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Abstract
A statistical analysis was used to determine which live animal traits are useful in predicting reproductive performance in first-calf heifers. Heifer condition score at calving and change in condition score postcalving, calving difficulty score, and milk production were related to the probability of estrus and pregnancy. Condition score at calving had the greatest impact and, to a great extent, moderates the influence of the other traits.

Keywords
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Factors Predicting the Probability of Estrus and Pregnancy

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Summary

A statistical analysis was used to determine which live animal traits are useful in predicting reproductive performance in first-calf heifers. Heifer condition score at calving and change in condition score postcalving, calving difficulty score, and milk production were related to the probability of estrus and pregnancy. Condition score at calving had the greatest impact and, to a great extent, moderates the influence of the other traits.

Introduction

Numerous research trials have identified nutritional, environmental, management, health and genetic factors that influence reproductive performance of beef females. Since the impact of a given factor is often herd-specific and complexly interrelated with other factors, it is difficult to predict the reproductive performance of a beef cow herd. This report is the result of a statistical analysis to determine the probability of estrus and pregnancy using data from first-calf heifers.

Experimental Procedures

Data were collected in a trial evaluating the effects of energy level and lasalocid on productivity of first-calf heifers (see pg. 50 in this report). This analysis capitalized on natural variation between individual heifer-calf performance as modified by nutritional treatments. A logistic multiple regression procedure was used to find which live traits influenced the probability of estrus and pregnancy by 120 days postcalving. Variables considered initially included heifer weight and condition score changes pre- and postcalving, condition score at calving, calving difficulty score, heifer backfat thickness precalving, and milk production and calf weights at 60 days postcalving. Mean, minimum, and maximum values of those characteristics are presented in Table 18.1. The analysis measured how much each characteristic contributed to the model's accuracy and eliminated or retained those variables accordingly.

Results and Discussion

Information was collected on about 100 heifers; 35 anestrus and 65 estrus, 41 open and 57 pregnant. Preliminary analyses indicated that condition score at calving, calving difficulty score, and condition score at calving were of value in predicting both estrus and pregnancy. Milk production was significant when it was

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above or below the mean. Intercepts and regression coefficients for the variables selected in the analyses (Table 18.2) were used in calculating the predicted probabilities of estrus and pregnancy (Table 18.3).

The impacts of individual characteristics were largely a function of their associated regression coefficient. Condition score at calving had the greatest impact on the probability of estrus and pregnancy and, to a great extent, moderated the influence of the other characteristics. For example, if calving difficulty score and condition score change postcalving were held constant, milk production had progressively less impact on reproductive performance as condition score at calving was increased. Additionally, calving difficulty had a greater negative impact on reproductive performance in nutritionally stressed (low condition score) heifers. This seems logical, since a heifer in good condition (condition score 6) at calving has more body reserves available for production or accommodation to a stress such as calving difficulty. Finally, an increase in condition score postcalving will offset, to some degree, the negative influence of calving difficulty, heavy milk production, and/or a low condition score at calving.

These models are useful only for data within the range of those collected. However, certain broad conclusions can be reached. Numerous genetic and non-genetic factors influence the incidence and severity of calving difficulty. Therefore, use of genetic information compiled by breed associations, careful attention to breed complementarity, and proper heifer development should be considered when attempting to minimize calving difficulty in a herd. Since milk production influences reproductive performance, the interrelationship of milk production and available feed resources also must be considered. Finally, heifer/cow condition scores should be evaluated several times throughout the year in order to use feed economically but not sacrifice reproductive performance.

Table 18.1. Values of Continuous Variables Initially Included in Logistic Regression Models Predicting the Probability of Estrus or Pregnancy

Variable	Mean	Minimum	Maximum
Wt. Change Prepartum, lb	167	46	269
Condition Score Change Prepartum[1]	.1	-1	1.3
Condition Score at Calving[1]	5.3	4	7.7
Calving Difficulty Score[2]	1.3	1	3
Backfat 90 d on Trial, in	.25	.12	.71
Milk Production at 60 d, lb	12.3	2.6	25.3
Calf Wt. at 60 d, lb	146	90	243
Wt. Change Postpartum, lb	4	136	145
Condition Score Change Postpartum[1]	-.11	-1.7	1.2

[1]Body condition scores: 1 = emaciated to 9 = obese.
[2]Calving difficulty scores: 1 = unassisted to 3 = mechanical assistance.

Table 18.2. Logistic Regression Models[1] Predicting the Probability of Estrus or Pregnancy

Variable	Estrus		Pregnancy	
	RC[2]	P	RC[2]	P
Condition Score at Calving	2.35	.0001	1.55	.001
Calving Difficulty Score	-.73	.04	-.71	.04
Condition Score Change Postpartum	1.20	.01	.90	.03
Milk category[3]	-.52	.05	-.45	.06

[1] Intercepts of the models predicting estrus and pregnancy were -10.4 (P=.0006) and -6.8 (P=.006), respectively.
[2] Regression coefficient.
[3] Categorized and coded into the model as below (-1) and above (1), respectively, the mean level of milk production at 60 d.

Table 18.3. Predicted Probabilities[1] of Estrus and Pregnancy for Certain Values of the Variables Selected by the Logistic Regression Model

Condition Score[2] at Calving	Calving Difficulty[3] Score	Change in Conditon Score Postpartum[2]	Milk Category[4]	Predicted Probability	
				Estrus	Pregnancy
4.0	1.0	1.0	1	.25	.31
4.0	1.0	1.0	-1	.49	.52
5.0	1.0	1.0	1	.77	.68
5.0	1.0	1.0	-1	.90	.83
5.0	1.0	-1.0	1	.25	.25
5.0	1.0	-1.0	-1	.48	.45
5.0	3.0	1.0	1	.46	.34
5.0	3.0	1.0	-1	.70	.56
6.0	1.0	.5	1	.95	.86
6.0	1.0	.5	-1	.98	.94
6.0	1.0	-.5	1	.85	.72
6.0	1.0	-.5	-1	.94	.86
6.0	2.0	.5	1	.91	.76
6.0	2.0	.5	-1	.97	.87

[1] Predicted probability = (natural logarithm of a)/(1 + natural logarithm of a). where a = Intercept + RC x condition score at calving + RC x change in condition score postpartum + RC x milk category + RC x calving difficulty score.
[2] 1 = emaciated to 9 = obese.
[3] 1 = unassisted to 3 = mechanical assistance.
[4] -1 = below and 1 = above, the mean level of milk production at 60 d.