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STUDIES ON THE PERSISTENCY OF LACTATION 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 the influence of season and some lactation parameters on persis tency of lactation. Milk yield averaged 1138 5 ± 26.8 kg with mean lactation period of 220.4 ± 3.2 days. Average peak yield per month and mean initial yield for first 60 days were 235.5 ± 4.8 kg and 431.6 ± 9.1 kg, respectively. The persistency of lactation averaged 66.2 ± 0.9 per cent and was not significantly affected by the season of calving.

The correlation co-efficients between persistency and three other variables, namely, peak yield, initial yield and lactation length were 0.108, 0.121, and 0.824, respectively. Multiple correlation for the combined effects of the three variables was 0.829. The test of significance of multiple correlation indicated that, of three variables, the lactation length after fitting peak yield and initial yield, was the factor affecting persistency significantly.

The multiple regression equation to predict persistency (Y) from peak yield (X_1), initial yield (X_2) and length of lactation (X_3) was :

$$Y = 15.0795 - 0.0325\ X_1 + 0.0219\ X_2 + 0.2239\ X_3$$

The standard partial regression indicated that lactation length was 4.57 and 3.58 times more important in influencing the persistency than peak yield and initial yield, respectively.

INTRODUCTION

Milk production in a particular lactation depends to a great extent upon

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the peak yield, initial milk yield, lactation length and the persistency of lactation. The persistency is the degree at which rate of milk flow is maintained as the lactation advances. It is generally agreed that cows having high degree of persistency are the most economical producers. Persistency, in turn, is influenced by numerous genetic and environmental factors. The persistency was reported to be influenced by year and season of calving (Mahadevan, 1951; Rakes *et al.*, 1963; Ahmad *et al.*, 1975; Mahto *et al.*, 1981). Peak yield was significantly correlated with persistency (Singh *et al.*, 1965; Paradhan and Dave, 1973; Gupta and Johar, 1982). The persistency tended to increase with increase in lactation length (Asker *et al* , 1959; Singh *et al.*, 1965; Rao and Sunderesan, 1979; Gupta and Johar, 1982). In several other studies it was shown that persistency was not affected by the season of calving (Saxena and Kumar, 1960; Sharma and Bhatnagar 1973; Singh and Gopal, 1982; Gupta and Johar, 1982). There existed no correlation between persistency and maximum initial yield (Lennon and Mixner, 1958).

Tharparkar breed of cattle is a dairy-cum-draught type and is well-adapted to semi-desert conditions. These cows under farm conditions can produce 2600 kg of milk per lactation. The breed has not been vastly studied for performance and various factors affecting production in Pakistan. A study was, thus, planned to precisely estimate the magnitude of variation in persistency due to peak yield, initial milk yield, lactation length and season of calving in the Tharparkar breed.

MATERIALS AND METHODS

A. Source of Data : Data on daily milk records of 218 lactations 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 lactation duration was divided into 10 periods of 30 days each for persistency studies. The persistency was worked out by using the formula derived by Ludwick and Petersen (1943).

B. Statistical Procedures : The data scattered over 13 years were grouped into four periods and four seasons of the year. The years were divided into periods: I (1965-68); II (1969-71); III (1972-74) and IV (1975-77). The year was arbitra-

rily divided into seasons: spring (February-April); summer (May-July); autumn (August-October) and winter (November-January). Analysis of variance based on Method of Unweighted Means was applied to find out the affect of periods and seasons (Bancroft, 1968).

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. Correlations between persistency (Y) and lactation parameters viz., peak yield (X_1), initial milk yield (X_2), lactation length (X_3), were worked out.

The method of linear multiple regression/correlation was used to estimate persistency (Y) using independent variables X_1, X_2 and X_3. The partial regression coefficient (b_1, b_2, b_3) were obtained by solving normal equations (Steel and Torrie, 1980) for use in prediction equation:

$$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3$$

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 the statistical significance of each independent variable was tested by analysis of variance.

RESULTS AND DISCUSSION

The peak and initial milk yields in this herd averaged 235.6 $\pm$ 4.8 and 431.5 $\pm$ 9.1 kg, respectively. Average lactation length was 220.4 $\pm$ 3.2 days and the mean lactation milk yield was 1138.5 $\pm$ 26.7 kg. The milk yield ranged from 233.6 to 2597.7 kg per lactation. The persistency ranged from 27.0 to 91.2 per cent with mean as 66.2 $\pm$ 0.9 per cent.

1. *Seasonal Variation in Persistency*

The values pertaining to average persistency in cows calving in different years and seasons are presented in Table 1. The cows calving in summer were more persistent than those calving in other seasons. The autumn calvers were the least persistent. A low persistency among autumn calvers seemed mainly due to sharp decline just after first month of calving which might be due to scarcity of green fodder in autumn and early winter. The persistency in cows

calving during different periods varied from 63.9 ± 1.7 to 68.4 ± 0.3 per cent and the cows calving in period I(1965-68) were comparatively more persistent. The analysis of variance, however, revealed that the yearly and seasonal variations in persistency were non-significant (Table 2). The period X seasons interaction was significant indicating that various seasons differed significantly invarious periods of calving.

Table 1. *Mean persistency (%) in cows calving in different periods (years) and seasons*

Period	Season of Calving				Overall
	Spring	Summer	Autumn	Winter	
I	71.4±2.0	69.3±2.1	58.8±5.8	82.3±2.1	68.4±0.3 (43)
II	67.7±2.2	66.2±3.2	66.5±1.9	63.3±3.3	64.0±1.6 (54)
III	65.5±2.3	68.0±3.0	83.6±4.2	66.5±5.3	67.0±1.7 (65)
IV	62.6±2.8	66.7±3.7	64.9±4.1	62.5±4.5	63.9±1.7 (56)
Overall	65.9±1.3 (87)	67.5±1.4 (80)	64.6±3.2 (18)	65.1±2.6 (33)	66.2±0.9 (218)

Figures in the parentheses are the number of records.

Table 2. *Analysis of variance based on the method of unweighted means for variation in persistency due to year and season of calving*

Source of variation	d. f.	Sums of squares	Means squares	F. ratio
Period	3	1.37	0.4567	1.927 N.S
Season	3	0.10	0.0333	0.141 N.S
Period X Season	9	5.10	0.5667	2.391*
Error	202		0.2370	

N.S = Non-significant.

* = Significant ($P < 0.05$).

The results of the present study are in agreement with those of Saxena and Kumar (1960); Sharma and Bhatnagar (1973); Singh and Gopal (1982) and Gupta and Johar (1982). Gupta and Johar (1982) reported that season and period had no significant effect on persistency in Tharparkar cows. However, persistancy was reported to be influenced by year and season of calving (Mahadevan, 1951; Rakes *et al.*, 1963; Ahmad *et al.*, 1975; Mahto *et al.*, 1981). Mahadevan (1951) reported that persistency varied significantly due to month of calving, the highest persistency was in winter calvers and the lowest in summer calvers. Ahmad *et al.* (1975) reported that in Sahiwal the highest persistency was in the cows calving in spring and the lowest in winter calvers.

2. *Influence of Various Lactation Parameters on Persistency*

a) *Peak yield* : Peak yield in 50.5 per cent of the total calvings was attained in second month of lactation. The peak in the first month of calving was observed in 39.0 per cent calvings, whereas in 10.5 per cent of the lactations, the peak was attained in third month of lactation. The correlation co-efficient between peak yield and persistency was 0.108 (Table 3), which indicated that the persistency was not appreciably affected by the level of peak yield. Lennon and Mixner (1958) found no correlation between persistency and maximum initial yield which was in line with the findings of the present study.

Table 3. *Correlation coefficient between various lactation parameters*

Parameter	Initial yield	Lactation length	Persistency
Peak yield	0.925**	N.S 0.092	N.S 0.108
Initial yield		N.S 0.070	N.S 0.121
Lactation length			0.824**

N.S = Non significant

** = Significant ($P<0.01$).

The results of the present study were not in agreement with those of many workers who reported that the correlation coefficient between peak yield and persistency ranged from 0.19 to 0.22 (Singh *et al.*, 1965; Sharma and Bhat-

nagar, 1973). On the other hand, Suchanek (1962) and Paradhan and Dave (1973) reported −0.21 and −0.52, respectively as the correlation coefficient between peak yield and persistency.

b) *Initial yield* : An increasing trend in persistency was observed with increasing level of initial milk yield. The correlation coefficient between initial yield and persistency was 0.121 which was statistically non-significant (Table 3).

These results are in line with those of Saxena and Kumar (1969) who reported a positive correlation of initial milk yield with persistency. On the contrary, Blau (1961) and Tapiay *et al.* (1964) reported that initial yield was negatively correlated with persistency.

c) *Length of lactation* : Mean persistency was 48.5±1.4 per cent for lactation period between 151 to 180 days and continued to increase with increase in lactation length. Mean persistency for lactation length of over 300 days was 82.5±1.4 per cent. The correlation between length of lactation and persistency was 0.824 which was significant (Table 3). A high positive correlation between these two traits indicated that in the present study, the length of lactation was the major factor affecting the persistency. It may be added that average lactation length in this herd was 220.4 days which was far less than the standard 305 days. Thus, to improve persistency of lactation milk yield, an increase in lactation length by selection and by improving the managemental and feeding practices is imperative.

Lactation length did not seem to depend upon the peak yield and the initial yield as the correlation coefficients between lactation length and the other two parameters were low and non-significant (Table 3). However, the correlation (0.925) between peak yield and initial yield was high and significant.

The results are in conformity with the findings of Singh *et al.* (1965), Rao and Sundaresan (1981), Singh and Raut (1982), Gupta and Johar (1982) who reported a significant positive correlation between length of lactation and persistency. Singh *et al.* (1965) reported that correlation coefficient between persistency and lactation length was 0.755.

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

The multiple regression equation developed to predict persistency (Y)

from peak yield (X_1), initial yield (X_2) and length of lactation (X_3) was :

$$Y = 15.0759 - 0.0325\ X_1 + 0.0219\ X_2 + 0.2239\ X_3$$

The partial regression coefficients are given in Table 4. It is obvious that for each one kg increase in peak yield (X_1), persistency (Y) decreased by 0.0325 per cent ($b_{y1.23}$) for fixed level of initial yield (X_2) and lactation length (X_3).

The partial regression coefficient ($b_{y\,2\,13}$) showed that persistency (Y) increased by 0.219 per cent for one kg increase in initial yield (X_2) for any fixed values of peak yield (X_1) and lactation length (X_3).

The partial regression of persistency on lactation length for fixed peak and initial yield ($b_{y3.12}$) was 0.2239 per cent which is much higher than the other two partial regressions.

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

Regression	$b_{y1.23}$	$b_{y2\,13}$	$b_{y3\,12}$
Partial	−0.0325	0.0219	0.2239
Standard	−0.1806	0.2302	0.8246

The standard partial regression revealed that lactation length (X_3) was 4.57 and 3.58 times more important in influencing the persistency than peak yield (X_1) and initial yield (X_2), respectively.

Multiple correlation coefficient ($R_{y.123}$) for combined effects of peak yield (X_1), initial yield (X_2) and lactation length (X_3) on persistency was 0.8295, indicating that persistency was greatly affected by the three variables.

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

error for testing that reduction for statistical significance. Thus the reduction due to X_1 is $[r^2_{y1}] \Sigma y^2$ and the appropriate error mean square is $[1-r^2_{y1}] \Sigma y^2/(n-2)$. The reduction due to X_2 after fitting X_1 is $[R^2_{y.12} - r^2_{y1}] \Sigma y^2$ and the appropriate error mean square is $[1-R^2_{y.12}] \Sigma y^2/(n-3)$. Similarly, reduction due to X_3 after fitting X_1 and X_2 is $[R^2_{y.123} - R^2_{y.12}] \Sigma y^2$ and the appropriate error mean square is $[1-R^2_{y.123}] \Sigma y^2/(n-4)$. The test of significance in this sequential order is presented in Table 5.

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

Source of variation	d. f.	Sums of squares	Mean squares	F. ratio
Total	217	35183.51		
Reduction due to X_1	1	407.35	407.35	2.53 N.S
Residual for X_1	216	34776.16	161.00	
Reduction due to X_2 after fitting X_1	1	109.68	109.68	0.68 N.S
Residual for X_2	215	34666.48	161.24	
Reduction due to X_3 after fitting X_1 and X_2	1	23689.28	23689.28	461.82**
Residual for X_3	214	10977.20	51.30	

N.S = Non-significant.

** = Significant ($P<0.01$).

It is evident that reduction due to peak yield (X_1) was non-significant. Similary, reduction due to initial yield (X_2) after fitting X_1 was also non-significant. However, reduction for lactation length (X_3) after fitting X_1 and X_2 was found to be highly significant.

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