Effects Of Previous Calving Interval On Milk Yield For The Mediterranean Italian Buffalo Population

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Introduction

Progressive dairy farmers aim to increase herd milk yield while to obtain the greatest profit from their cows. However, ample evidence exists for genetic antagonism of milk yield and fertility (Swanson L.V. et al. (1989); Lucy M. C. et al. (2001)). Calving interval is the fertility index widely used at the small farm level for Italian buffalo. Under herd conditions, a buffalo usually produces two calves in three years. But in well- managed herds of dairy buffalo, calving intervals of 11-12 months have been achieved. Prolonged calving interval in buffalo is primarily related to delayed breeding. Breeding may be delayed by prevalence of silent estrus, summer infertility, low progesterone levels (Qureshi M.S. and Ahmad N., (2007)), and lower LH levels (Batra S.K. and Pandey R.S. (1983)). Seasonality of breeding and nutritional status are additional contributing factors (Qureshi M.S. et al. (1999)). Month of calving had significant effects on calving interval in the Italian buffalo population (Zicarelli, L. et al. (2007)). Because buffalo are less sensitive to high temperatures than bovine, they tend to reproduce more efficiently during the warmest months of the year (Zicarelli L. et al. (2007)). Therefore, females that calved between April and September had shorter intervals than those calving between October and December (Zicarelli L. et al. (2007)). A negative correlation between calving interval and milk yield have been reported in dairy cow population (Gaines W. L. and Palfrey G.R. (1931)). Moreover, high milk production lead to longer calving intervals (Everett R.W. et al. (1966)). The objective of this study was to evaluate the effect of the previous calving interval on milk yield in the current lactation for the Mediterranean Italian buffalo population.

Material and methods

Data. Data for 86,585 lactation records from the Italian Buffalo Breeders Association (ANASB) database, were used to determine the effect of previous calving intervals (CI) on milk yield for the Mediterranean Italian buffalo breed. Only records from buffalo with a calving date after December 31, 1980, were included in the analyses. CI were calculated as the number of months between two calving dates. Records for a buffalo were excluded if the CI was less then 11 months or greater then 30 months. Each month of CI (from 11 to 30 months) represented a single class. After preliminary analyses, parities were grouped into three different classes: parities 1, 2 and equal to or greater than 3. Ninety-three age classes were formed. Twenty-one classes (25- 45 months) were assigned to parity 1, twenty-nine (37- 65 months) classes were assigned to parity 2, and forty-three classes (45- 90 months)

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were assigned to parities equal to or greater than 3. All age classes contained a single age in months, with the exception that the last class in parities equal to or greater than 3 included all ages greater than 90 months. Contemporary groups were formed by grouping records of buffalo calving in the same herd, in the same year, and season of calving within the year. Three seasons of calving were defined: months from January through April constituted the first season; months from May thorough August constituted the second season; and months from September through December, the third season. This data set was reduced by removing contemporary groups with a number of observations less then five.

Statistical Models. Milk yield can be affected by a number of different factors, such as age-parity, length of previous calving interval, and herd, which tries to account for differences in management practices among herds. In order to evaluate the effect of the previous CI on milk yield in the current lactation, estimates of milk yield need to be adjusted for these factors. The effect of the previous CI on these adjusted milk yields can then be evaluated. Two statistical analyses were used sequentially in evaluating the effect of the previous CI on milk yield in the current lactation. Estimates of milk yield (expressed as deviations from the mean) from the first analysis were used in the second analysis. The first analysis included the fixed effects of age-parity, previous calving interval, and herd contemporary group. The MTDFREML programs (Boldman et al. (1995)) were used for this analysis. The second analysis fit the solutions of milk yield for the effect of months of CI from the first analysis using linear regression, where CI class in months from 11 to 30 was the explanatory variable. PROC REG, the linear regression procedure of SAS (SAS Institute (2005)) was used for this analysis.

Results and discussion

Summaries of number of records, frequencies of records, and arithmetic means for milk yield by class of CI are shown in Table 1. Most of the lactation records (59.66%) had CI between 11 and 14 months, with the most numerous class at 12 months (21.26 %). Other lactation records were distributed between 15 and 24 months (37.91 %). A small percentage of records showed CI greater than 24 months (2.42 %). This distribution of CI may be, in part, the result of herd management strategies. Dairy producers try to shorten the CI of their herd in order to get the most profit from early conceptions of the buffalo. Thus, most of the records are distributed between CI of 11 and 14 months. Average milk yield ranged between 2,254 kg of milk yield for the 29 month CI class and 2,441 kg of milk yield for the 22 month CI class. In general, lactation records with longer CI showed greater milk yield than lactation records whose previous CI were shorter. These results agree with previous experimental studies (Everett R.W. et al., 1966) that found longer CI in high milk producing cows. The results for the regression model are shown in Table 2. The regression model was statistically significant ($P < 0.0001$). The coefficient of determination (R^2) was equal to 0.58. The intercept (a) was equal to 72.42 kg; and the linear coefficient (b) was equal to -3.43. Both coefficients estimated were statistically significant ($P < 0.0001$). The negative value of b denotes a negative effect of months of calving interval on milk yield. Solutions by month of CI on milk yield from the management adjusted model and the predictions from the linear model expressed as deviation from the mean of milk yield (2,356 kg) are shown in Table 1. Milk solutions ranged between –80.60 kg and 32.69 kg, respectively for 29 and 15 months of CI.

Whereas, the liner predictions ranged between -29.58 kg and 35.02 kg, respectively for 30 and 11 months of CI. The solutions and the predictions by CI on milk yield are presented in Figure 1. The linear model was a good fit of the management adjusted milk yield solutions for CI between 11 and 24 months. Whereas, the solutions for CI equal to or greater then 25 exhibited greater deviations from their linear prediction. The small number of records in those classes, or some kind of error in reporting calving dates, could be an explanation of those outliers. As shown from the graph, there was a negative relationship between milk yields and CI length. For each month increase in CI, there was an approximate drop of 3.5 kg in milk yield, which leads to a decrease of close to 60 kg from 11 to 24 month CI. This result agrees with the finding of Gaines W. L. and Palfrey G.R (1931) that demonstrated a negative correlation between CI and milk yield. There may be a physiological reason for the negative correlation between CI length and milk production. In fact, for longer CI, the mammary gland may become quiescent. And, it may regress to a primitive status, similar to that of a primiparous. Thus, longer CI will lead to lower milk production.

Table 1. Number of records (N), frequencies of records (%) with average means, management adjusted solutions [a] and linear predictions [b] of milk yield by CI (months) expressed as deviation from the mean milk yield (2,356 kg).

CI	N	Frequency	Milk Yield		
			Average mean	Herd adjusted [a]	Linear Prediction [b]
11	12,096	13.74	2,356	27.11	35.02
12	18,724	21.26	2,361	21.99	31.62
13	12,910	14.66	2,374	20.49	28.22
14	8,806	10.00	2,372	19.36	24.82
15	6,800	7.72	2,394	32.69	21.42
16	5,707	6.48	2,386	22.30	18.02
17	5,388	6.12	2,406	20.07	14.62
18	4,421	5.02	2,402	1.49	11.22
19	3,323	3.77	2,411	9.96	7.82
20	2,369	2.69	2,428	9.63	4.42
21	1,688	1.92	2,411	-10.33	1.02
22	1.446	1.64	2,441	10.03	-2.38
23	1,259	1.43	2,427	3.55	-5.78
24	984	1.12	2,422	0.00	-9.18
25	673	0.76	2,437	11.42	-12.58
26	434	0.49	2,362	-30.90	-15.98
27	340	0.39	2,404	5.19	-19.38
28	280	0.32	2,369	-31.58	-22.78
29	211	0.24	2,254	-80.60	-26.18
30	195	0.22	2,348	-20.73	-29.58

[a] Effects included in management adjusted model were: age-parity class, CI class, and contemporary group in herd as fixed effects; and residual error as random effect.

[b] Effects included in the linear prediction model were: intercept and linear coefficient of regression of CI on milk yield solutions from the management adjusted model.

Table 2. Parameters of the equation [1] $y_{ij} = a + bx_j$ to predict milk yield (kg) at various interval of CI in months.

Parameter	Estimate	Std. Error	t- value	Pr > t
a	72.42	14.45	5.01	< 0.0001
b	-3.43	0.68	-5.06	< 0.0001

[1] y= milk yield at various interval from parturition; x= CI.

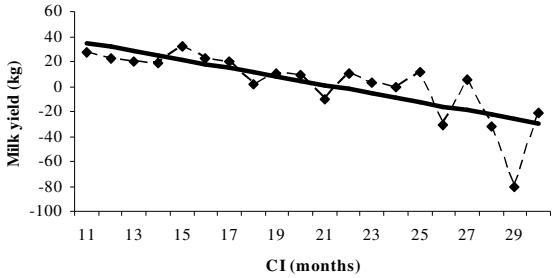

Figure 1: Plots of average solutions for CI classes from management adjusted model (♦–♦) and predictions from linear prediction model (—) for milk yield expressed as deviation from the mean milk yield (2,356 kg).

Conclusion

The present study indicates that there is a negative linear relationship between previous CI length and milk yield in the current lactation in the Italian buffalo population. This means that shorter previous CI have less of a negative effect on milk production of Italian Mediterranean buffalo than longer previous CI. Therefore, a short CI may increase the profits of the farm through higher milk production.

References

Batra, S. K. and Pandey, R. S. (1983). *J. Reprod. Fertil.*, 67: 191–196.

Boldman, K. G., Kriese, L. A., Van Vleck, L. D. *et al.* (1995). *Agric. Res. Serv.*, USDA.

Everett, R. W., Armstrong, D. V., and Boyd, L. J. (1966). *J. Dairy Sci.*, 49: 879–886.

Gaines, W. L. and Palfrey, J. R. (1931). *J. Dairy Sci.*, 14: 294-306.

Lucy, M. C. (2001). *J. Dairy Sci.*, 84: 1277–1293.

Qureshi, M. S., Samad, H. A., Habib, G. *et al.* (1999). *Asian-Aust. J. Anim. Sci.*, 12(7): 1019–1024.

Qureshi, M. S. and Ahmad, N. (2007). *Anim. Reprod. Sci.*, 106: 380–392.

SAS/STAT User's Guide, Version 9.1. (2005). Cary, NC: SAS Institute.

Swanson, L. V. (1989). *J. Dairy Sci.*, 72: 805–814.

Zicarelli L., Di Palo, R., Neglia, G. *et al.* (2007). *Ital. J. Anim. Sci.*, 6: 709–712.