

## TOTAL DETERMINATION OF CALVING INTERVAL BY PATH ANALYSIS IN MURRAH BUFFALOES

S. Banik and S.S. Tomar

Dairy Cattle Breeding Division,  
National Dairy Research Institute, Karnal - 132 001, India

### ABSTRACT

Based on 1277 observations of Murrah buffaloes, the calving interval was found to be  $454.8 \pm 5.8$  days with service period of  $145.3 \pm 5.8$  days, gestation period of  $309.5 \pm 0.3$  days, lactation length of  $285.8 \pm 2.2$  days and dry period of  $143.6 \pm 5.1$  days based on all lactations. The path analysis of calving interval by taking reproductive components showed that maximum variability in calving interval was due to service period (99.26%), whereas the effect of gestation period was very small. For considering different lactations, it was observed that the service period explained 99.18 to 99.70 per cent variation in calving interval. The total effect of service period was due to its direct effect. The gestation period explained 0.31 to 0.81 per cent variation in different lactations. By taking the effects of productive components on calving interval, it was shown that the effect of dry period was more than the lactation length. The total effects of dry period and lactation length were 69.8 per cent and 49.0 per cent, respectively, considering all lactations. Maximum of the total effects was due to the direct effects of these characters. In both the cases of reproductive and productive traits, the model explained the total variation in calving interval.

### INTRODUCTION

The knowledge of interrelationship between character and its components and among the components themselves is necessary for the simultaneous improvement in these characters. As more variables are included in correlation study, the indirect association becomes more complex. In such situation, the path coefficient analysis derived by Wright (1921) provides an effective mean of finding direct and indirect association between characters. Calving interval is contributed by two reproductive components, *viz.*, service period (SP) and gestation period (GP). Calving interval has also its two productive components, *viz.*, lactation length (LL) and dry period (DP). Path coefficient provides information on direct and indirect contribution of causal factors/characters to the effect (milk production). The characters having direct contribution are more important in a breeding programme, and the information thus can be used for selection.

### MATERIAL AND METHODS

The causal connection for calving interval and its components of 1277 records of reproductive components and 1173 records

of productive components of Murrah Buffaloes during the period of 15 years (1985-2000) at National Dairy Research Institute (NDRI) herd, Karnal were ascertained following path analysis after Wright (1921) as described by Singh and Choudhury (1977) and Tomar (2000). The reproductive components for calving interval were taken as service period (SP) and gestation period (GP) (Fig. 1) whereas; the productive components were lactation length (LL) and dry period (DP). The analyses were carried out up to fifth lactation separately and for overall lactations.

The correlation coefficients among the traits were estimated following Snedecor and Cochran (1967). A set of simultaneous equation were set up which on solution on matrix analysis after Singh and Choudhury (1977), yielded path coefficient of respective effects (both direct and indirect effects). The perusals of path analysis have been given in Table 1 and Table 2, respectively.

### RESULT AND DISCUSSION

#### i) Reproductive Components

The calving interval in this herd ranged

Table 1. Direct and indirect effects of service period (SP) and gestation period (GP) on calving interval (CI)

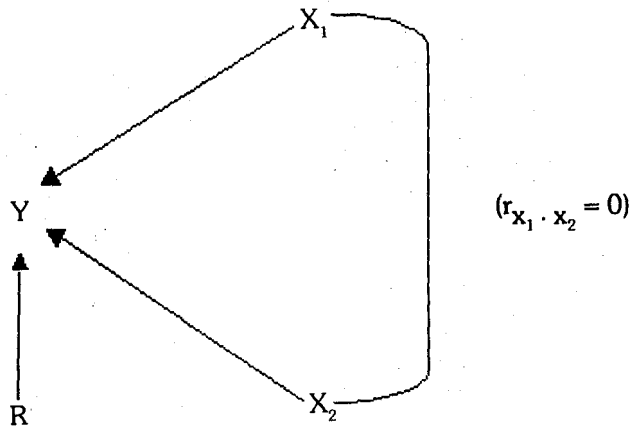
Characters	Lactation					All Lactations
	1	2	3	4	5	
<b>a) SP and CI</b>						
Total effect (Direct + Indirect)	1.0006	0.9989	0.9963	0.9931	1.0006	0.9997
Direct effect	1.0006	0.9989	0.9963	0.9931	1.0006	0.9997
Indirect effect via GP	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
<b>b) GP and CI</b>						
Total effect (Direct + Indirect)	0.0560	0.0612	0.0603	0.0905	0.0567	0.0613
Direct effect	0.0560	0.0612	0.0603	0.0905	0.0567	0.0613
Indirect effect via SP	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
<b>c) Residual effect</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
No. of observations	409	300	206	147	100	1277

Table 2. Direct and indirect effects of lactation length (LL) and dry period (DP) on calving interval (CI)

Characters	Lactation					All Lactations
	1	2	3	4	5	
<b>a) LL and CI :</b>						
Total effect (Direct + Indirect)	0.8009	0.8778	0.4727	0.6420	0.7614	0.7002
Direct effect	0.5384	0.7872	0.3403	0.5430	0.4800	0.5597
Indirect effect via DP	0.2625	0.0906	0.1324	0.0990	0.2814	0.1405
<b>b) DP and CI :</b>						
Total effect (Direct + Indirect)	0.8700	0.6338	0.9417	0.8426	0.8978	0.8357
Direct effect	0.6538	0.1463	0.8912	0.7731	0.1911	0.7276
Indirect effect via LL	0.2162	0.4875	0.0505	0.0695	0.7067	0.1081
<b>Residual effect</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
No. of observations	407	287	203	139	97	1173

## CAUSAL SCHEME

$$Y = X_1 + X_2 + R$$



Path diagram

Where,

- Y = CI (Calving interval)  
 X<sub>1</sub> = SP (Service period)  
 X<sub>2</sub> = GP (Gestation period)

Fig. 1. Showing path diagram for calving interval (CI) with service period (SP) and gestation period (GP)

from  $429.00 \pm 7.2$  to  $467.9 \pm 7.8$  days in different lactations. The range in service period was observed from  $119.6 \pm 7.2$  to  $158.0 \pm 7.8$  days whereas the gestation period remained around  $309.5 \pm 0.3$  days in different gestations (Table 3).

Service period explained maximum of variability in calving interval in all the cases. It explained 99.18 to 99.70 per cent of all the variability in calving interval in all the lactations. The direct effects of service period explained 99.26 per cent to 100.00 per cent of variability in all the cases. The correlation between service period and gestation period was found very small and negligible (0.0261). In practical sense, the correlation between service period and gestation period is non-sense correlation.

Hence, the correlation assumed between the two is zero. So, the indirect effects of service period via gestation period were nil in all the cases.

Gestation period explained a very little amount of variation in calving interval. In different cases, it explained only zero per cent to 0.81 per cent of variability of calving interval. The direct effects explained 0.31 per cent to 0.81 per cent variability in calving interval in all the cases. As the assumed correlation between service period and gestation period was zero, so the indirect effects of gestation period through service period were nil.

The residual effect obtained in all the cases was zero. It indicated that this model explained all the variation of calving interval.

Table 3. Means and standard errors of different characters

Sl.No.	Characters	Lactation					All Lactations
		1	2	3	4	5	
1.	Lactation length (days)	306.63±3.53 (504)	286.81±4.52 (401)	286.87±5.43 (300)	278.53±6.51 (208)	261.52±8.31 (150)	285.85±2.18 (1779)
2.	Dry period (days)	151.25±6.88 (407)	137.03±6.50 (287)	173.90±6.83 (203)	122.25±9.02 (139)	142.37±8.02 (97)	143.62±5.14 (1173)
3.	Service period (days)	158.01±7.81 (409)	136.34±7.43 (300)	143.39±8.60 (206)	119.61±7.20 (147)	122.55±11.58 (100)	145.32±5.83 (1277)
4.	Gestation period (days)	309.89±0.43 (409)	309.07±0.45 (300)	308.95±0.52 (206)	309.38±0.65 (147)	310.38±0.65 (100)	309.50±0.32 (1277)
5.	Calving interval (days)	467.91±7.79 (409)	445.41±7.43 (300)	452.34±8.63 (206)	429.00±7.25 (147)	432.93±11.56 (100)	454.82±5.83 (1277)

Figures in parentheses are number of observations.

The result of path analysis showed that variability of calving interval could be completely explained by the variability of service period, whereas the effect of gestation period was almost nil.

#### ii) Productive Components

The average lactation length had been in the range of  $261.5 \pm 8.3$  to  $306.6 \pm 3.5$  days in different lactations. The dry period was found to range from  $122.2 \pm 9.0$  to  $151.2 \pm 6.8$  days in this herd in different lactations (Table 1).

The effect of lactation length for overall lactations explained 49.0 per cent of total variation in calving interval, whereas, its direct effects explained only 31.30 per cent. For considering the individual lactations, it was observed that total effects ranged from 41.2 to 77.0 per cent in different lactations except for third lactation, where it was comparatively low (22.3%). Among the total effects of lactation length, maximum were contributed due to its direct effects in all the cases, whereas, the indirect effects via dry period were very small. The direct effects ranged from 23.0 to 61.9 per cent in different lactations except for

third lactation, where it was small (11.5%).

The total effect of dry period for overall lactation was 69.8 per cent, out of which maximum was contributed by its direct effect (52.9%). For considering the individual lactations, it was observed that total effects ranged from 70.9 to 88.6 per cent except for second lactation (40.7%). Maximum of the variation was explained by its direct effects in all the cases except for second and fifth lactations, where the indirect effects of dry period via lactation length were higher. For other cases, the indirect effects via lactation length were lower than its direct effect.

The residual effect obtained in all the cases was observed as zero. It indicated that total variation of calving interval was explained by this model.

The result of path analysis of calving interval by taking productive components had shown that the effect of dry period explains more variation in calving interval than lactation length.

#### REFERENCES

- Singh, R.K. and Chaudhury, B.D. (1977). *Biometrical Methods in Quantitative Genetic Analysis*. Kalyani Publishers, New Delhi and Ludhiana.
- Snedecor, G.W. and Cochran, W.G. (1967). *Statistical Methods*. Oxford and IBH Publication Co. Calcutta, Bombay, New Delhi.
- Tomar, S.S. (2000). In: *Compendium of Lectures. National Training Programme on Applied Statistical Methodology with Computer Orientation in Animal Breeding*, February 10 to March 1, (2000). Dairy Cattle Breeding Division, NDRI, Karnal, India.
- Wright, S. (1921). *J. Agric. Res.*, 20: 357-385.