

THE NEMESIS OF A BEEF COW-CALF OPERATION: THE FIRST-CALF COW

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INTRODUCTION

For cattle producers, heifers that have just given birth to their first calf (first-calf heifers) are the toughest group of females to manage. Giving birth for the first time is a shocking experience for a heifer, but stress associated with the first birth also is confounded with numerous other management related issues. After birth, the first-calf heifer is required to nurse a young calf, her reproductive tract needs to undergo repair (uterine involution) to prepare for the next pregnancy, and she is required to maintain her own condition in order to become pregnant during the subsequent breeding season. All of these factors are new to a heifer and she is required to do this at a time when she is introduced to the mature cow herd. In other words, a heifer that has just given birth needs to compete with older, more aggressive cows for feed and yet continue to grow to a mature weight and become pregnant to calve during the following calving season.

In most herds, 15 to 20% of the cow herd is replaced annually by replacement females. These replacement females represent the future genetics of the operation and could dictate the ultimate profitability of the operation. Sound selection for females that will produce offspring on a yearly basis, nurture their offspring until weaning with a minimum of disease or sickness, and wean their offspring with acceptable weaning weights is paramount to a successful operation.

Replacement, virgin beef heifers require little input from a producer. After weaning, heifers selected as replacements usually are forgotten or neglected until shortly before the breeding season. However, the management decisions on how we treat our replacement heifers, usually affects their performance for a period of time following the birth of their first calf. In fact, when one considers that a replacement heifer remains in the herd for almost three years before she makes a financial contribution to the producer, it is imperative that we pay close attention to our genetic selection and management of our future “bread winners”.

The ultimate goal for cow/calf producers is to obtain one live calf from each cow, every year. Unfortunately most beef cattle operations fail to achieve an annual 100% calving rate. For a producer to ensure that each cow calves on a yearly basis, cows are required to conceive within 83 days after calving. Many beef cattle have not even resumed their estrous cycles by this point, especially cows that have given birth to their first calf! Several factors contribute to delaying the onset of estrous cycles in postpartum cows; however, nutrition and suckling are the two critical factors that tend to dictate when cows begin to cycle. Because most beef cows are suckled within the first few months after calving, nutrition becomes the major component that can be managed to enhance productivity of beef cows. Yet, we must keep in mind that the goal of sound nutritional management, in a beef production setting, is to satisfy the cows reproductive needs.

The nutrition/reproduction interaction involves several intricate relationships. From a nutrition standpoint, energy, protein, minerals and vitamins all affect reproduction through various avenues. The hypothalamus, pituitary, and/or the ovaries can be affected by a nutritional deficiency. As beef producers, we must understand the nutrition/reproduction axis to fully appreciate how our cows respond to nutritional management and produce a live, healthy calf on a yearly basis.

Why, then, are first-calf heifers a nemesis to our beef cattle operations? Firstly, these young cows need additional nutrients, because even though they are cows, they are still growing themselves; therefore, not only do they need nutrients for their calves, but they need nutrients for further growth. Secondly, from a physiological standpoint, these cows have never experienced a birth. They generally have smaller pelvic areas than mature cows, which increases the incidence of dystocia; they have to struggle with the stress of calving for the first time; they are required to raise a calf; and, they must reinitiate estrous cycles to become pregnant during the subsequent breeding season. Even in an ideal setting, we require these young cows to perform at unrealistic levels. Nonetheless, with a little foresight we can set the stage to allow these cows to have an opportunity to become productive mature cows.

FACTORS AFFECTING DYSTOCIA

Calving difficulty (dystocia) is probably the single greatest factor that dictates whether females resume their estrous cycles after birth and become pregnant during the following breeding season. Preparing replacement heifers to avoid dystocia improve the transition of first-calf heifers to mature cows without a large culling percent.

Two traits that affect whether heifers have an increased probability of dystocia are: birth weight and pelvic area (Table 1). Heifers born with large birth weights tend to have increased dystocia when they give birth, probably due to an increase in birth weights of their newborn calf. Pelvic area also can determine which heifers to eliminate before calving to prevent major calving difficulties or caesarean section. Pelvic areas do not necessarily predict which heifers will require more assistance at birth, but can be used to eliminate heifers with excessively small pelvic areas. These heifers may require caesarean section, an economical nightmare for producers.

To counteract potential incidences of dystocia, producers should pay close attention to sire selection. The use of expected progeny differences (EPDs) are essential for cattle operations to compete in today's cattle market. First-calf heifers require bulls with a low birth weight EPD with high accuracy. The major cattle breeds all have bulls within their breed that have low birth weight EPD bulls, yet provide adequate or good performance. After the cow has given birth to her first calf, a producer can then pay closer attention to selecting bulls for performance traits, with less emphasis on birth weights.

Table 1. Relationship between dam size and calving difficulty score

Trait	Calving difficulty score ^b				
	1	2	3	4	5
No. of Females	197	25	104	33	30
Body weights, lbs					
Birth	88.2 ^x	90.2 ^{x,y,z}	89.8 ^{x,y}	93.3 ^{y,z}	94.6 ^z
12 months	651 ^x	669 ^{x,y}	653 ^{x,y}	673 ^y	664 ^{x,y}
22 months	957 ^x	999 ^y	968 ^{x,y}	992 ^y	979 ^{x,y}
Pelvic area, cm ²					
12 months	171.8 ^x	174.9 ^x	170.4 ^x	173.7 ^x	165.3 ^y
22 months	245.2 ^x	247.0 ^x	244.3 ^x	245.4 ^x	235.4 ^y
25 months	268.6 ^x	269.0 ^{x,y}	267.0 ^{x,y}	266.4 ^{x,y}	260.7 ^y

^a Adapted from Colburn et al., 1997

^b Scoring system 1 to 5; 1 = hand pull, 3 = mechanical pull, and 5 = Caesarean section.

^{x,y,z} Within a row, means with unlike superscripts differ (P < .05).

Table 2 demonstrates the importance of selecting low birth weight EPD bulls. Not only is dystocia or severity of dystocia decreased, but few first-calf heifers require caesarean sections. Just as importantly (and often not realized), calves born to sires with lower birth weight EPDs tend to have more vigor at birth, they stand up quicker and start suckling within a few hours after birth. These intangibles allow for a greater calf immunity and ultimately a healthy calf throughout the suckling period.

Table 2. Dam and calf measurements by sire^a

Trait	Low birth weight EPD sire ^b		High birth weight EPD sire ^b	
	1	2	3	4
No. of Females	139	137	137	136
Calving difficulty score ^c	2.0 ^{x,y}	1.9 ^x	2.5 ^z	2.2 ^{y,z}
Caesarean section, %	3 ^x	5 ^x	16 ^y	7 ^x
Calf vigor score ^d	2.7 ^x	3.0 ^{x,z}	3.2 ^{y,z}	3.3 ^y

^a Adapted from Colburn et al., 1997

^b Sire birth weight EPD: 1 = -2.1, 2 = -1.8, 3 = +6.4, 4 = +5.9 lbs.

^c Scoring system 1 to 5; 1 = hand pull, 3 = mechanical pull, and 5 = Caesarean section.

^d Scoring system 1 to 5; 1 = nursed unassisted within 30 min, 3 = nursed unassisted within 75 min, and 5 = dead at birth.

^{x,y,z} Within a row, means with unlike superscripts differ (P < .05).

Calf sex is a major factor that influences dystocia (Table 3). Female calves tend to be smaller than male calves at birth and, therefore, dystocia tends to occur more often when the calf is a male. We cannot predict what sex each calf will be before birth in most production settings; however, the use of sexed embryos, sexed semen, and ultrasound technology are fast becoming management tools used by many cattle operations. These management tools could help dictate which cows to expect to have more calving difficulties.

Table 3 also demonstrates that the majority of females to have calving difficulties are 2-year old cows (first-calf heifers). Even though birth weights increase as a cow ages, dystocia decreases. This phenomenon indicates that our main challenge is to decrease dystocia in the first-calf heifers and ensure that they become pregnant during the following breeding season, after this point, labor input per cow decreases.

Table 3. Association between calving difficulty and age of dam or calf sex^a

Age of dam, years	Sex of calf			
	Male		Female	
	Dystocia, %	Birth weight, lbs	Dystocia, %	Birth weight, lbs
2	60.0 ± 2.3	72.4 ± 5.4	39.2 ± 2.4	66.1 ± 5.6
3	18.9 ± 3.1	78.2 ± 7.3	8.2 ± 2.9	72.3 ± 6.8
4 and 5	6.3 ± 3.0	81.1 ± 7.1	3.6 ± 3.3	73.5 ± 7.7

^a Adapted from Laster et al., 1973.

FACTORS AFFECTING REPRODUCTION

Ultimately, the primary hurdle for a first-calf heifer to overcome is to become pregnant during her second breeding season. In most cattle operations, cows that do not calve once a year are culled because they become an economical liability. If we can ensure that our first-calf heifers are pregnant by the end of the second breeding season most of our goals regarding first-calf heifer management will have been achieved.

For producers using a short breeding season, estrus expression is important for either AI technicians or a bull. First-calf heifers with greater incidences of dystocia tend to have poorer fertility responses (Table 4). Detection of estrus, conception rates, and overall pregnancy rates are all factors negatively affected by dystocia. In addition, as cows become more comfortable with each additional birth the incidence of dystocia decreases and fertility traits increase.

Table 4. Effect of calving difficulty on detection of estrus, conception rates, and pregnancy rates^a

Group		During AI period			
Dystocia class	Cow age	No. of cows	Detected in estrus, %	Conception rates, %	Overall Pregnancy rate, %
No dystocia	2	584	68.3 ^x	66.0 ^x	79.6 ^x
Dystocia	2	366	59.3 ^y	50.6 ^y	71.4 ^y
No dystocia	3	451	71.8 ^x	63.6 ^x	86.6 ^x
Dystocia	3	69	55.1 ^y	46.0 ^y	72.6 ^y
No dystocia	4	388	86.1 ^x	77.9 ^x	89.7 ^x
Dystocia	4	31	77.4 ^y	64.1 ^y	64.1 ^y

^a Adapted from Laster et al., 1973.

^{x,y,z} Within a cow age group and column, means with uncommon superscripts differ (P < .01).

A recent study (Table 5; Stevenson et al., 1997) determined the incidence of cyclicity in beef cows at the initiation of the breeding season. As expected, a majority (87.7%) of the virgin heifers had reached puberty by the beginning of the breeding season. In the two suckled beef cow groups multiparous cows had a greater (P < .05) incidence of cyclicity than primiparous cows (74.1 vs 53.4%, respectively). This experiment provides further evidence that first-calf heifers tend to have greater difficulty resuming their estrous cycles after calving than mature cows. Therefore, it is imperative to ensure that precalving management allows first-calf heifers sufficient resources to recover following calving, and yield acceptable fertility results.

Table 5. Cycling status of beef females before the beginning of the breeding season^a

Category	No. of females	Percent cycling, %
Virgin heifers	73	87.7
Primiparous cows	101	53.4
Multiparous cows	178	74.1

^a Adapted from Stevenson et al., 1997.

THE NUTRITION/REPRODUCTION INTERACTION

Body condition scoring (BCS) is a reliable method to assess the nutritional status of a cow herd, but is especially important in first-calf heifers. A visual body condition scoring system developed for beef cattle uses a scale from 1 to 9, with 1 representing emaciated and 9 obese cattle (Whitman, 1975). A linear relationship exists between body weight change and

body condition score (using a 1 to 9 scale), where approximately a 90-lb weight change is associated with each unit change in BCS.

Table 6. Body condition scores and animal appearance at each condition score

BCS	Condition	Appearance
1	Emaciated	Shoulder, ribs and back are visible
2	Very thin	Some muscle, no fat deposits
3	Thin	Some fat deposits, ribs visible
4	Borderline	Foreribs not noticable
5	Moderate	12 th and 13 th ribs not visible
6	Good	Ribs covered, sponginess to tailhead
7	Very good	Abundant fat on tailhead
8	Fat	Fat cover thick and spongy
9	Obese	Extremely fat throughout

Live weight at calving has no effect on reproductive performance, whereas calving condition score is a better indicator than prepartum change in either weight or condition score on the duration of postpartum anestrus (Whitman, 1975; Lalman et al., 1997). When cows are thin at calving or have BCS of 4 or less, increased postpartum level of energy increases percentages of females exhibiting estrus during the breeding season. Likewise, heifers that calve with a BCS of 4, and are fed to maintain weight after parturition, have a reduction in ovarian activity and lower pregnancy rates than to heifers that calve at a similar body condition and gain weight after parturition (Wetteman et al., 1986). Body condition score at parturition and breeding are the dominant factors influencing pregnancy success, although body weight changes during late gestation modulated this effect.

The general belief is that cows maintained on an increasing plane of nutrition prior to parturition usually have a shorter postpartum interval to their first ovulation than cows on a decreasing plane of nutrition. Energy restriction during the prepartum period results in thin body condition at calving, prolonged postpartum anestrus, and a decrease in the percentage of cows exhibiting estrus during the breeding season. Pregnancy rates and intervals from parturition to pregnancy also are affected by level of prepartum energy.

Some experts have suggested that when prepartum nutrient restriction is followed by increased postpartum nutrient intake, the negative effect of prepartum nutrient restriction may be overcome partially. However, the effectiveness of elevated postpartum nutrient intake may depend on the severity of prepartum nutrient restriction (Lalman et al., 1997). This conclusion concurred with that of Perry et al. (1991) in which prepartum nutrient restriction resulted in 1.8

units loss in BCS during a 90-d prepartum period. Enhanced energy in the postpartum diet reduced, but did not completely abolish, the negative effects of prepartum energy restriction on postpartum anestrus.

Table 7 demonstrates the importance of prepartum nutrition on return to estrous cycles in suckled beef cows. Cows calving in poor condition (i.e BCS of 3 or 4) had longer intervals before resuming their estrous cycles than cows calving in good condition (i.e. BCS 5 or greater). Remember, for cows to calve on a yearly interval they are to conceive within 83 days after calving; therefore, if cows only reinitiate there estrous cycles at 70 to 90 days postcalving the possibility of a yearly calving interval is vastly reduced.

Table 7. Influence of body condition on return to estrous cycles in beef cows^a

BCS	Postpartum interval, days
3	88.5
4	69.7
5	59.4
6	51.7
7	30.6

^a Adapted from Houghton et al., 1990.

Short and Adams (1988) prioritized the metabolic use of available energy in ruminants ranking each physiological state in order of importance, as follows: 1) basal metabolism; 2) activity; 3) growth; 4) energy reserves; 5) pregnancy; 6) lactation; 7) additional energy reserves; 8) estrous cycles and initiation of pregnancy; and 9) excess energy reserves. Based on this list of metabolic priorities for energy, reproductive function is often compromised in first-calf heifers because even though they are nursing a calf they are still growing; therefore, they are required to consume nutrients for growth, milk production, and energy reserves before pregnancy can be established. In contrast, mature cows have quit growing and, thus, can concentrate there nutrient intake on nursing a calf and then establishment of pregnancy.

MANAGEMENT CONSIDERATIONS

The first management decision that has a major impact on postpartum fertility is the length of the breeding season. Having a restricted breeding season has many advantages, such as a more uniform, older calf crop, but most importantly a reduced breeding season (60 days or less) increases the percentage of females cycling during the next breeding season. If the breeding season is shortened, then all cows have a high probability for pregnancy at the beginning of the next breeding season. Any cow that becomes pregnant after 83 days in a long breeding season will not have calved by the time the next breeding season starts.

For first-calf heifers, because they usually have a longer period of postpartum anestrus, producers should consider breeding their yearly replacement heifers to calve at least two weeks before the rest of the cow herd. This will give the first calf heifers an additional fourteen days to prepare for the breeding season.

The second management decision to consider for decreasing postpartum infertility in first-calf heifers is nutrition. As mentioned above, nutritional levels and BCS have a major impact on anestrus and potential fertility. Often it is impractical to measure body weight in many production settings, but in most situations a procedure can be developed for monitoring BCS. It is difficult and expensive to correct nutritional problems that exist at calving by increasing intake after calving. Therefore, monitoring condition, and adjusting condition before calving, is the most economical method to ensure that first-calf heifers calve at a BCS greater than 5.

The third management decision to minimize postpartum infertility is to consider options that include minimizing stress from dystocia, perhaps putting a sterile bull with cows during the early postpartum period before the breeding season starts, and using estrous synchronization treatments that initiate estrous cycles after calving and reduce the incidence of short estrous cycles (a common problem in postpartum suckled beef cows). The deleterious effects of dystocia can be minimized by careful attention to the following: selection of replacement heifers, selection of sires used on replacement heifers, providing appropriate obstetrical assistance at parturition. Putting a bull with cows during the postpartum period to reduce postpartum infertility is a new approach. However, the relative cost of using bulls is low and should be considered by producers although more information is required to discern the ideal bull:cow ratio. Estrous synchronization is potentially the most promising alternative to a production system, it can be used effectively to shorten the breeding season and take advantage of possible stimulatory effects of the synchronization products to initiate estrous cycles.

Table 8 demonstrates the advantages of using a synchronization program, including norgestomet (a progestin) and GnRH, to enhance fertility in beef females. As expected, first-calf heifers (primiparous cows) had lower pregnancy rates than heifers or mature cows; however, once a progestin is included in the system (PGF_{2α}/NORG/GnRH) the first service conception rates were almost 10% greater. More recent research seems to indicate similar results using an intravaginal progesterone insert as the progestin (Lamb et al., unpublished).

Table 8. Effect of including a progestin in a synchronization system on conception rates for suckled beef cows^a

Category	PGF _{2α} /PGF _{2α}		PGF _{2α} /NORG/GnRH	
	No.	% Pregnant	No.	% Pregnant
Parity ^b				
Virgin heifers	36	50.0	37	64.9
Primiparous cows	51	41.1	50	50.0
Multiparous cows	92	51.1	86	64.0
Cycling status ^c				
Noncycling	49	26.5	53	62.2
Cycling	130	56.2	120	59.2

^a Adapted from Stevenson et al., 1997.

^b Parity effect (P < .05).

^c Treatment × Cycling status (P = .06).

The final management alternative to consider is decreasing the suckling stimulus. This alternative should be considered a last resort, because this alternative potentially has more serious economic and management consequences, such as an increased potential for calf diseases and for reduced calf weaning weights. All the other management alternatives should be considered and dealt with before resorting to this option. The suckling stimulus can be decreased by complete weaning or weaning for a short period of time (48 hours). In some cases of limited feed supplies later in lactation, weaning can be an effective tool for managing BCS entering winter in order to minimize fertility problems during the subsequent year. The potential economic and management disadvantages should be carefully weighed against the potential advantages of increased fertility.

KEYS TO FIRST-CALF HEIFERS MAKING AN ECONOMICAL CONTRIBUTION TO THE PRODUCER

- 1) Feed replacement heifers to achieve 65% of their mature weight by initiation of the breeding season (usually 1.5 to 2.0 lbs per day).
- 2) Utilize a prebreeding reproductive tract exam to eliminate heifers with under developed reproductive tracts.
- 3) Use pelvic measurements to identify heifers that have excessively small pelvic areas.
- 4) Utilize EPD's to ensure that heifers are bred to low birth weight EPD bulls.
- 5) Use estrous synchronization when breeding replacement heifers – this will result in most first-calf heifers calving at the beginning of the calving season.
- 6) Prepare replacement heifers to calve 2 wks before the mature cow herd.
- 7) Heifers should calve with at least a BCS of 5 or greater.
- 8) Use estrous Synchronization including a progestin (Norgestomet, Intravaginal progesterone insert, or MGA) on first calf heifers to trigger postpartum estrous cycles.
- 9) Shorten breeding season gradually by culling late calving cows.

- 10) Wean calves from first-calf heifers early to allow cows to enter winter in good condition.
- 11) Feed thin cows and first-calf heifers separately from mature cows to avoid competition for feed.

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