

Strategies to Improve Reproductive Efficiency of Heifers

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Understanding proper heifer development is key to improving reproductive efficiency and profitability in a beef cattle operation. The first step toward achieving reproductive efficiency is to properly manage reproduction in yearling heifers. Research shows heifers that conceive earliest in the first breeding season have fewer calving difficulties, becoming the most productive and profitable. Giving heifers the chance to conceive early is the goal. Manage so that the age of puberty is reduced, the time from puberty to conception is shortened, and fertility is increased.

Age at Puberty

Most producers don't consider their heifers' age at puberty to be a major issue, but it is the most important factor in managing heifer reproduction. Few producers know how many heifers are actually cyclic—how many have reached the age of puberty—at the beginning of the breeding season. A Nebraska study showed that, in a single herd, the proportion of heifers that had reached puberty by the first day of the breeding season varied greatly over five consecutive years, ranging from 21% to 64% over that period. For maximum fertility and reproduction, heifers must have had at least one estrus *before* the beginning of the breeding season.

Onset of puberty is regulated by age, weight, and genetic makeup of the heifer, and it is most limited by age, because heifers must reach a minimum biological age before the pubertal process can be started.

They must also weigh at least 67% of their expected mature weight for puberty to occur. This percentage of mature weight is referred to as *target weight*. Most heifer development programs require that heifers reach their target weight by the onset of their first breeding season.

Puberty is also influenced by genetic makeup: breeds excelling in milk production reach puberty at a younger age than breeds with lower milk production. For example, among British breeds, Angus and Shorthorn, heavier milking breeds, reach puberty at a younger age than Hereford, a lighter milking breed. Among Continental breeds, Simmental and Gelbvieh reach puberty at a younger age than Charolais, Limousin, and Chianina. Females in

Brahman-influenced breeds can reach puberty as late as age 24 months, resulting in even more problems managing reproduction.

Two breeding management practices can be used to reduce age at puberty in heifers: crossbreeding and selection. One major benefit of crossbreeding is an increase in reproductive performance, including reduced age at puberty. Crossbred heifers (those that have a genetic makeup of no more than 75% of one breed) have a significantly reduced age at puberty compared to heifers that are straight-bred (only one breed in the genetic makeup). Overall fertility will also increase in crossbred heifers due to hybrid vigor.

Unfortunately, we cannot directly select for age at puberty in our breeding programs. Age at puberty can be reduced in replacement heifers by selecting bulls that have a great scrotal circumference or a greater scrotal circumference EPD. Scrotal circumference in a bull is highly related to age at puberty in the daughters of that bull. For every 1 centimeter increase in scrotal circumference of a male, the age of puberty of that bull's daughter is reduced by four days. Therefore, a bull with a 45-centimeter scrotal circumference will sire daughters that attain puberty 40 days earlier than a bull with a scrotal circumference of 35 centimeters.

Research clearly shows that fertility increases approximately 20% from the first to third estrus after puberty. Therefore, it is logical to manage heifers to reach puberty before the breeding season begins.

Steps to Proper Heifer Development

Follow these steps for proper heifer development:

1. At weaning, select the oldest heifers that are closest to their target weight. Select at least 20% more heifers than are needed, which will allow you to cull and replace heifers that do not perform during development.
2. Set the breeding date. It is widely recommended that heifers be bred 20 to 30 days before the mature cowherd. For example, if mature cows start calving on March 1, heifers should start calving about February 1.

3. Use a gestation table to determine the start of the breeding season. In this example, the breeding season starts April 25. To ensure that only the most fertile heifers are selected for replacements, limit the breeding season to only 30 days and cull those heifers that do not conceive during that time.
4. After you determine the start of the breeding season, figure the number of days from weaning to breeding. Then, subtract 30 days, which will give you the number of days for the heifers to reach their target weight. If the heifers are weaned October 1, there will be 207 days from weaning until the breeding season starts on April 25. Subtracting 30 days leaves 177 days for the heifers to reach their target weight.
5. Examine the cowherd and determine the cows' approximate weight, then use this weight to set the heifers' target weight—67% of expected mature weight. Then, determine the amount of weight gain needed to reach the target weight. If the average mature weight of the cowherd is 1,200 pounds, the target weight of the heifers is 800 pounds. If the heifers weighed an average 500 pounds at weaning, the heifers need to gain 300 pounds to reach their target weight. Dividing the weight by the number of days will tell you, in this example, that the heifers need to gain approximately 1.7 pounds per day to reach their target weight 30 days before the start of the breeding season.
6. Once the daily weight gain is determined, develop a ration so heifers can reach their target weight. It is a good practice to weigh the heifers periodically to ensure that they are gaining the appropriate amount of weight. If they are not, the ration can be adjusted to compensate.
7. Three steps need to be taken one month before breeding season begins:
 - pelvic area measurements should be determined.
 - reproductive tract scores (RTS) should be tallied.
 - heifers should be vaccinated.

Pelvic area is a measurement of the birth canal's size. Heifers (especially large heifers) with small pelvic areas tend to have greater difficulty calving. Gene Deutscher and co-workers at the University of Nebraska developed a table to help producers relate size of heifer, size of pelvic area, and the potential size of an easily deliverable calf (Table 1). To determine the size of deliverable calf, divide the pelvic area by the appropriate ratio as determined by age and weight. For example, an 800-pound yearling heifer with a pelvic area of 180 square centimeters should be able to deliver a 78-pound calf (180/2.3) with little difficulty. Most heifer development professionals cull heifers with a pelvic area too small to allow delivery of a 70- to 75-pound calf, so an 800-pound heifer with a pelvic

Table 1. Pelvic area/calf birth weight ratios for various heifer weights and ages.

Heifer wt (lb)	Age at Time of Measurement (months)			
	8-9	12-13	18-19	22-23
	Ratios of Pelvic Area to Calf Birth Weight			
500	1.7	2.0	--	--
600	1.8	2.1	--	--
700	1.9	2.2	2.6	--
800	--	2.3	2.7	3.1
900	--	2.4	2.8	3.2
1000	--	2.5	2.9	3.3
1100	--	--	--	3.4

Source: Deutscher, 1988 University of Nebraska Agricultural Experiment Station.

area of less than 160 square centimeters should be culled. It is important to recognize that: 1) The ratios used to determine size of a deliverable calf are only about 80% accurate, so some variability does exist in this model, and 2) Producers should set a minimum pelvic area that works for their individual operations. If you want your 800-pound yearling heifers to be able to deliver an 80-pound calf, set your required pelvic area at no less than 184 square centimeters.

The reproductive tract score (RTS) is used to determine the heifer's maturity. It can range from 1 to 5; heifers with higher reproductive tract scores are more mature. If estrus synchronization is *not* going to be used (see step 8, below), cull those heifers with a RTS of less than 3. If estrus is to be synchronized using melengestrol acetate (MGA), an RTS of 2 is acceptable.

Heifers should be vaccinated against *Vibrio fetus*, Leptospirosis, and the respiratory disease complex which includes PI₃, BRSV, BVD, and IBR. A modified-live vaccine is preferred because it generally stimulates a better immune response. Heifers also need to be dewormed at this working.

8. The final step in heifer development is breeding. Producers should consider estrus synchronization and/or artificial insemination (AI). Advantages of estrus synchronization include higher pregnancy rates; heavier, more uniform calves at weaning; and increased production and labor efficiency. The greatest advantage of AI is giving operators the ability to use superior, more predictable sires. Since a majority of calving problems in a herd occur when heifers are calved for the first time, it is logical to use estrus synchronization and AI with bulls of proven calving ease. The best methods for synchronization of estrus in yearling beef females is discussed in the Cooperative Extension Service publication *Estrus Synchronization Protocols for Yearling Heifers* (ASC-164).