delta G_1 = 2(b_{PT} - b_{PT}/s)$ where $b_{PT}$ is the regression of performance (FLP) on time (year of calving) and $b_{PT}/s$ is the within-sire regression of performance on time, (ii) $\Delta G_2 = -2b(p_jp_{jT})/s$, where $b(p_jp_{jT})/s$ is the within-sire regression of performance, taken as deviation from herd mean, on time, and (iii) $\Delta G_3 = 2$ times the difference of the weighted regression of least-squares year means on time when (a) sire was not included in the model and (b) sire was included in the model along with the fixed effects of year and season of calving and regression on age at first calving; the weights were the inverse of the corresponding variance of least-squares year means.

Three estimates of environmental trend ($\Delta E$) were obtained as follows:

\[
\begin{align*}
\Delta E_1 &= \Delta p_1 - \Delta c_1 \\
\Delta E_2 &= \Delta p_1 - \Delta c_2 \\
\Delta E_3 &= \Delta p_2 - \Delta c_3
\end{align*}
\]

The two estimates of phenotypic trend and three estimates of genetic and environmental trend in first lactation production are given in Table-1. The first two estimates of genetic trend as also of environmental trend were subjected to high errors of estimation and so were statistically not significant. The third estimate of genetic trend was $+20.486 \pm 6.360$ kg per year which was statistically significant ($P < 0.01$). The third estimate of environmental trend was $-52.060 \pm 7.625$ kg per year which was statistically significant ($P < 0.01$).

Judging by the criterion of smallest variance or equivalently the standard error of the estimate of genetic trend, the third method of estimating genetic and environmental trend is considered as most efficient. Higher standard errors of the estimates of genetic trends by the first two methods have been reported for similar size and nature of data (Nerain and Garg, 1972; Reddy, 1980) or even for larger size of data (Harville and Henderson, 1967; Hargrove and Legates, 1971; Johnson et al., 1976).

The sources of bias in estimation of genetic trend due to non-random distribution of sires' mates with respect to production and age, were examined. The intra-sire regression of dam production on sire age was $-1.013 \pm 0.279$ kg per month which is statistically significant ($P < 0.01$). However, the correction for this source of bias altered the estimate of genetic trend by Method-I to the extent of only 1.11 percent. The within-sire regression of dam age on sire age was $0.205 \pm 0.049$ months per month, which is statistically significant ($P < 0.01$). This indicates that there was tendency of older dams being mated to older sires. The effect of adjustment for this source of bias was to multiply $(b_{PT} - b_{PT}/s)$ by the factor 1.660 instead of 2.000. The net effect of adjustment of method-I for these two sources of bias was inconsequential as the estimate was still not significant being subjected to high standard error.
Table 1: Phenotypic, genetic and environmental trends in first lactation milk production in Tharparkar herd.

<table>
<thead>
<tr>
<th>Phenotypic trend (kg per year)</th>
<th>Genetic trend (kg per year)</th>
<th>Environmental trend (kg per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta P_1 = -25.948 \pm 2.578^{**}$</td>
<td>$\Delta G_1 = -17.500 \pm 21.842$</td>
<td>$\Delta E_1 = -8.448 \pm 32.005$</td>
</tr>
<tr>
<td>$\Delta P_2 = -31.574 \pm 21.3^{**}$</td>
<td>$\Delta G_2 = -5.971 \pm 20.524$</td>
<td>$\Delta E_2 = -19.977 \pm 20.698$</td>
</tr>
<tr>
<td>$\Delta G_3 = 20.486 \pm 6.360^{**}$</td>
<td>$\Delta E_3 = -52.060 \pm 7.629^{**}$</td>
<td></td>
</tr>
</tbody>
</table>

** Statistically significant (P < 0.01)

Number of cows = 894
Number of sires = 44

The significant estimate of negative environmental trend (-52.060) in first lactation milk production indicates that the changes in management and nutritional practices over the course of time have had unfavorable effect. Similar findings were reported by Henderson (1950), Arave et al. (1964) and Kumar and Karan (1979). This result suggested necessity of periodical appraisal of management and nutritional practices at such farms.

SUMMARY

Three methods of estimating genetic trend ($\Delta G$) in first lactation milk production of Tharparkar cattle over a period of 36 years were employed. These were: (i) $\Delta G_1 = 2(b_p T - b_s T/s)$, where $b_p T$ is the regression of performance on time, $b_s T/s$ is the within sire regression of performance on time, (ii) $\Delta G_2 = -2b (\bar{y} - y) T/s$, where $b (\bar{y} - y) T/s$ is the within sire regression of performance, taken as deviation from herd mean, on time and (iii) $\Delta G_3$ = Twice the difference of the weighted regression of least squares year means on time when (a) sire was not included in the model and (b) the sire was included in the model along with the fixed effects of year and season of calving and regression on age at first calving. The weights were the inverse of corresponding variance of least-squares year means. The three estimates of genetic trend were -17.500 ± 21.842, -5.971 ± 20.524 and 20.486 ± 6.360 kg per year. The first two estimates were statistically not significant whereas the third estimate was statistically significant (P < 0.01). The bias in estimation of genetic trend in milk production due to differential production of sire's mates was small and negligible. The correction for bias due to differential age of sires' mates suggested multiplication of ($b_p T - b_s T/s$) by 1.66 instead of 2.00.
References


ZUSAMMENFASSUNG

Drei Methoden wurden benutzt, um den genetischen Trend (ΔG) in Erstlaktationsmilchleistung der Tharparkar Viehrasse für eine 36-jährige Zeitspanne zu schätzen. Die waren: (i) ΔG = 2(bp · t - bP · T/s), wo bp · t die Regression der Leistung über Zeit ist, bP · T/s die in den Grenzen der Bullonregression der Leistung über Zeit ist; (ii) ΔG = 2(bP · p/s), wo bP · p/s die in den Grenzen der Bullonregression der Leistung über Zeit ist, genommen als Abweichung von Herdmittelwert, und (iii) ΔG = zweimal der Unterschied der belasteten Regression der Kleinstquadrat - Jahresmittelwerte über Zeit, wenn (a) der Bull nicht im Modell einbezogen war, und (b) der Bull in Modell mit festen Einflüssen von Jahr und Jahreszeit der Abkalbung und Regression über Alter bei Erstabkalbung; die Belastungen waren die Inverse der entsprechenen Varianz von Kleinstquadrat - Jahresmittelwerten. Die drei Schätzungen der genetischen Trends waren -17,500 ± 21,842, -5,971 ± 20,524 und +20,486 ± 3,360 kg pro Jahr. Die ersten zwei Schätzungen waren statistisch nicht bedeutsam, wohingegen war die dritte Schätzung statistisch bedeutend (P < 0,01). Die Zunahme in Schätzung der genetischen Züge in Milchleistung war wegen der Ausgleichsproduktion der Weibchen des Bullen klein und geringfügig. Wegen des Ausgleichsalters der Weibchen des Bullen schlug die Verbesserungszunahme eine Multiplikation von (bP · t - bP · T/s) mit 1,66 statt 2,00 vor.