Replacement Beef Heifer Development

Selecting and developing beef heifers to replace culled cows or increase herd numbers impacts the economics of a cow-calf operation through genetics and longevity. Improved genetics can enhance growth performance and carcass value, while eventual longevity of the heifer as a mature cow is influenced by reproductive success during the first breeding season.

Purchasing versus Developing Replacement Heifers

The first decision regarding replacement females is whether to keep weaned heifers and develop them to breeding or market all heifers and purchase bred females (cows or heifers) that have been bred to fit a specific calving season. Several factors that impact this decision include economics, available resources, experience, genetic improvement, and convenience. The financial concerns of developing replacement heifers are related to diverting cash flow and resources. If immediate revenue is required to maintain normal production capacity, consider selling weaned heifers and purchasing bred replacements later. Also consider purchasing replacements if higher returns can be generated by an alternative use for the proceeds from market cow and feeder calf sales.

Farm or ranch resources also direct this decision. If forage or feed supplies are already maximized or overextended by the mature cow herd, purchasing replacement heifers would be an obvious choice. Proper development of heifers takes a certain amount of knowledge and experience that differs from management of a mature cow herd. Mississippi State University Extension agents are always available to help answer questions and provide educational resources, and this publication is a guide. However, to hedge against risk, you should have a certain amount of confidence before developing your first group of virgin heifers.

One of the most important opportunities in selecting replacement females is the potential for genetic improvement. Give special attention to sire selection if you're planning to raise replacements. Do this before breeding so productive cows, which could produce high quality heifers, can be mated to sires that will further improve those genetics. Currently, sexed semen technology that results in more females may be cost-prohibitive, but in the future it could be a viable management option.

Opportunity costs are often overlooked when making management decisions. Having someone else raise replacements is very convenient, especially when the cattle operation is not your primary source of income, or operator time or labor time is limiting. Custom heifer development centers have become a support-business of the cow-calf sector. Consigning heifers to a custom developer is the best way to retain herd genetics while not diverting money and resources from the cow herd to raise heifers. These operations are usually affordable because they take multiple consigners and operate on a large-scale economy. Reputable custom heifer developers have the experience to raise and breed heifers that will be more likely to rebreed after first calving and be a productive part of the mature cow herd for many years. Establish a good working relationship with the custom developer. A customer-focused custom heifer development operation should be willing to answer questions and invite consigners to be present when working the heifers.

Developing Weaned Heifers

Selection

Selecting early born heifers may be useful, because older heifers will be more likely to reach target weights by the start of breeding. A less aggressive nutritional program may be used for heavier weaning heifers and possibly reduce feed costs. However, genetically superior heifers born later in the calving season can be managed to reach proper target weights by breeding and should be considered as replacements over older heifers with less performance potential. Also, selecting only the largest heifers at weaning could result in larger, less efficient mature cows. Evaluating the mature size and genetic growth potential of the sire and dam will also be important.

Temperament should be a key selection criterion in deciding which heifers warrant development as herd replacements. Many beef producers have adopted a "chute scoring" method to keep temperament records. When heifers are restrained in the working chute, they are assigned a score from 1 to 4 (1 = calm; 2 = restless shifting; 3 = squirming; 4 = twisting and rearing). Temperament is a very heritable trait, and removing temperamental heifers from the herd improves farm safety. Temperament can negatively affect feeding behavior of not only the individual heifer but the group it is fed with as well.

All heifers selected for development as breeding females should be structurally sound. Leg and hoof structure are good indicators of skeletal ruggedness. Heifers that do not fit ranch specifications for breeding females may be better suited for post-weaning development programs that ultimately result in harvest before advanced maturity.

Nutritional Management

The most important consideration in developing weaned heifers is nutritional management. The traditional approach to developing heifers has been the "target weight" method.

For heifers to breed at 13 to 15 months of age and calve as 2-year-olds, they must achieve approximately 65 to 70 percent of their mature weight by the start of the breeding season. For British breeds, this usually means heifers need to weigh approximately 650 to 700 pounds at 14 to 15 months of age. For Continental breeds, this typically means heifers should weigh approximately 750 to 800 pounds at 14 to 15 months of age. Brahman-influence cattle may be slower maturing. For example, if a heifer is expected to weigh 1,200 pounds as a mature cow, she should weigh 780 to 840 pounds before the beginning of the breeding season. This is referred to as target weight.

After determining the target weight, calculate the time from weaning to breeding. If the heifers are weaned on October 1 and will be bred on April 25, that leaves 177 days to reach the target weight. Then, determine the average daily gain (ADG) required over the 177-day period to reach target weight. For this example, if the heifers are weaned at 500 pounds and the target weight is set at 800 pounds (1,200 × 67 percent = 800), they will need to gain a total of 300 pounds in 177 days. That results in a required ADG of 1.69 pounds (300 ÷ 177 = 1.69). Monitor weight gains every 30 to 60 days to make sure the heifers are gaining on schedule, and adjust the feeding program if appropriate.

To calculate target weights:

1. determine the desired breeding date based on desired calving date
2. determine heifer age at start of breeding
3. determine expected mature weight
4. determine required average daily gain

Target Weight Example

Heifer birth date	February 1 (current year)
Weaning date	October 1 (current year)
Weaning weight	500 pounds
Expected mature weight	1200 pounds
Desired breeding date	April 25 (next year)

Calculations

67% of mature weight = .67 × 1200	800 pounds
Weight gain needed = 800 – 500	300 pounds
Days from weaning to breeding	177 days
Average daily gain needed to reach target weight = 300 ÷ 177	1.69 pounds per day

When designing a nutritional program to develop heifers to target breeding weights, evaluate pasture, hay quality, and supplies ahead of time. Determine supplemental feed requirements by examining weight gains needed to reach target breeding weights, animal nutrient requirements, and forage program deficiencies.

The plane of nutrition for reaching the target weight can be altered to match forage availability or feed cost (Figure 1). For instance, if forage is abundant or supplemental feed is relatively inexpensive early in the development period, heifers can be fed to maintain a high ADG early and reach the target weight faster. Then, when forage or supplemental feed availability declines, they can be maintained on a maintenance (or slightly above maintenance) diet until breeding. On the other hand, if forage is limited and supplemental feed cost is high during early development, heifers can be maintained on a low ADG and then pushed to reach the target weight as forage becomes available or supplemental feed cost decreases. If supplemental feed and forage availability are not a concern, a steady ADG can be maintained. At this point in developing replacement heifers, experience in feeding cattle is critical. Take weights frequently to ensure the heifers reach their targets.

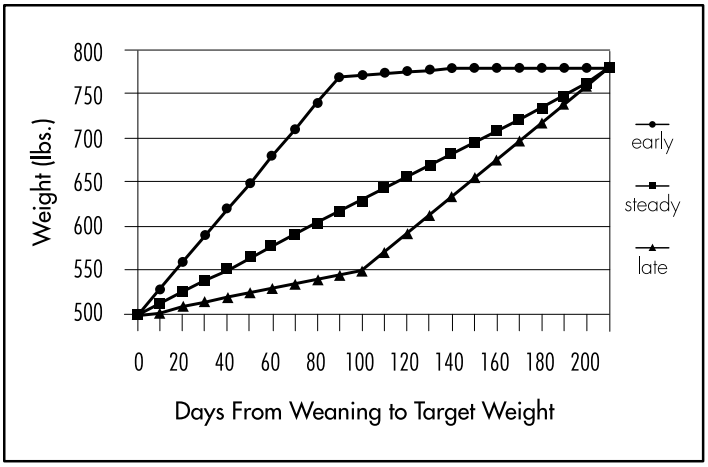

Figure 1. Optional planes of nutrition for heifer development.

More recent reports have suggested the "target weight" system for developing heifers is outdated and costly. As beef cattle producers switched from calving heifers as 3-year-olds to calving as 2-year-olds, more emphasis has been placed on selecting heifers that reach puberty at an earlier age and lighter weight in relation to their expected weights as mature cows.

In support of this idea, field trials have demonstrated that heifers developed to only 53 percent of their mature weights achieved similar pregnancy rates and longevity in the herd over 4 years compared to traditionally fed heifers (67 percent of mature weight). When cost of production outpaces revenue, developing heifers to a lighter target weight may be more appropriate. However, management practices should not be changed suddenly. Implement this practice carefully and only when genetic potential of the specific group of heifers is known.

Regardless of the nutritional program used, it is important to remember that the heifers should not be allowed to lose weight ("back up") or become too fat during the developmental period. Losing weight can alter the age at puberty even if the target weight is reached at the desired time. If heifers are overfed, fat accumulation in the udder will inhibit milk production as a first-calf heifer and mature cow. Furthermore, multiple feeding groups should be used because individual heifers will require different nutritional inputs.

Minerals and vitamins are important for reproductive success. Pay special attention to salt because feedstuffs do not normally meet the requirements for sodium and calcium. Other macro minerals include magnesium, potassium, chlorine, and sulfur. These may or may not need to be added to the diet, depending on their concentrations in the forage, feedstuffs, and water. It is important to remember that feeding excessive minerals can be costly and negatively impact reproduction.

Required trace minerals include copper, cobalt, iodine, iron, manganese, and zinc. Developing heifers' growth and reproductive performance can be hindered if these are not in the diet or if other elements affect their availability. Most of the required vitamins are made by the heifer or are already in common feed ingredients and do not need to be added to the diet. Vitamin A may need to be added when heifers are grazing low-quality forages or crop residue.

Some feed additives or specific feed ingredients can be used to improve heifer development and reproductive performance. Heifers fed an ionophore (Bovatec and Rumensin) during development likely will reach puberty at an earlier age and lighter weight. The effect of an ionophore is most obvious in less-intensively managed herds. Dietary fat supplementation increases the energy density of the diet and can help improve reproductive function. Additionally, fat supplementation seems to have a direct impact on reproduction independent of the added energy. Similar to ionophores, supplemental fat is most effective when heifers are nutritionally challenged.

Reproductive Management

Puberty in heifers can be characterized as the first estrus (standing heat). Heifer fertility increases approximately 20 percent from the first to third estrus after puberty. Nutrition plays a large role in when heifers reach puberty. If producers practice the nutritional management outlined in the previous section, heifers should display estrus before the breeding season.

Genetics also influence the age at puberty. Numerous studies have reported both between-breed and within-breed differences in age and weight at puberty. Breed differences, sire and dam effect within breed, and heterosis (hybrid vigor) all contribute to heifer age at puberty and should be considered when selecting heifers at weaning or when making breeding decisions for cows that will potentially produce replacements.

Producers using Brahman-influenced genetics should plan heifer development programs taking into account the later maturity rates generally associated with these cattle compared to other beef breeds. Crossbred heifers with less than 75 percent of one breed have a significantly reduced age at puberty compared to purebred heifers. Additionally, overall fertility is increased in crossbred heifers due to hybrid vigor.

Three management practices should be completed one month before the breeding season begins:

1. Pelvic area measurements
2. Reproductive tract scores
3. Vaccination and parasite control

Pelvic area measurements are simply a measurement of the size of the birth canal (Figure 2). The original use of pelvic area measurements was to relate the size of heifer, size of pelvic area, and potential size of an easily deliverable calf.

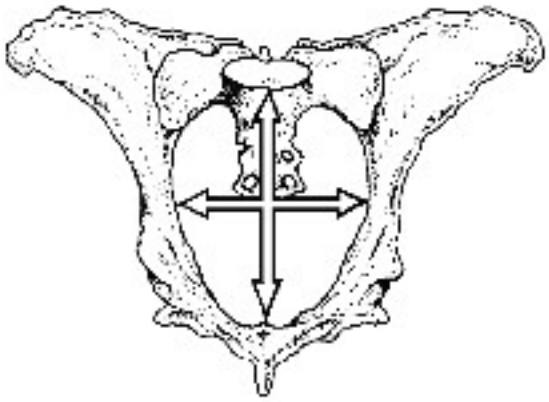

Figure 2. Bone structure of a heifer pelvis. Vertical and horizontal measurements are taken to determine pelvic area.

To determine the size of a deliverable calf, divide the pelvic area measurement by the ratio as determined from Table 1 using age and weight of the heifer. For example, a 900-pound yearling heifer with a pelvic area of 170 square centimeters should be able to deliver a 71-pound calf (170 ÷ 2.4) without assistance. Because the ratios used to determine size of a deliverable calf are only about 80 percent accurate, most custom heifer development programs cull heifers with a pelvic area too small to allow delivery of a 70- to 75-pound calf. Therefore, an 800-pound yearling heifer with a pelvic area of less than 160 square centimeters would be culled.

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

	Age at time of measurement (months)			
Heifer wt (lb)	8 to 9	12 to 13	18 to 19	22 to 23
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: Deutsher, 1988. University of Nebraska Agricultural Experiment Station

Reproductive tract scores determine a heifer's reproductive maturity (Table 2). This procedure was developed because directly measuring puberty in a group of heifers is time-consuming and labor-intensive. The score can range from 1 (immature) to 5 (cycling). It is simply a subjective estimate of sexual maturity based on ovarian follicular development and palpable size and tone of the reproductive tract.

Table 2. Reproductive tract scores.

	Ovaries – approximate size (mm)				
Reproductive tract score	Uterine horns	Length	Height	Width	Ovarian structures
1	Immature <20mm diameter; no tone	15	10	8	no palpable follicles
2	20–25mm diameter; slight tone	18	12	10	8mm follicles
3	20–30mm diameter; good tone	22	15	10	8–10mm follicles
4	30mm diameter; good tone	30	16	12	>10mm follicles; possible corpus luteum
5	>30mm diameter; good tone, erect	>32	20	15	>10 mm follicles; corpus luteum present

Source: Anderson et al., 1991

It is critical to use an experienced, reliable technician for reproductive tract scoring. The measurement is usually taken at the same time pelvic area is assessed. If estrus synchronization is not going to be used, consider culling heifers with a reproductive tract score less than 3, especially if the genetic value is marginal. If estrus will be synchronized using melengestrol acetate (MGA) or a controlled intervaginal drug releasing device (CIDR), a tract score of 2 is acceptable.

The third practice to be completed 1 month before the breeding season is vaccination. Heifers should be vaccinated against Vibrio fetus, Leptospirosis, and a respiratory complex that includes parainfluenza type 3 (PI3), bovine respiratory syncytial virus (BRSV), bovine viral diarrhea (BVD), and infectious bovine rhinotracheitis (IBR). A

modified-live vaccine is recommended because it stimulates a better immune response than a killed vaccine. It is also suggested to test each heifer for persistently infected bovine viral diarrhea virus (BVD-PI). Do this by collecting a skin sample, usually in the form of an ear notch, and sending it to a lab that will test for BVD-PI (locate labs by contacting the Mississippi State University Extension Service or the Mississippi Board of Animal Health). Heifers should also be dewormed at this time. Effective fly control is needed during the fly season, as well.

The next step in heifer development is breeding. Estrus synchronization and/or artificial insemination (AI) have advantages. The advantage of using estrus synchronization is increased pregnancy rates, a more uniform calf crop at weaning, and increased labor efficiency at breeding and calving. The major benefit AI offers is access to proven calving ease sires with superior growth and carcass performance genetics. Because most calving problems occur when heifers calve for the first time, make sure the sire has a desirable calving ease and/or birth weight expected progeny difference (EPD) with a high degree of accuracy.

Calving ease direct EPDs account for birth weight information, provide information about the expected assistance required at birth for an animal's calves, and predict the ease with which an animal's calves will be born to first-calf heifers. Calving ease direct indicates the percent of calves out of a particular animal that are expected to require more or less assistance at calving out of 2-year-old heifers. For example, a bull with a calving ease direct EPD of +10 percent compared to a bull within the same breed with a calving ease direct EPD of +2 percent is expected to sire, on average, 8 percent (10 – 2) more calves that can be born unassisted.

Consider calving ease when selecting a "clean-up" or natural service sire to be used for the rest of the breeding season after AI. Choosing an estrus synchronization protocol that uses some form of progestin (MGA or CIDR) stimulates heifers on the threshold of puberty to begin to cycle and have a better chance to breed later in the breeding season.

Post-breeding Heifer Management

Management of heifers from the end of the breeding season until calving often receives less attention and fewer resources than nutritional development and breeding, yet it is as important to longevity as any other management practice. The first step in post-breeding management should be pregnancy diagnosis. Depending on the skill and experience of the practitioner, this can be done about 45 to 60 days after the clean-up bull is removed. This allows for enough fetal development in the last heifers bred by natural service to be detected by transrectal palpation. Ultrasound pregnancy diagnosis can be performed 30 days after the clean-up bull is removed with the same accuracy as palpation performed later.

Culling criteria should be based on the following:

- pregnancy diagnosis
- performance data
- genetic potential

After pregnancy diagnosis, sell open (nonpregnant) heifers as soon as the market is optimal. Feeding open heifers may be profitable only when cost-of-gain allows added pounds to increase the profit margin. Marketing heifers as soon as they are confirmed open is usually the most economical decision. If there are more bred heifers than required replacements, cull those bred late in the breeding season. Search for a beef cattle producer who uses a later calving season to market these heifers at a larger profit than heavy, open heifers. Base further culling on performance data and genetic potential. Keep heifers that grew well and were more efficient during the development phase or that have a dam and/or sire with proven valuable EPDs or performance records.

Body condition scoring (BCS) is useful in evaluating heifer nutritional status as calving approaches. It can be easily evaluated in the pasture. Heifers are still growing and have higher nutrient requirements than mature cows. Manage them to calve at a body condition score of 6 (where 1 = extremely thin and 9 = extremely fat) or high-moderate condition, with considerable fat cover over the ribs and firm pressure needed to feel the spine.

Cows and heifers use energy for maintenance, growth, lactation, and reproduction. A beef heifer's energy needs for maintenance, growth, and lactation must be met before energy is used for reproduction. Adequate nutrition is critical during the last 2 months of gestation, since much of the fetal growth occurs then.

Separating heifers from the mature cow herd limits competition for bunk space and allows them to be placed on separate nutritional programs that better meet their requirements. Depending on breeding weight, bred heifers usually need to gain about 1 pound per day until calving. The weight at first calving should be 85 to 90 percent of the expected mature weight. This translates to a target weight at calving of approximately 850 to 950 pounds for British breeds and approximately 950 to 1050 pounds for Continental breeds.

They should have a body condition score of 6 and be on a positive plane of nutrition before calving. Underfeeding heifers just before calving does not significantly reduce calf weight and does increase calving difficulty and decrease calf immunity. Thin heifers may lack the stamina to deliver a calf without distress.

A heifer that has just calved needs to be able to milk well and return to estrus (start cycling) before the start of the breeding season. This requires additional nutrients for the first few months after calving (Table 3).

Reproduction is tied to nutrition, so having cattle in proper body condition at calving positively impacts rebreeding rates. Cows and heifers in thin body condition at calving time are slower to rebreed, produce less colostrum (first milk after calving that is very important for proper calf immune function), and are less likely to wean a live calf 7 to 8 months later. In addition, calves born to heifers with a BCS of 5 or 6 stand sooner after birth than calves out of heifers with a BCS of 3 or 4.

Even though adequate nutrition is crucial before calving, heifers should not be fed too much. Excessive body fat decreases fertility at rebreeding, and fat accumulation in the udder inhibits milk production. Ideally, heifers should not lose more than 1 BCS after calving.

Proper management practices are fundamental for a successful replacement heifer development program. Whether developing retained heifers, purchasing bred heifers, or providing custom development services, the practices outlined here are the foundation for a successful program. For more information on replacement heifer development, contact your local MSU Extension office.

Table 3. Nutrient requirements of beef females after calving (20 lb/day peak milk production).

Beef female	Expected mature weight (lb)	Months since calving	Daily dry matter intake (lb)	Total digestable nutrients (% dry matter)	Crude protein (% dry matter)
Cows	1,000	1	24.0	59.6	10.5
		2	25.0	60.9	11.2
		3	25.4	58.6	10.4
	1,200	1	26.8	58.7	10.1
		2	27.8	59.9	10.7
		3	28.4	57.6	9.9
2-year-old heifers	1,000	1	20.4	61.0	10.6
		2	21.2	62.1	11.1
		3	21.8	59.8	10.4
	1,200	1	22.9	60.4	10.2
		2	23.8	61.4	10.7
		3	24.5	59.2	10.0

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

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