Age of First Calving and Subsequent Fertility and Survival in Holstein Friesian Cattle

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Abstract
The aim of the study was to investigate the relationship between age at first calving (AFC) and subsequent fertility and survival up to third calving in Holstein Friesian heifers. Study comprised 116 consecutively born female calves from the same herd. The animals were divided in four AFC groups for analysis: <24 months, 25-27 months, 28-30 months, > 30 months. Fertility before first calving was recorded as age at first breeding (AFB), services per conception (S/C), age at conception, first service conception rate (FSCR) and actual AFC. After first calving, fertility was recorded as days to first service (DFC), days to conception (DTC), S/C and FSCR. Survival rate up to third calving also was recorded. The proportion of heifers conceiving to first service, before calving, was highest (100%) for the youngest AFC group (<24 month) and worst (33.33%) for the oldest AFC group (>30 month). Fertility in the first lactation was best in primiparous cows calving at 25-27 months. Survival rate up to third calving was 42.85% for <24 months group, 75.55% for 25-27 months group, 68.42% for 28-30 months group and 44.44% for >30 month group. In conclusion, performance in Holstein Friesian cows was achieved with an AFC of 25-27 months. These animals performed well in terms of fertility and survival.

Keywords: age at first calving; fertility; Holstein Friesian heifer, longevity.

1. Introduction

Reproductive efficiency of a cow is measured by factors such as age at first calving, calving interval, days open and number of services per conception.
Age at first calving (AFC) affects the profitability of a dairy farm. A heifer does not normally become profitable until his second lactation. An earlier age at first calving can reduce rearing costs due to decreased feed and labor cost. Some economic analysis showed that reducing AFC from 25 to 24 or 21 months, the replacement costs decreased by 4.3% or 18% respectively [1]. Also, reducing AFC allows surplus heifers to be sold, maximizing herd profitability.

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Decreasing age at first calving has a positive effect on genetic progress because the generation interval decreases and progeny tests of bulls are carried out earlier [2].
Theoretically, reduction of age at first calving can increase the number of calves per cow but dystocia can be a factor that may reduce the livability of calves, as discussed elsewhere [3, 4]. Monitoring growth of heifers to join the herd at an age and body weight that will enable them to achieve their full lifetime potential is also fundamental.
Gestation length is fixed; therefore AFC is a function of the age at the beginning of first breeding and the reproductive efficiency of the animal. When to start breeding is influenced by nutrition and health. Poor growth during the rearing period has been associated with delayed first breeding. Poor fertility can lead to a large spread in AFC and may be large differences between target and actual AFC achieved. Values

of heritability of age at first calving are inconsistent raging in from 0.05 to 0.74 [5, 6].
Current data on the influence of AFC on the subsequent performance of dairy cows are not always in agreement. These differences may in part be caused by variations in genetics and management between different studies.
The effect of age at first calving on longevity is not clear [7, 8] and lifetime performance appears to be maximized with freshening at 22.5 to 23.5 months [9]. There is, also, little information available about influences of AFC on subsequent survival. Farmers need information in their management decisions on heifer growth and breeding strategies.
The aim of this study was to investigate the relationship between AFC and subsequent fertility and survival up to third calving in Holstein Friesian heifers.

2. Material and methods

The dataset comprised 116 consecutively born Holstein Friesian female calves from the research farm (herd size, 260) of Agricultural and Development Research Station (ARDS) Simnic-Craiova, Romania (182 m above sea level, $4^{o}19'N$, $23^{o}48'E$).
Female calves were recruited at birth and monitoring until removal from the herd or third calving. All heifers were artificially inseminated at the first observed estrus and then again at any subsequent estrus from the start of service period. Pregnancy was confirmed by transrectal palpation. Following calving all cows were artificially inseminated at observed estrus after a voluntary wait period of 60 days, and pregnancy was confirmed by transrectal palpation.
The fertility of heifers was recorded as age at first breeding (AFB), services per conception (S/C), age of conception, first service conception rate (FSCR) and actual AFC.
After first calving, fertility war recorded as days to first service (DFS), days to conception (DTC), S/C, FSCR and calving interval (CI).
Heifers were grouped retrospectively based on their actual AFC: <24 month, 25-27 month, 28-30 month and >30 month. This grouping was based on the spread of the AFC observed. Data are presented as means ± standard deviation. Differences among groups compared using analysis of variance (ANOVA). Data were considered statistically significant if p values were ≤ 0.05.

3. Results and discussion

Of the 116 consecutively born female calves recruited, 17 (14.7%) failed to reach first calving, all due to mortality or culling during the rearing period.
A summary of the fertility performance of heifers is shown in table 1.
The mean AFC of all heifers was 27.4 months despite a target AFC of 25 months. AFC average is 25.8 months in Ireland [10], 28.1 months in Italy [2] and 28,4 months in Sweden [11].
The variation in calving age observed in the farm (683 days for <24 month group, 796 days for 25-27 month group, 879 days for 28-30 month group, and 981 days for >30 month group) may be attributed to difference in age at first breeding (410 days for <24 month group, 515 days for 25-27 month group, 586 days for 28-30 month group and 667 days for > month group) and is related to heifer fertility.
It is widely accepted that Holstein Friesian cows have suffered reducing fertility over the past 40 years as genetic selection for milk yield has increased [12], and putting less emphasis on fertility of nulliparous heifers. In this study FSCR was 100% for <24 month group, 88.88% for 25-27 month group, 63.15% for 28-30 month group and 33.33% for >30 month group. Fertility deteriorated as heifers aged (table 1).
Age at conception was 410 days for heifers in <24 month group, 519 days for 25-27 month group, 601 days for 28-30 month group and 703 days >30 month group (table 1).
The variability of fertility parameters of cows during first lactation in relation to age at first calving is presented in table 2.
The results of this study confirmed previous reports that AFC effects fertility in the first lactation. Animals in <24 month group, and in 25-27 group tend to have the best fertility in their first lactation (table 2). Animals calving in the oldest group had the lowest first service conception rate, 28.57% compared with 66.66% in <24 month group and 53.33% in 25-27 month group.

Table 1. Fertility of heifers (before calving) in relation to their age at first calving

	Age at calving of heifers:				ANOVA
	<24 months	25-27 months	28-30 months	>30 months	p-value
Number of heifers	7	45	38	9	
AFB (days)	410±42[d]	515± [c]29	586[b]±27	667±[a]61	0.001
S/C	1.00[b]	1.13[b]	1.44[b]	2.10[a]	0.001
FSCR	7/7(100%)[a]	40/45(88.88%)[b]	24/38(63.15%)[c]	3/9(33.33%)[d]	0.001
Age of conception (days)	410±42[d]	519±29[c]	601±27[b]	703±39[a]	0.001
Average gestation length (days)	273±5	277±5	278±5	278±5	NS
Actual AFC (days)	683±42[d]	796±29[c]	879±28[b]	981±40[a]	0.001

Values are mean ±SD; within vows a>b>c>d using ANOVA; NS = not significant

Table 2. Reproductive performance of cows during first lactation in relation to age at first calving

	Age at first calving				ANOVA
	<24 months	25-27 months	28-30 months	>30 months	p-value
Starting number of cows	7	45	38	9	
Day to first service	63.6±13.5	92.0±38	81.6±24.0	106.4±56	NS
First service CR	4/6(66.66%)	24/45(53.33%)	18/34(52.94%)	2/7(28.57%)	NS
S/C	1.2	1.8	2.0	2.14	NS
Days to conception	72.2±25[c]	124.7±70[b]	132.6±85[ab]	136.2±57.3[a]	0.01
Average gestation length (days)	274.6±4.1	278±5.5	279.6±5.1	282±6.3	NS
Age at second calving (days)	1030[d]	1199[c]	1291[b]	1399[a]	0.001
Calving interval	347	403	412	418	

Values are mean ±SD; within vows a>b>c>d using ANOVA; NS = not significant

Table 3. Reproductive performance of cows during their second lactation

	Age at calving				ANOVA
	<24 months	25-27 months	28-30 months	>30 months	p-value
No. of cows (%)	5/7(71.40)[b]	39/45(86.66)[a]	32/38(84.21)[a]	5/9(55.55)[b]	0.05
DFS	90±36.0	76.67±31.3	83.1±24.0	96.3±51.8	NS
FS Conception rate	¾(75%)	23/34(67.64%)	13/32(40.62%)	2/4(50%)	NS
S/C	1.5	1.6	1.9	1.5	NS
DTC	102.7±39.5	97.0±49.4	131.9±62.1	90±36	NS
Age at 3rd calving	1408[c]	1575[b]	1703[a]	1772[a]	0.05
Calving interval	378	376	412	373	NS
Number of cows at 3rd calving	3/7(42.85%)[c]	34/45(75.55)[a]	26/38(68.42%)[b]	4/9(44.44%)[c]	0.01
Average for all ages at 3rd calving	67/99 = 67.67%				

Values are mean ±SD; within vows a>b>c>d using ANOVA; NS = not significant

Primiparous cows in <24 month group and in 25-27 month group had a lower calving interval (347 days and 403 days respectively) compared to older age groups (412 days for 28-30 month group and 418 days for >30 month group).

Good female fertility is characterized by cows that return to cyclicity soon after calving, show signs of estrus, have a high probability of becoming pregnant, and have the ability to carry the resulting fetus to term. Cow survival to lactation 2 was better for 25-27 month group (86.66%), 28-30 month group (84.21%) and for <24 month group (71.40%). The fertility parameters of cows in their second lactation in relation to age at first calving are presented in table 3.

Days open can be split in two partial intervals: interval between calving and first service, and interval between first service to conception. The first one expresses the ability to return to cyclicity and the second one to become pregnant.

First service conception rate was good for cows in second lactation in <24 month group and in 25-27 month group (75% and 67.64% respectively), and badly in 28-30 month group (40.62%) and in >30 month group (50%).

There was no significant effect of AFC group on DFS, S/C or DTC in this study. As expected DFC

was significantly associated with age at second calving and at 3rd calving (table 2 and 3). Heifers calving initially at <24 month calved for a third time at 1408 days. This was similar to the age at second calving of 1399 days for the >30 month AFC group.

The number of cows reaching third calving was better for 25-27 month group (75.55%) and 28-30 month group (68.42%), and badly for <24 month group (42.85%), and >30 month group (44.44%).

Primary reasons given for culling at any time after first calving were: infertility (n=15), low yield (n=5), metabolic problems (n=4), mastitis (n = 2), aborted second pregnancy (n=2) and calving related problems (n=2).

4. Conclusions

In conclusion, optimum performance in Holstein Friesian cows over 3rd calving or 5 years of life was achieved with an AFC of 25-27 month as these animals performed well in terms of fertility and survival. Animals with poor herfer fertility had reduced survival and are this unlikely to repay their rearing costs.

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