Postpartum Performance of Dairy Heifers Freshening at Young Ages[1]

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ABSTRACT

Records from Florida Agricultural Experiment Station dairy herd for 1144 heifers freshening from 1959 to 1979 were studied to evaluate effects of age and problems at parturition on subsequent yield and reproduction. Statistical analysis was by method of ordinary least squares analysis of variance; five measures of reproduction, survival to second lactation, and 15 measures of yield were studied. Mean first parturition age was 25.8 mo with 40% of individuals ≤23 mo; survival to second parturition was 67%. No effects of age at first parturition were detected on survival, postpartum reproductive performance, or milk composition other than lactose-mineral, chloride, and acidity percentages; effects on yield were similar to previous reports. Stillbirth did not affect subsequent reproductive performance but was associated with decreased milk yield: 181 kg or 5.2% of overall mean. Milk yield was depressed by 239 kg for retained fetal membrane, 173 kg for dystocia, and 98 kg for metritis; milk composition essentially was unaltered. Heritability of postpartum days to first estrus was .14; estimates were 0 for days to first service, days open, and calving interval. Additional research is needed on interrelationships of gestation length with subsequent yield and reproduction and in alleviating detrimental effects of problems at parturition.

(Key words: young heifers, yield, reproduction)

INTRODUCTION

Mean age at first parturition of Florida cows is about 26 mo (13). Hargrove et al. (3) found that maximum lifetime milk yield should result from heifers freshening first at 27 mo, but Gill and Allaire (2) indicated that optimal age for total lifetime performance was about 23 mo; maximum profit per day of herd life was for heifers freshening first at about 25 mo. Lee (5) estimated the genetic correlation between age at first parturition and milk yield to be .27; negative correlations of −.15 to −.32 between age and total lifetime yield and profit were found by Gill and Allaire (2), however. The latter also found first lactation yield and lifetime yield and profit to be highly correlated genetically (.93 and .74). Martin et al. (7) and Thompson et al. (12) found that calving difficulty did not affect subsequent milk yield but was followed by lowered fertility and higher culling rates. Days open increased linearly with increased age at first parturition (b = 2.3 d/mo) in a study by Wilcox (14).

In a designed experiment, Lin et al. (6) studied performance through three lactations of heifers bred after 350 d (n = 253) or after 462 d (n = 249) at five research stations. Following first parturition, the earlier bred heifers did not differ significantly from later bred heifers, although means favored the former for service period (5 d), days open (8 d), first service conception rate (9%), and number of services per conception (.2). These and other estimates led these authors (6) to conclude that dairy farmers should breed first at 12 or 13 mo under proper management conditions.

Increases in frequency of problems at parturition associated with reduction of age at first

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parturition to 22 mo in this herd would be expected to be slight or nil (11). Objectives of the present study were to delineate effects of problems at parturition on subsequent yield and reproduction during first lactation and to study effects of age at first parturition.

MATERIALS AND METHODS

Data were from first lactation cows freshening at the Florida Agricultural Experiment Station Dairy Research Unit herd from 1959 to 1979. Collection, handling, and screening of data and definition of problems at parturition were reported by Simerl et al. (11). After first parturition, heifers were examined within 7 d postpartum to determine reproductive status and treated and reexamined as warranted. First service for animals of apparently normal reproductive status was ≥50 d postpartum. Voluntary culling was performed for low milk yield (age adjusted) and days open ≥305. Milk sampling and testing procedures were reported by Sharma et al. (10) and Simerl et al. (11). Data were analyzed by method of ordinary least squares analysis of variance using standard computer packages (1, 4). Overall mathematical model was breed, sire within breed, season of parturition, year, and age at parturition. Year-season interactions could not be included in the model because solutions could not be obtained for such models. Calf gestation length and birth weight were included in some analyses as appropriate. Problems at parturition were included as independent variables in analyses of yield responses. Breeds were analyzed separately, but results were pooled in some cases because of lack of heterogeneity of response between breeds. Breed representation was Guernsey, 12.4%; Ayrshire, 3.1%; Brown Swiss, 3.8%; Jersey, 39.3%; and Holstein, 41.3%.

RESULTS AND DISCUSSION

Mean Performance

Postpartum reproductive performance is in Table 1 and yield in Table 2. Values within each column in Table 1 are not necessarily additive because numbers of observations for each response varied. Some individuals failed to come into estrus prior to culling; hence, their data were not used in calculating means in Table 1 but were used for means in Table 2. Performance overall was adequate for a subtropical climate and for the time involved. Data subsets after screening included 766 to 1144 heifers; 82 others were excluded for various reasons. Of these, 39 (3.2% of total) had less than 30 DIM. Fifteen (13 Holsteins, 1 Jersey, and 1 Guernsey) suffered problems at parturition; their mean age was 25.0 mo compared with 28.5 mo for the remaining 24 heifers and 25.8 for those surviving screening. Of the 24, 20 were removed for blind quarters, mastitis, or immeasurably low milk yield; the remaining were lost, one each, to diarrhea, pneumonia, hardware, and milk fever. Although culling was lower among Holsteins than others (67% of all heifers initiated a second lactation), this doubtless reflected management choice to increase Holstein herd size at the expense of other breeds.

TABLE 1. Mean postpartum reproductive performance of Jerseys, Holsteins, and all data.

	Jerseys	Holsteins	All data[1]
Number	297 to 428[2]	338 to 396	766 to 1067
Days to first estrus[3]	31	36	34
Days to first service[3]	74	70	73
First to successful service	38	45	43
Days open[3,4]	122	120	121
Calving interval[3]	391	394	395

[1]Includes data from five breeds.

[2]Range in number of observations for five responses; lowest number is for calving interval.

[3]From parturition.

[4]Length of lactation records: Jerseys, 264; Holsteins, 266; all data, 262.

TABLE 2. Mean lactation yield of Jerseys, Holsteins, and all data.

	Jerseys	Holsteins	All data
Number[1]	389 to 450	370 to 473	969 to 1144
Length of record, d	264	266	262
Days pregnant[2]	142	146	141
Milk yield[3]	2764	4434	3494
Fat yield	139	151	143
SNF Yield	265	413	324
Total solids yield	405	573	472
Protein yield	103	144	120
Lactose-mineral yield	161	263	203
Fat, %	5.00	3.42	4.25
SNF, %	9.36	8.74	9.10
Total solids, %	14.37	12.14	13.38
Protein, %	3.69	3.19	3.45
Lactose-mineral, %	5.68	5.55	5.64
Chloride, %	.137	.141	.138
Acid, %[4]	.169	.169	.167
SNF:Fat	1.90	2.60	2.21
Protein:fat	.75	.95	.84

[1]Range in number of observations for all responses.

[2]During first lactation.

[3]Yields in kilograms.

[4]Titratable acidity.

Effects of Age at Parturition

No effects of age at first parturition on survival to second parturition were detected, although animals freshening at 25 to 27 mo had slightly higher survival rates (.69) than all others (.66; $\chi^2 = 1.38$, $P > .20$). Older heifers (≥28 mo at parturition) had slightly (not significant) lower (.645) survival rates than young (≥23 mo) heifers (.663). Furthermore, we could not detect effects of age on any of the five measures of reproductive performance. Mathematical model for these analyses also included calf gestation length and birth weight; their deletion, however, altered estimates only slightly and did not alter conclusions. All linear regression coefficients for age were positive (no significant quadratic or cubic terms) (Table 3), suggesting that lower ages likely were not associated with poorer reproduction, even though these measures are not independent.

Age effects for six yield traits in Table 2 were detected and were curvilinear (quadratic) except for milk and lactose-mineral yield, which were linear. All yield increased with age as expected. The mathematical model for this study (results not shown) included the

TABLE 3. Regression of postpartum reproductive performance on age[1] at parturition, pooled across breeds.

	β_0	β_1	SE[2]	P[a]
Days to first estrus	44	.04	.18	.81
Days to first service	68	.21	.16	.21
Days open	102	.48	.61	.43
Days to successful service	67	.26	.51	.65
Calving interval	374	.96	.66	.15

[a]Approximate probabilities associated with estimates of β_1; no higher order, to third order, significant ($P > .15$).

[1]Independent variable, range 18 to 40 mo.

[2]Standard error of linear regression coefficient, β_1. Table 1 shows overall means for each variable.

TABLE 4. Effects in days of problems at parturition on subsequent reproductive performance, pooled across breed.

	Stillbirth	Retained fetal membranes	Dystocia	Metritis
Days to first estrus	–1.9	8.6*	–1.1	1.8
Days to first service	–2.5	–3.2	2.4	.6
Days open	–.4	31.1**	48.6**	25.1**
Days to successful service	2.0	34.9**	46.6**	23.9**
Calving interval	–1.5	33.1**	44.7**	27.2**
Frequency	.115	.036	.039	.105

*$P < .05$.

**$P < .01$.

variables listed for study of reproductive traits plus days pregnant and length of record. Age effects on percentages or ratios were not detected except for lactose-mineral percentage, which increased, and chloride percentage, which decreased, both linearly. Percentage of acidity decreased curvilinearly. Prediction equations for each are available from the authors.

Effects of Problems at Parturition on Performance

Although herd managers attempted to alleviate harmful effects of problems at parturition by treatment and special care in essentially all cases (i.e., no cases purposely were left untreated), problems at parturition often were associated with impaired subsequent reproductive performance. Stillbirth had no detectable effect on subsequent reproduction, however (Table 4); range in five least squares estimates was –2.5 to 2.0 d. Likewise, days from parturition to first service were relatively unaffected. This measure was under management control to some degree, or, at least, this result suggests that animals with problems recovered to the degree that they exhibited what apparently was normal estrus; at that time, they were inseminated. The only detectable effect was on days to first estrus followed occurrence of retained fetal membranes, increasing the period by 8.6 d. Pelissier (9) found that, following retained fetal membranes, first service conception rate dropped from 41.5 to 29.7%, and number of services required per conception increased from 2.73 to 3.43. Martin et al. (7) could not detect detrimental effects on milk yield following retained fetal membranes; normal animals gave slightly less milk (.9 kg at peak day, 45 kg for 305 d). Reproductive performance was affected, however; retention resulted in an increase of 4 d to first service, 19 d to successful service, and .2 services per conception. These estimates agreed with the present study, which showed increased days open, days to successful service, and days calving interval of 31 to 35 for retained fetal membranes, 45 to 49 for dystocia, 24 to 27 for metritis, and 33 to 35 for one or more of these problems. McDaniel (8) found in Holsteins that days open increased by 8 to 14 d for animals that needed some assistance at parturition and 21 to 39 d for severe dystocia.

Effects of the different problem categories on yield are in Table 5. Stillbirth was associated with decreased yield, although not significantly so for SNF and lactose-mineral yield. Estimates of detrimental effects ranged from 83 to 239 kg or from 2.4 to 6.8% of overall yield. Yield variables are highly correlated phenotypically and genetically, so similar estimates of detrimental effects would be expected; all 30 estimates were negative, although not all significant. McDaniel (8) found detrimental effects of severe dystocia on milk and fat yield of 206 and 287 and of 11 and 15 kg. Milk composition was essentially unaffected by problems. Exceptions were slight decreases in percentage of acidity; protein to fat ratios were increased slightly by metritis because of slight and nonsignificant increases in protein and decreases in fat percentages.

Genetic Aspects

Heritabilities and genetic correlations between all pairs of yield variables were esti-

TABLE 5. Effects[1] of problems at parturition on subsequent yield, pooled across breed.

Variable	Stillbirth	Retained fetal membranes	Dystocia	Metritis	SE[2]
Milk yield[3]	−181.2**	−238.7**	−173.2**	−97.7*	42.3
Fat yield	−8.8**	−11.4*	−1.0	−6.1*	2.4
SNF Yield	−12.7	−21.2	−6.4	−7.1	7.2
Total solids yield	−18.8*	−31.2**	−5.3	−11.6	8.3
Protein yield	−5.8**	−7.9**	−2.1	−1.6	1.9
Lactose-mineral yield	−5.8	−14.3	−7.0	−5.7	8.7
Fat, %	−.025	−.040	−.044	−.039	.049
SNF, %	.003	−.039	.027	.006	.045
Total solids, %	−.004	−.030	.029	−.028	.051
Protein, %	.019	.010	.034	.037	.038
Lactose-mineral, %	−.019	−.057	−.015	−.037	.046
Chloride, %	−.001	−.005*	−.001	.002	.002
Acid, %	−.000	−.007*	.004	.001	.003
SNF:Fat	−.007	.022	.053	.049	.029
Protein:fat	−.001	.026**	.003	.025**	.006

[1]Values are least squares estimates.

[2]Standard errors for effects of metritis; estimates for other columns are similar.

[3]Yields are in kilograms.

*$P < .05$.

**$P < .01$.

mated but are not presented here. Daughters by the same sire were assumed to be paternal half-sibs. Estimates agreed closely with previous estimates for this population [e.g., (9)], although several for heritability were slightly higher. Genetic correlations between measures of reproductive performance were not estimated because all estimates of sire variances but one were negative. Heritability of days from parturition to first estrus was .14 ± .11. Estimates of the genetic parameters have large standard errors because of the small size of the data set and low frequency of the traits studied.

CONCLUSIONS

There seems little evidence that frequency of problems at parturition will increase appreciably if dairy farmers reduce age at first parturition and manage pregnant heifers reasonably. The present study was small and on a single herd, so conclusions are tentative. Although data were adjusted for sex, birth weight, and gestation length of the calf and for other factors, we were unable to detect age effects with heifers as young as 23 mo. The interrelationships of these variables are mathematically and biologically complex and merit continued study. In any event, frequencies of problems of older heifers ≥28 mo appeared higher than average; reducing the number of animals freshening in this age class should be beneficial. Postpartum reproductive performance, including survival in the milking herd to second lactation, was unaffected in our study by age at parturition. Problems at parturition, except for stillbirth, apparently increased days open and calving interval. Stillbirth, however, was associated with decreased yield, as were the other problems (although not always significantly so). Research to ameliorate detrimental effects of problems at parturition seems warranted.

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