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STUDIES ON THE FACTORS AFFECTING MILK YIELD IN THARPARKAR COWS

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ABSTRACT

Data on 218 lactations of 127 Tharparkar cows at the Government Livestock Farm, Rakh Ghulaman, District Bhakkar were analysed for variation in milk yield due to season of calving and some physiological factors. Milk yield averaged 1128.6 ± 26.8 kg and was significantly affected by the season of calving. The cows calving during autumn were the poorest in milk yield but the production did not differ significantly in cows calving during the other three seasons. Peak yield and initial milk yield were 235.5 ± 4.8 and 431.5 ± 9.1 kg, respectively. Mean lactation period was 220.4 ± 3.2 days and the persistency avraged 66.2 ± 0.9 per cent. The correlations between lactation milk yield and the other variables, viz., peak yield, lactation period and persistency were 0.81, 0.78, 0.38 and 0.47, respectively. Multiple correlation for the combined effects of peak yield, initial yield and persistency of lactation milk yield was 0.896. The test of significance indicated that each independent variable contributed significantly to the lactation yield. The multiple regression equation to predict lactation milk yield (Y) from peak yield (X_1), initial yield (X_2) and persistency (X_3) was :

$$Y = \_667.39 + 3.2424\ X_1 + 0.5928\ X_2 + 11.8568\ X_3$$

The standard partial regression indicated relative importance of 50:17:33 for peak yield, initial yield and persistency in influencing the milk yield.

INTRODUCTION

Tharparkar breed of cattle is a dairy-cum-draught type and mainly

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inhabits the semi-desert areas of Sind. The breed has the potential to produce 2500 kg of milk per lactation, but there exists a wide variation in this trait which can be attributed to several environmental factors in addition to the inherent capabilities of the cows. The milk yield had been reported to be significantly affected by the year and season of calving (ZurKowska and Wyrobisz, 1973; Ahmad *et al.*, 1978; Rao and Sundaresan, 1979). However, Gavriclatos (1969) found no correlation between season of calving and lactation milk yield in Brown Swiss cows.

The lactation milk was significantly correlated with peak yield (Suchanek, 1962; Paradhan and Dave, 1973) and it increased with increase in the peak yield. Sikka (1950), however, reported a negative correlation between these traits. Initial milk yield was positively correlated with lactation milk yield (Mahadevan, 1951; Ullah, 1952; Lennon and Mixner, 1958). Lactation milk yield was significantly correlated with lactation length (Singh *et al.*, 1965; Rao and Sundaresan, 1979; Singh and Raut, 1982) and persistency (Paradhan and Dave, 1973; Rao and Sunderesan, 1981; Gupta and Johar, 1982). A negative correlation between persistency and total milk yield was obtained by Tapiay *et al.* (1964). The present study was aimed at estimating the magnitude of variation in lactation milk yield of Tharparkar cows due to season of calving and lactation parameters like peak yield, initial yield, lactation length and persistency.

MATERIALS AND METHODS

A. *Source of Data* : Data on 218 lactation records of 127 Tharparkar cows kept at the Government Livestock Farm, Rakh Ghulaman, District Bhakkar were used in this study. Normal lactations of 150-day and above were included in the analyses. The records scattered over 13 years were grouped into four period : I (1965-68); II (1969-71); III (1972-74), and IV (1975-77). The year was arbitrarily divided into spring (February-April); summer (May-July); autumn (August-October) and winter (November-January) seasons . Daily milk records on each lactation were collected and divided into 10 periods of 30 days each for persistency studies. Maximum milk produced in a particular period of 30 days was designated as peak yield. Milk yield for first 60 days was regarded as initial yield.

B. *Statistical Procedures* : Analysis of variance based on the Method of Unweighted Means (Bancroft, 1968) was applied to find the effect of periods and seasons on milk yield. The persistency was worked out by Ludwick and Peterson (1943). Correlation coefficient between 305-day milk yield and other lactation parameters viz., peak yield, initial yield, lactation period and persistency expressed in per cent were worked out. The method of linear multiple regression/correlation was used to estimate lactation milk yield (Y) using independent variables, peak yield (X_1), initial yield (X_2) and persistency (X_3). The partial regression coefficients (b_1, b_2, b_3) were obtained by solving normal equations (Steel and Torrie, 1980) for use in the prediction equation :

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3$$

The partial regressions were standardized to indicate the relative importance of the independent variables. To measure the combined effects of X_1, X_2 and X_3 on the dependent variable (Y), the multiple correlation was computed and statistical significance of each independent variable was tested by analysis of vairance based on separating, in sequential order, the remaining variance at each stage into a part attributable to reduction due to a certain independent variable, and the error for testing that reduction.

RESULTS AND DISCUSSION

The means and coefficient of variation for various lactation parameters are presented in Table 1. Out of 218 calvings, maximum (40 %) occurred during, spring followed by the summer seasons (37%). The calving frequency was the lowest during autumn (8%), whereas it was 15 per cent during winter season.

Table 1. *Means and coefficient of variation (CV) of various lactation parameters*

Lactation parameter	Mean ± S E.	CV
Peak milk yield (kg)	235 6± 4.8	30.0
Initial milk yield (kg)	431.5± 9.1	31.0
Lactation length (days)	220.4± 3 2	21.3
Persistency (%)	66.2± 0.9	19.2
Lactation milk yield (kg)	1138.5±26.8	34.8

1. *Seasonal Variation in Lactation Milk Yield*

Average milk yield in cows calving in different years and seasons is given in Table 2. Mean lactation milk yield among the cows calving in spring season was 1152 ± 47 kg. The summer and winter calvers yielded 1152 ± 37 and 1158 ± 80 kg milk, respectively, which is almost similar to the milk yield of cows calving in spring season. However, autumn calvers produced 979 ± 68 kg milk which significantly differed from mean yields of cows calving in the other three seasons (Table 3).

Analysis of variance indicated significant variation due to year of calving. The yield was the highest (1320 ± 49 kg) for cows calving during the period III (1972-74) and the lowest (870 ± 38 kg) in period IV (1975-77).

These findings are in agreement with those of several workers who reported that milk yield was maximum in the cows calving during winter season. ZurKowska and Wyrobisz (1973); Ahmad *et al.* (1978) andRao and Sundaresan (1979) reported that season and year of calving had significant effect on total milk yield. On the other hand, Gavrielatos (1969) reported that season of calving was not significantly correlated with lactation milk yield in Brown Swiss cows. Relatively low milk yield as obtained in this study among the autumn calvers may be attributed to the scarcity of green fodder in autumn and early winter.

Table 2. *Average milk yield in cows calving in different years (periods) and seasons*

Period	Season of calving				Overall
	Spring	Summer	Autumn	Winter	
I	1227 ± 181	1164 ± 46	1002 ± 87	1646 ± 226	1169 ± 62 (43)
II	1227 ± 90	1154 ± 69	955 ± 47	1188 ± 212	1174 ± 54 (54)
III	1306 ± 78	1344 ± 71	1150 ± 32	895 ± 150	1320 ± 49 (65)
IV	848 ± 55	864 ± 87	873 ± 233	918 ± 56	870 ± 38 (65)
Overall	1152 ± 47 (87)	1152 ± 37 (80)	979 ± 68 (18)	1158 ± 80 (33)	1139 ± 27 (218)

Figures in the parentheses are the number of records.

Table 3. *Analysis of variance based on the method of unweighted means for variations in lactation milk yield due to season and year (period) of calving*

Source of Variation	d.f.	Sums of squares	Mean squares	F. ratio
Seasons	3	1099212.2	366404.1	3.88*
Periods	3	1676355.2	558785.1	5.91**
Period x Seasons	9	2259156.1	251073.4	2.66**
Error	202		94498.1	

* Significant ($P<0.05$).

** Significant ($P<0.01$).

2. *Lactation Milk Yield as Affected by various Lactation Parameters*

a) *Peak yield* : Milk yield increased with increasing level of peak yield. Mean yield was 631.8 ± 53.1 kg for peak yield less than 150 kg, and 1825.8 ± 144.3 kg for peak yield more than 325 kg. The correlation between peak yield and lactation milk yield was 0.81 which was significant.

These results are similar to those reported by Suchaneck (1962), Paradhan and Davo (1973) who reported a correlation of 0.75 and 0.68, respectively between these two traits. On the other hand, Sikka (1950) reported that peak yield and lactation milk yield was negatively correlated with each other, which is not in conformity with the results of the present investigation.

b) *Initial yield* : The correlation between initial yield and lactation yield was 0.78 which was significant. Mean lactation yield increased with increasing level of initial yield. Average lactation yield was 565.4 ± 87.5 kg for initial yields less than 250 kg and it increased to 1883.5 ± 136.1 kg for initial yields more than 600 kg.

The results obtained in the present study are in line with Mahadevan (1951), and Ullah (1952), Lennon and Mixner (1958) who reported that initial milk yield was positively and significantly correlated with lactation yield. Lennon and Mixner (1958) reported a correlation coefficient of 0.81, which was close to the correlation obtained in the present study.

c) *Lactation length* : Milk yield was significantly correlated with lactation length. Correlation coefficient between the two traits was 0 38. An increase in milk yield was observed with increasing length of lactation upto 270 days. Thereafter, is showed a slight decrease. Mean yields for lactation length of 151-180, 241-270 and more than 300 days were 858.1 ± 49.8, 1384.3 ± 73.7 and 1272.9 ± 118.7 kg, respectively.

These findings are supported by the results of Singh *et al.* (1965), Rao and Sundaresan (1979) and Singh and Raut (1982) who reported correlation coefficient ranging from 0.43 to 0.50.

d) *Persistency* : Mean yield increased with increasing persistency. It was 855.4 ± 88.4 kg for persistency less than 40 per cent and increased to 1512.7 ± 81.4 kg for persistency of more than 80 per cent. The correlation between persistency and lactation milk yield was 0.47 which was significant.

The persistency was reported to be correlated with total milk production by many workers (Sikka, 1950; Ullah, 1952; Paradhan and Dave, 1973; Kozel Skil and Ivanova, 1980; Rao and Sundaresan, 1981; Gupta and Johar, 1982). The correlation between persistency and total milk yield as reported by Ullah (1952) was 0.41. Other workers reported that the correlations between these two traits ranged from 0.21 to 0.68. On the contrary, Tapiay *et al.* (1964) obtained a negative correlation between persistency and total milk yield, which was not in line with the results of the present study.

3. *Multiple and Partial Regression and Correlation Analysis of Lactation Parameters Influencing Milk Yield*

Multiple regression equation developed to predict the lactation milk yield (Y) from peak yield (X_1), initial yield (X_2) and persistency (X_3) was :

$$Y = -667.39 + 3.2434\ X_1 + 0.5928\ X_2 + 11.8568\ X_3$$

The partial regression coefficients are given in Table 4. It is evident that milk yield increased by 3 2434 kg (by 1.23) for each kg increase in peak yield (X_1) for fixed initial yield (X_2) and persistency (X_3). The values of by 2.13showed that lactation milk yield (Y) increased by 0.5928 kg for each kg increase in initial yield (X_2) considering the effect of peak yield (X_1) and persistency (X_3)

as constant. The partial regression coefficient of lactation milk yield (Y) on persistency (X_3) for fixed X_1 and X_2 (by 3.12) was 11·8568 kg which was higher as compared to the other two partial regressions. The standard partial regressions indicated relative importance of 50:17 :33 for peak yield (X_1), initial yield (X_2) and persistency in influencing the milk yield.

Table 4. *Partial and standard linear regression of milk yield (Y) on independent variables peak yield (X_1), initial yield (X_2) and persistency (X_3)*

Regression	^{b}y 1.23	^{b}y 2.13	y 3.12
Partial (kg)	3.2434	0 5928	11 8568
Standard (b')	0.5793	0.2007	0.3116

Multiple correlation coefficient ($R_{y.123}$) indicating combined effects of X_1, X_2 and X_3 variables on lactation milk yield (Y) was 0.896, which indicated that lactation yield was greatly affected by three variables.

Table 5. *Test of significance of multiple correlation of lactation milk yield (Y) with peak yield (X_1), initial yield (X_2) and persistency (X_3)*

Source of variation	d.f.	Sums of squares	Mean squares	F. ratio
Total	217	33971169.9		
Reduction due to X_1	1	22063419.0	22063419.0	400.3**
Residual for X_1	216	11907750.8	55128.5	
Reduction due to X_2 after fitting X_1	1	324751.6	324751.6	6.1*
Residual for X_2	215	11582999.2	53377.9	
Reduction due to X_3 after fitting X_1 and X_2	1	4873512.4	4873512.4	155.4**
Residual for X_3	214	6109486.8	31352.7	

* Significant ($P<0.05$).

**Significant ($P<0.01$).

To find out the relative importance of three independent variables viz. initial yield (X_1), peak yield (X_2) and persistency (X_3), in predicting the lactation yield (Y), a test of significance was made by separating, in sequential order, the remaining variance at each stage into a part attributable to reduction due to certain independent variable and an error for testing that reduction for statistical significance (Table 5).

It indicated that reduction in lactation yield due to peak yield(X_1) was highly significant ($P<0.01$). Similarly, the reduction due to initial yield (X_2) after fitting X_1 was significant ($P<0.05$), and reduction due to persistency (X_3) after fitting X_1 and X_2 was also significant ($P<0.01$). This analysis suggested that each independent variable contributed significantly to the lactation yield.

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