The relation of the post-partum breeding interval to reproductive efficiency in the dairy cow

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For profitable milk production the dairy cow must reproduce regularly. An interval of 12 to 13 months between calves usually is considered satisfactory. Cows calving every 12 months or less had higher yields per day for the interval between calves than did cows that required more than 12 months before reproducing in studies by Gaines and Palfrey (1931) and Chapman and Casida (1935). This observation suggests that optimum milk-producing efficiency would be obtained by breeding cows as soon as possible after calving. Such a practice fails to consider the other possible physiological aspects of the problem.

Casida and Venzke (1936) found that approximately 26 days were required following calving for the uterus to return to normal position, tonus, and size. Hofstad (1941) in a study of 309 conceptions in a dairy herd in New York reported that 34 cows bred before the sixtieth day following calving required a higher average number of services per conception than did cows first bred more than 60 days after calving. The percentage of abortions and cases of metritis, dystocia, and retained placenta were much higher in the animals bred at less than 60 days post-partum than in those first bred later than that date. In a study of 291 range cattle, Lasley and Bogart (1943) found that of 35 cows bred 10 to 40 days after calving 48.6 percent settled with one insemination, but a maximum fertility of 75 percent conception with one insemination was obtained in 12 cows bred 161 to 190 days after calving. Erb and Shaw (1948) reported in a summary of a survey of breeding failures in Washington that there was an apparent improvement in breeding efficiency by waiting at least 50 days after calving before rebreeding. Similar improved results for delayed breeding have been reported by Jennings (1941) in breeding mares less than 9 days following foaling as compared with allowing more rest after foaling before rebreeding.

While the literature indicates that lowered reproductive efficiency may result from breeding too soon after calving, the evidence is limited. Records in one of the artificial breeding units in Illinois show that 20 to 25 percent of the cows are being serviced in a post-partum breeding interval of less than 60 days. This practice and the limited evidence available concerning

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what recommendations should be made prompted a detailed study of the breeding records of the cows in the University of Illinois dairy herd to determine the effect of the post-partum breeding interval on reproductive efficiency.

**Methods**

The breeding records of 593 cows representing the five major dairy breeds in the University of Illinois dairy herd were analyzed to determine the post-partum interval to first service for each conception which occurred over a period of approximately 28 years. The conceptions in this study were predominately from natural service.

Data on a total of 1,674 pregnancies, as confirmed by subsequent calving, were tabulated to show the number of days post-partum when first service was accomplished and the number of services required for conception in each case. Pregnancies which terminated in abortion were omitted since in such cases, where more than one service was required, the service date at which conception took place could not be definitely fixed.

The simple correlation coefficient between the post-partum interval to first service and the number of services required for conception was calculated on the individual observations. Methods described by Snedecor (1946) were used also to test the goodness of fit of the data to a second degree polynomial curvilinear regression using the formula $Y = a + bX + cX^2$, where $Y$ represents the estimated number of services per conception, and $X$ is the number of days from calving to the first subsequent service.

**Results and Discussion**

In this study of 1,674 pregnancies in 593 cows it was found that 1.97 services were required per conception over the entire period of 28 years. In table 1 a breakdown of the total conceptions shows that 55.8, 21.0, 11.1, and 5.1 percent of the conceptions were accomplished on the first, second, third, and fourth services, respectively; the remaining 7 percent of the pregnancies took 5 or more services with nearly 1 percent of these requiring 9 or more services. These results show a conception rate only slightly altered
from that presented by Trimberger and Davis (1945) for artificial breeding. Also, the results show the usual decrease in the efficiency of each subsequent service as the more highly fertile cows at a particular service are selected out by becoming pregnant. The breeding efficiency for each of the first 5 services was as follows: 55.8 percent conception in first service cows, 47.6 in second, 48.0 in third, 42.6 in fourth, and 41.4 percent conceptions in cows serviced for the fifth time.

The effect of the length of the post-partum interval to first service on reproductive efficiency is indicated in table 2. From this table it can be seen

<table>
<thead>
<tr>
<th>Post-partum interval to 1st service (days)</th>
<th>Total number conceptions</th>
<th>Total number services</th>
<th>Services per conception</th>
<th>Percent services resulting in conceptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-20</td>
<td>7</td>
<td>20</td>
<td>2.86</td>
<td>35.0</td>
</tr>
<tr>
<td>21-40</td>
<td>75</td>
<td>183</td>
<td>2.44</td>
<td>41.0</td>
</tr>
<tr>
<td>41-60</td>
<td>130</td>
<td>295</td>
<td>2.39</td>
<td>43.2</td>
</tr>
<tr>
<td>61-80</td>
<td>242</td>
<td>476</td>
<td>1.97</td>
<td>50.8</td>
</tr>
<tr>
<td>81-100</td>
<td>269</td>
<td>505</td>
<td>1.98</td>
<td>52.8</td>
</tr>
<tr>
<td>101-120</td>
<td>218</td>
<td>377</td>
<td>1.73</td>
<td>57.8</td>
</tr>
<tr>
<td>121-140</td>
<td>241</td>
<td>460</td>
<td>1.97</td>
<td>54.4</td>
</tr>
<tr>
<td>141-160</td>
<td>191</td>
<td>366</td>
<td>1.92</td>
<td>52.4</td>
</tr>
<tr>
<td>161-180</td>
<td>106</td>
<td>208</td>
<td>1.96</td>
<td>51.0</td>
</tr>
<tr>
<td>181-200</td>
<td>80</td>
<td>155</td>
<td>1.94</td>
<td>51.6</td>
</tr>
<tr>
<td>201 and over</td>
<td>115</td>
<td>248</td>
<td>2.16</td>
<td>46.3</td>
</tr>
<tr>
<td>Totals</td>
<td>1674</td>
<td>3293</td>
<td>1.97</td>
<td>50.8</td>
</tr>
<tr>
<td>Means 117 (days)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

that on the average the cows first bred within 20 days after calving required 2.86 services per conception, thus, only 35.0 percent of the services resulted in conception. The average fertility level of the cows increased with each additional 20 day interval, with a maximum number of services resulting in conception in those cows first bred 101 to 120 days after calving. This group required 1.73 services per conception. With a post-partum interval to first service of 121 to 200 days there was little change in reproductive efficiency. The percentage of services resulting in conception was slightly lower in cows first bred more than 200 days after calving.

Calculation of the simple correlation coefficient between the post-partum interval to first service (days) and the number of services required for conception for each calf produced resulted in an $r$ value of $-0.02$, which is not significant. However, analyses of only the 454 conceptions which
occurred from breeding within 80 days after parturition showed a significant correlation coefficient of \(-0.116\) between the days postpartum to first service and the services required for conception. The simple regression line of that analysis is presented in figure 1 as the solid line.

Since the over-all picture showed no simple correlation between time of breeding after calving and reproductive efficiency, but did show a significant relationship between these two for one portion of the data, the possibility of a curvilinear relationship was suggested.

When the entire body of data was fitted to a curve by the use of the second degree polynomial regression equation, \(Y = a + bX + cX^2\), it was found that the departure from linear regression or the curvilinearity of the data was highly significant. The regression equation derived from the data was \(Y = 2.605 - 0.0102X + 0.000033X^2\), where \(X\) is the number of days from parturition to first service and \(Y\) is the resulting estimated number of
services required for conception. The analysis resulted in a multiple correlation coefficient of $R = 0.10$, which is significant at the 1 percent level of probability. Though significant, this multiple correlation coefficient shows that only a very small portion of the variance in services required for conception was accounted for by the interval after calving when a cow was first bred.

The regression curve describing the data is illustrated in figure 1 by the broken line. The actual averages of the data for each time interval shown in table 2 also are indicated in figure 1. An analysis of variance showed the differences between the mean number of services required for conception at the various time intervals were significant at the 1 percent level of probability.

Discussion

The results of this study with known fertile cows indicate that reproductive efficiency in dairy cows increases as the post-partum interval to first breeding increases up to a limit. In these studies maximum breeding efficiency resulted when breeding was delayed an interval of from 100 to 120 days after calving and decreased slightly thereafter. The mean post-partum interval to first service was 117 days and the standard deviation was 53.3 days. This long interval probably was not due to pathological conditions making postponement of service advisable on that account, but to the fact that most of these cattle were routinely milked for 365-day lactation periods. Gaines (1927) in his studies of Guernsey cows on Advanced Registry tests found the average post-partum interval to conception to be 174 days whereas in this case it was approximately 158 days. From the results of this and other studies, it is questionable if a standard interval from calving to first service can be recommended for optimum results under all conditions. However, it seems well established that a certain minimum post-partum interval is required for involution of the uterus (Casida and Venzke, 1936) for the cow to come into estrus following calving (Chapman and Casida 1934), and for recovery of the uterine mucosa so as to avoid possible infections consequent to service (Hofstad, 1941). On the other hand, these minima probably vary within fairly wide limits and may be dependent to some degree on a relation to the mammary gland. Cows milked $2 \times$ daily came into heat following calving on the average 23 days sooner than did cows milked $4 \times$ daily in data reported by Clapp (1937). Whether or not this effect is a consequence solely of frequency of milking and not of level of production cannot be ascertained, though presumably frequency of milking is of major importance as nurse cows suckling calves showed first estrus after calving somewhat later than did cows milked $4 \times$ daily. There is
some evidence suggesting that level of milk yield has no observable effect on reproductive efficiency (Gaines, 1927) as measured by the length of the service period, or the post-partum conception interval.

From the standpoint of milk production itself, the effect of pregnancy in accelerating the rate of decline after the midpoint of the gestation period is well known, and may influence markedly the total production in a lactation. However, Gaines and Palfrey (1931) and Chapman and Casida (1935) have shown that prolongation of the calving interval results in a decrease in the average production per day between calves. On the other hand, the gain in milk yield per day in the current lactation from a short calving interval is lost in the following lactation (Matson, 1929; Gaines and Palfrey, 1931). Matson also concluded that the optimum calving interval varied directly with the milking capacity of the individual cow and inversely with her age up to maturity. Thus, it appears that no date can be fixed as the optimum post-partum breeding interval which would be applicable to all cows in general. However, the lowered conception rate, the probable increased breeding troubles, and the questionable net gain in production over a period of more than one lactation from a short post-partum breeding interval suggest that it is probably unwise to breed cows sooner than 60–80 days after calving.

Summary

A study of 1674 pregnancies in 593 cows of the University of Illinois dairy herd showed that:

(1) A mean of 1.97 services were required per conception, and the mean post-partum interval to first service was 117 days. The standard deviation of services per conception was 1.60 and of post-partum interval was 53.3 days.

(2) Fertility increased with the length of the post-partum interval to first service up to 100 to 120 days.

(3) In the cows bred less than 20 days after calving only 35 percent of the services resulted in conceptions, while nearly 58 percent of the services were effective in those cows bred 100 to 120 days after calving.

(4) Reproductive efficiency for the cows first bred 120 to 200 days after calving remained fairly constant, but those first bred more than 200 days after calving required a slightly greater number of services per conception.

(5) The simple correlation between the post-partum interval to first service and reproductive efficiency was not significant; however, a curvilinear relationship was indicated by the significant departure from linearity when the data were fitted to a curve by the use of a second degree polynomial curvilinear regression equation.
Literature Cited


