Gestation Length and Overall Performance in the Subsequent Lactation of Dairy Cows Conceiving to Holstein, Jersey, or Angus Semen: An Observational Study

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Summary

Breeding strategies adopted by commercial dairy herds have evolved in recent years by incorporating the use of several breeds, including beef sires. Results of such strategies on offspring performance have been studied but reports on the effects on dam's overall performance after calving are still lacking. The goal of this observational study was to investigate the associations between sire breed of previous conception, gestation length, and postpartum performance of dairy cows. Records from Holstein and crossbred cows from a Kansas commercial herd were extracted. Data pertaining to cows that conceived from Holstein, Jersey, or Angus sires and initiated second lactation or greater from June 2017 to May 2018 were used in this study. Gestation length was shorter for cows that conceived from Holstein (274.9 ± 0.6 days) compared with Angus sires (276.5 ± 0.6 days). Cows that conceived from Jersey sires had the longest gestation length (278.0 ± 0.4 days). For Holstein cows, milk yield in the first 60 days after calving was influenced by sire breed used on the previous lactation. Holstein cows that became pregnant with Holstein sires had the lowest milk yield compared with other permutations of dam and conceptus breeds. Interestingly, sire breed of previous conception did not influence milk yield in the subsequent lactation of crossbred cows. Cows that became pregnant with Angus sires had greatest incidence of postpartum disorders compared with cows conceiving from Jersey or Holstein sires (28.0, 11.5, and 9.4%, respectively). Nonetheless, sire breed of previous conception did not affect probability of culling in the first 60 days after calving. This study presents evidence that breed of conceptus influences gestation length and milk yield of the dam in the subsequent lactation.

Introduction

Breeding programs in dairy herds have historically been designed to generate replacement heifers of superior quality to promote genetic progress according to the long-term objectives of each operation. With recent advances in reproductive performance, many dairy herds are producing a surplus of heifers, which can negatively impact profitability when feed prices are high, or the market value of replacement heifers is low. In order to optimize profitability, several dairy producers are striving to generate only the necessary number of dairy replacement heifers to maintain the lactating herd. Therefore, dairy

semen is utilized in a limited number of inseminations and beef sires are used in the remaining services. On Kansas dairy farms, this strategy is currently being adopted by herds milking both Holstein and crossbred cows. Even though it is well-documented that breed of sire influences performance of the offspring, the effects of sire breed of previous conception on postpartum health, productive, and reproductive performance in the subsequent lactation of the dam are unknown.

Objectives of the present study were to investigate the association between sire breed of previous conception and gestation length, health, productive, and reproductive performance in the subsequent lactation of dairy cows from one commercial herd in Kansas.

Experimental Procedures

Records of Holstein (n = 749) and crossbred (Holstein × Jersey; n = 360) cows from a large commercial dairy herd in Kansas were used for this observational study. Data of cows initiating their second lactation or greater from June 2017 to May 2018 were extracted from the on-farm management software. In the previous lactation, cows were inseminated with Holstein or Jersey semen for the first 3 services. After the third insemination, cows were inseminated with Holstein, Jersey, or Angus sires until conception. Records of cows that became pregnant at first insemination were not included in the analyses.

For each cow, gestation length was calculated by subtracting date of calving from date of previous conception. Cows that aborted or had gestation length shorter than 256 days or longer than 297 days were not included in the study. Data for offspring sex, twinning, and stillbirths were also extracted from the farm software.

Postpartum information regarding occurrence of uterine diseases (retained placenta and metritis), non-uterine diseases (mastitis, displaced abomasum, pneumonia, and lameness), and culling within the first 60 days in milk (DIM) were evaluated. Health or culling events occurring after 60 DIM were not included in the analyses.

Monthly milk tests were conducted in the herd and estimated weekly milk yield was calculated by the on-farm software. Weekly milk yield for the first 8 weeks of lactation was extracted. Records of cows culled before 60 DIM were used until the last complete week preceding culling.

Cows were eligible to be inseminated starting at 50 DIM. Days in milk at first service was calculated as the difference between date of first insemination and date of calving. In addition, pregnancy per artificial insemination (P/AI) at first service was calculated by dividing the number of cows that became pregnant at first AI by the number of cows inseminated.

A linear regression model was used to investigate the association of sire breed of previous conception and gestation length. In addition to sire breed, variables explored in the initial model included cow breed (Holstein vs. crossbred), lactation number, projected milk yield, DIM at conception, season of the year when calving occurred, twinning, offspring sex, and the interaction between sire breed of previous conception and cow breed.

Association of milk yield in the first 8 weeks and sire breed of previous conception were explored using a mixed model statistical approach (MIXED procedure of SAS; Version 9.4, SAS Inst. Inc., Cary, NC). In addition to the variables described in the initial model, gestation length, duration of dry period, days spent in close-up pen, occurrence of stillbirth, week of lactation, and the interactions between sire breed and week, cow breed and week, sire and cow breeds, and week and sire and cow breeds were tested.

Logistic regressions were used to evaluate the association between sire breed of previous conception and occurrence of diseases, culling, and P/AI at first service, and a linear regression was used to explore the association between sire breed of previous conception and DIM at first service in the subsequent lactation.

Given the breeding strategy of the herd, DIM at conception in the previous lactation was forced to remain in all models because it was considered a confounder variable. All linear and logistic regressions were conducted using the GLIMMIX procedure of SAS.

Results and Discussion

Days in milk at conception was considerably greater ($P < 0.01$) for cows that became pregnant with Angus sires than cows pregnant with Jersey or Holstein sires (221.1 ± 43.7, 126.0 ± 44.8, and 122.8 ± 54.5 DIM, respectively). This occurred because of the breeding strategy used by the herd, which did not use Angus semen in the first 3 services. Angus-bred cows also had greatest projected 305-day mature equivalent milk yield (Table 1). Because cows with greater milk yield are less likely to be culled, it is possible that the decision not to use Angus semen in the first 3 services resulted in a biased projected milk yield, favoring cows inseminated with beef semen. Further descriptive information about cows used in the study is summarized in Table 1.

Cows inseminated with Holstein semen had the shortest ($P < 0.01$) gestation length (274.9 ± 0.6 days) and conception with a Jersey sire resulted in the longest gestation length (278.0 ± 0.4 days; Table 2). We speculate that the reduced size of Jersey- and Angus-crossbred calves delayed the initiation of the calving process of cows pregnant with Jersey and Angus sires, and ultimately, extended gestation length of the dams. Further variables and their respective associations with gestation length are presented in Table 2.

Incidence of uterine or non-uterine diseases and mortality within 60 DIM were not affected ($P > 0.16$) by breed of cows or by breed of sire of previous conception (Table 3). When uterine and non-uterine diseases were combined, there was a tendency ($P = 0.07$) for cows conceiving with Angus sires to have greater ($P < 0.05$) disease incidence within 60 DIM than cows conceiving with Jersey or Holstein sires. High body condition score (BCS) at dry-off has been demonstrated to be a risk factor for several metabolic and infectious diseases early in the subsequent lactation. Even though BCS was not assessed in the present study, we speculate that Angus-bred cows had greater BCS at dry-off because they became pregnant in later stages of lactation compared with cows inseminated with Holstein or Jersey sires. High BCS may have contributed to the increased risk of health disorders observed in this group of cows. Nonetheless, sire breed of previous conception was not associated ($P > 0.77$) with proportion of cows sold or culled within 60 DIM. Dam breed impacted culling in the first 60 DIM because a

greater proportion ($P < 0.01$) of Holstein cows were sold or culled within 60 DIM than their crossbred counterparts.

For Holstein cows, sire breed of previous conception was associated ($P = 0.02$) with milk yield (Figure 1). Holstein cows that conceived to Holstein sires had reduced ($P \leq 0.09$) milk yield in the first 60 DIM compared with other permutations of dam breed and sire breed of previous conception. Milk yield for crossbred cows was not affected by sire breed of previous conception. It is possible that conceptus breed influenced size of calves at birth. The potentially larger size of Holstein calves and lack of heterosis of Holstein dams may have negatively impacted calving difficulty, and consequently, decreased milk production in early lactation.

Days in milk at first service did not differ ($P = 0.28$) among cows that conceived from Holstein, Angus, or Jersey sires in the previous lactation (62.2 ± 0.3 d). For P/AI at first service, an interaction occurred between dam breed and sire breed of previous conception. Holstein cows inseminated with Holstein sires had greater ($P = 0.05$) P/AI at first service than the other combinations of dam and sire breeds explored in the study (48 vs. 29%). It is important to note that to investigate differences in P/AI, a large number of services must be evaluated. Therefore, limited conclusions related to reproductive performance can be drawn from this observational study. Days in milk or P/AI at first service did not differ between crossbred and Holstein cows.

In conclusion, the current study presents evidence that gestation length is shorter for dairy cows conceiving with Holstein semen compared with Jersey or Angus sires. In addition, Holstein cows that become pregnant with Holstein sires have reduced milk yield compared with cows pregnant with Jersey or Angus sires, but sire breed does not seem to affect subsequent milk yield of crossbred dams. Further research is necessary to confirm these findings and to evaluate the economic implications of using beef or dairy semen in Holstein and crossbred cows in order to help dairy producers to make profitable decisions when planning breeding programs.

Table 1. Descriptive data (mean ± SD[1]) of multiparous cows that conceived in the previous lactation after artificial insemination using Holstein, Jersey, or Angus sires after two or more services at a commercial dairy farm in Kansas

	Sire breed of previous conception		
Item	Holstein	Jersey	Angus
Number of cows	107	895	107
Lactation number[2]	3.4[a] (1.4)	2.9[b] (1.0)	3.0[b] (1.1)
Previous projected 305-day mature equivalent milk yield, lb	26,434[a] (4354)	27,944[b] (4965)	29,301[c] (4750)
Days in milk at conception	122.8[a] (54.5)	126.0[a] (44.8)	221.1[b] (43.7)
Dry period length, days	56.4[a] (6.1)	60.8[b] (6.8)	62.1[b] (7.6)
Days spent in close-up pen	26.4[a] (5.7)	30.2[b] (5.9)	30.2[b] (5.1)
Stillbirth, %	0.9[a]	2.4[a]	7.6[b]
Twinning, %	1.9	3.7	9.6

[1]Standard deviation.
[2]Lactation number when cows conceived after insemination with Holstein, Jersey, or Angus sires.
[abc]For each item, values within a row with different superscripts differ ($P \leq 0.05$).

Table 2. Gestation length (mean ± SEM[1]) of cows that conceived after artificial insemination using Holstein, Jersey, or Angus sires after two or more services at a commercial dairy farm in Kansas

Item	Gestation length, d	SEM[1]	*P*-value
Sire breed of previous conception			< 0.01
Holstein	274.9[a]	0.6	
Jersey	278.0[b]	0.4	
Angus	276.5[c]	0.6	
Lactation number[2]			< 0.01
1	275.4[a]	0.5	
2	276.5[b]	0.5	
3	277.2[b]	0.5	
≥ 4	276.8[b]	0.6	
Season of calving			0.01
Summer	275.7[a]	0.5	
Fall	277.0[b]	0.5	
Winter	276.6[b]	0.5	
Spring	276.5[b]	0.5	
Twin calving			< 0.01
Yes	274.1[a]	1.2	
No	278.9[b]	0.7	
Offspring sex			< 0.01
Female	275.5[a]	0.9	
Male	277.3[b]	0.9	

[1]Standard error of the mean.
[2]Lactation number when cows conceived after insemination with Holstein, Jersey, or Angus sires.
[ab]For each item, values within a column with different superscripts differ ($P \leq 0.05$).

Table 3. Incidences of uterine, non-uterine, or combinations of uterine and non-uterine diseases within 60 days in milk (DIM) and proportion of cows that died, were sold, and were culled within 60 DIM for multiparous Holstein or crossbred cows that conceived in the previous lactation after artificial insemination using Holstein, Jersey, or Angus sires after two or more services at a commercial dairy farm in Kansas

	Cow's breed		Sire's breed			*P*-value	
Item	Holstein	Cross-bred	Holstein	Jersey	Angus	Cow's breed	Sire's breed
Uterine diseases,[1] %	6.1	4.7	3.7	4.6	16.8	0.55	0.45
Non-uterine diseases,[2] %	8.0	5.6	5.6	6.9	11.2	0.17	0.22
Diseases within 60 DIM,[3] %	14.2	10.3	9.4[a]	11.5[a]	28.0[b]	0.13	0.07
Died within 60 DIM, %	1.3	0.3	0.0	1.1	0.9	0.21	0.60
Sold within 60 DIM, %	6.0[a]	1.7[b]	1.9	4.0	12.2	< 0.01	0.90
Culled within 60 DIM, %	7.3[a]	1.9[b]	1.9	5.1	13.1	< 0.01	0.78

[1]Retained placenta or metritis.
[2]Mastitis, displaced abomasum, pneumonia, or lameness occurring within 60 DIM.
[3]Retained placenta, metritis, mastitis, displaced abomasum, pneumonia, or lameness within 60 DIM.
[ab]For each item, values within a row with different superscripts differ ($P \leq 0.05$).

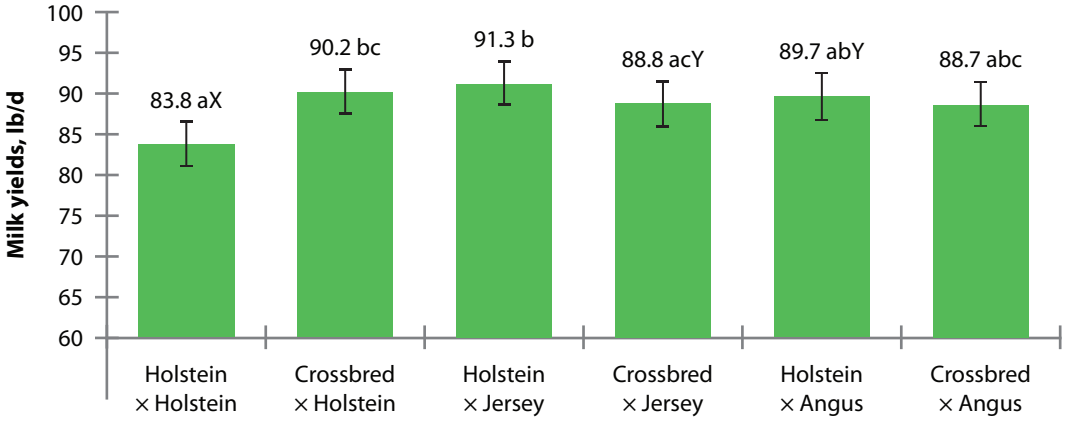

Figure 1. Average milk yield in the first 8 weeks of lactation of multiparous Holstein or crossbred cows that conceived in the previous lactation after artificial insemination using Holstein, Jersey, or Angus sires at a commercial dairy farm in Kansas. Cow breed, $P = 0.53$; sire breed of previous conception, $P = 0.25$; interaction between cow and sire breed, $P = 0.02$. Differences and tendencies are represented by different letters (a, b, c: $P \leq 0.05$; X, Y: $P \leq 0.10$).