

Pre-Breeding Considerations for the Development of Replacement Beef Heifers¹

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The efficiency of post-weaning development of heifers has a major impact on the overall profitability of cow-calf operations. To ensure satisfactory performance during the first breeding season, replacement heifers must be subjected to an adequate development program. A program should provide proper conditions for heifers to conceive, maintain full-term pregnancies, calve without assistance, wean a healthy calf, and conceive again as first calf-heifers. Knowledge of the basic physiology underlying heifer performance and the available breeding preparation strategies is important. This awareness allows producers to adjust their replacement heifer system and increase the economic returns of their operations.

Age at Puberty, Nutrition, and Target Body Weight Gain

Age at puberty is a major factor that influences reproductive success of beef heifers. Ideally, heifers should reach puberty approximately 60 days before the beginning of their first breeding season, increasing their chances of becoming pregnant and allowing them to conceive earlier in the season.

The timing of first conception is also important to the overall productivity of a heifer. Females that calve at the beginning of their first calving season have been shown to have a greater probability of pregnancy in the subsequent breeding season when bred as first-calf heifers (Patterson

et al. 1992). Cows that calve in the beginning of the calving season were also shown to wean heavier calves (Rodgers et al. 2012) and stay productive in the herd for a longer period of time (Cushman et al. 2013). Therefore, increasing the proportion of beef females that calve earlier can increase the economic returns of cow-calf producers (Rodgers et al. 2012; Lamb et al. 2016). Management strategies that lower the age at which heifers reach puberty can have a great impact on the reproductive efficiency of beef heifers and positively affect overall profitability for the producer.

Breed is an important aspect that must be considered when preparing heifers for breeding. Most US heifer herds are composed of *Bos taurus* breeds in which heifers are bred to calve at 2 years of age. However, in the southern states, such as Florida, more than 50% of heifers calve at a later age (Day and Nogueira 2013). This is a result of a greater presence of *Bos indicus* genotype in these particular herds. *Bos indicus*-influenced heifers reach puberty later. Producers generally manage their herds to achieve parturition at 30–36 months of age for this reason. However, *Bos indicus* heifers can be developed to calve at 2 years old if they are properly managed. The use of nutrition strategies and pharmacological treatments that accelerate puberty allows producers with *Bos indicus* cattle to breed heifers to calve at 24 months (Day and Nogueira 2013).

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The period of time that precedes puberty is called the peripubertal period. From an endocrine standpoint, this period is characterized by a wavelike pattern of follicular growth in the ovaries with the occurrence of follicular dominance. However, dominant follicles fail to ovulate during the peripubertal period as a result of negative feedback of estradiol on GnRH secretion. The negative feedback of estradiol decreases as puberty approaches, allowing the secretion of GnRH and LH to increase. Increased LH activity stimulates final follicular growth and maturation of the dominant follicles, therefore increasing estradiol concentration to a threshold that activates the pre-ovulatory LH surge and causes ovulation.

The mechanisms that control the decrease in the negative feedback of estradiol are not completely understood. Nevertheless, it is well-documented that nutrition is a key factor that influences age at puberty and, consequently, reproductive performance of heifers (Patterson et al. 1992; Day and Nogueira 2013). An adequate plane of nutrition is required for pregnancy to occur. When establishing the nutritional scheme for a heifer development program, it is important to consider that *Bos taurus* beef heifers generally reach puberty at 55%–60% of their expected mature body weight. With that in mind, the use of a target average daily gain (ADG) is a common and effective way to prepare heifers for breeding. It is recommended that *Bos indicus*-influenced heifers achieve 60%–65% of their mature body weight before the breeding season starts (Lancaster and Lamb 2014). A nutritional program should be capable of providing sufficient energy and protein to heifers so they can attain this final target weight before the beginning of the breeding season.

Pelvic Area Measurements and Reproductive Tract Score

Dystocia is a constant concern in heifer management. The incidence of dystocia is increased in heifers that are not fully grown at the time of first calving. Heifers with small pelvic areas are more likely to have greater calving difficulty. The measurements of pelvic area can help producers determine which animals are ready to be exposed to breeding and decrease the risk of dystocia by helping them select animals with larger birth canals (Troxel 2011).

Another valuable pre-breeding strategy is the use of reproductive tract scores (RTS). The RTS is utilized to assess reproductive maturity and determine a heifer's ability to conceive. Through rectal palpation or ultrasonography, the reproductive tract structures are evaluated. Each

heifer receives a score from 1 to 5 (Table 1) based on their uterine and ovarian characteristics. This information allows producers to select heifers that have greater chances of becoming pregnant as replacement heifers and to potentially cull late-maturing females.

Table 1. Reproductive tract score (RTS) description.

RTS	Uterine Horns	Ovarian Structure
1	<20 mm diameter, no tone	No palpable structure
2	20–25 mm diameter, no tone	8 mm follicles
3	25–30 mm diameter, slight tone	8–10 mm follicles
4	30 mm diameter, good tone	>10 mm follicles, corpus luteum possible
5	>32 mm diameter, good tone, erect	>10 mm follicles, corpus luteum present

Adapted from Anderson et al. (1991).

Herd Health

Adequate herd health is essential for optimal performance. Several diseases (such as Infectious Bovine Rhinotracheitis, Bovine Viral Diarrhea, brucellosis, leptospirosis, trichomoniasis, campylobacteriosis, and neosporosis) can cause embryonic loss and abortion, which result in significant economic losses. Fortunately, the majority of diseases in heifers can be controlled with proper vaccination protocol and adequate nutrition. Standard vaccination protocols are available (Table 2), but working closely with veterinarians once they have become familiar with the operations and the local diseases that can impact the herd is advisable. The veterinarian also has an important role in the establishment of management strategies that assist in the control of infectious diseases. An example of management strategy is the breeding soundness examination of bulls prior to the breeding season, which helps to control certain diseases and prevent poor results related to male infertility (Dahlen and Stokka 2015). The control of parasites is also important. Adequate deworming protocols are required to guarantee desirable animal performance.

Table 2. Standard vaccination protocol.*

Vaccine	Period of Vaccination
<i>Clostridium</i>	3 months and weaning
IBR	Weaning and prior to breeding
BVD-PI3	Weaning and prior to breeding
BRSV	Weaning and prior to breeding
Brucellosis**	4–12 months
Campylobacteriosis (Vibriosis)	Weaning and prior to breeding
Leptospirosis	Weaning and prior to breeding

*Producers should work with their veterinarian to choose a vaccination protocol that fits their operation.

**States with brucellosis-free status do not require vaccination.

Conclusion

The profitability of beef cow-calf operations depends on an adequate heifer replacement system. The reproductive performance of heifers relies on the use of adequate management strategies during the pre-breeding period. Understanding the mechanisms that control the age of puberty can help producers comprehend the available heifer development strategies and customize a development program that fits their own operations.

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