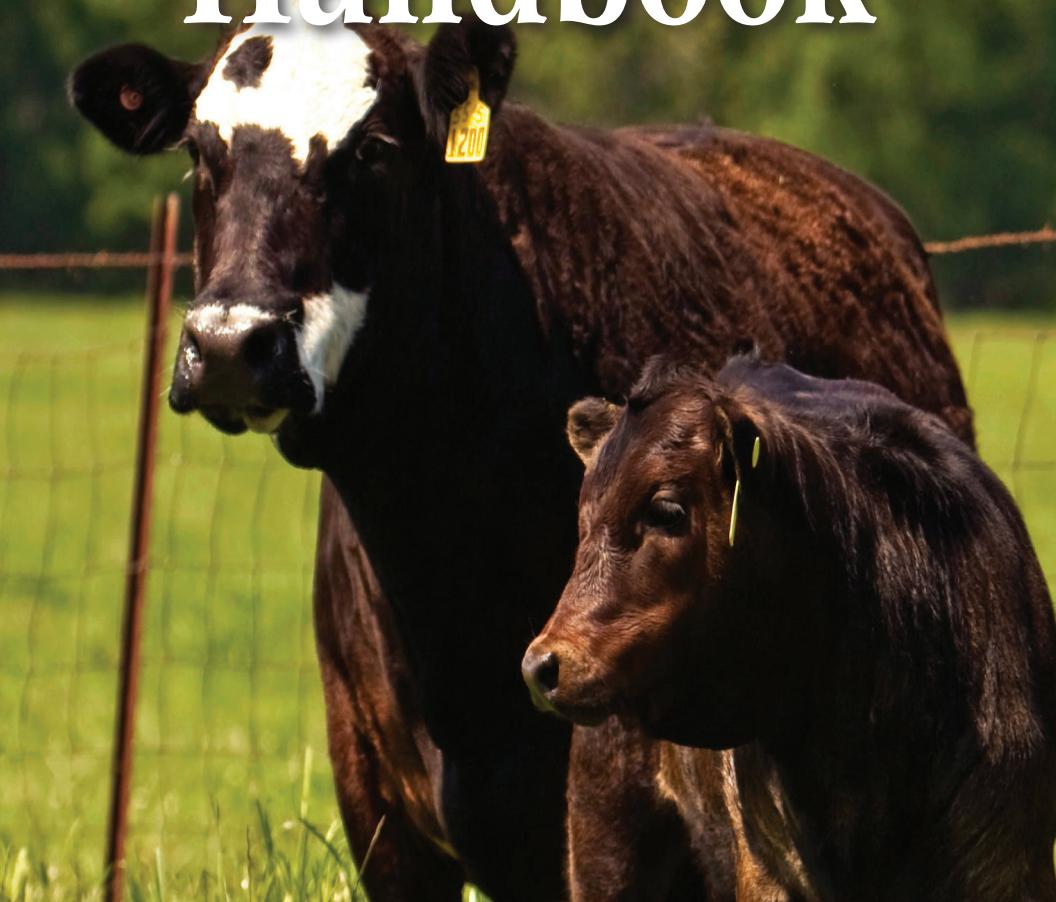


Alabama Beef Handbook



Alabama Beef Handbook

Providing Alabama beef producers with Extension-based research and practices to aid with risk management, improve profitability, and maintain competitiveness in today's cattle industry.



United States Department of Agriculture
National Institute of Food and Agriculture



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Preface

Beef cattle represent one of the largest segments of Alabama's agriculture industry, providing a great source of income for the state. This handbook explains basic beef cattle practices and is intended to aid beef cattle producers in today's business. The recommendations and guidelines suggested in this guide address common questions and concerns about running a profitable beef cattle business.

The authors do not assume any responsibility, make any guarantees, or offer any warranties in regard to the results obtained from the use of any management practices or suggestions made in this guide.

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Forage Management

Forage Crops

Forage crops make invaluable contributions to the total ecosystem in which we live. Forages provide most of the nutrition for beef cattle, dairy cattle, and sheep. They also supplement the diets of many other farm animals, including horses, swine, and goats. In addition, they provide food and shelter for countless species of wildlife.

Less well known is that forage crops are important in rotations with row crops and horticultural crops. They are a primary source of pollen and nectar for bees and the production of honey. They also add immeasurable beauty to the countryside.

Even more significantly, they protect the soil from erosion and thus make a major contribution to improving the quality of our water. The immense significance of forage crops is revealed by a single statement—they occupy more open land in Alabama than all other crops combined.

Categories of Forage Crops

More than forty species of forage crops are commonly grown in Alabama.

Each is normally distinguished as being

1. a grass or a legume
2. an annual or a perennial
3. a warm-season or cool-season plant

Use of these criteria creates eight basic categories that include all commonly used Alabama forages.

Table 1. Forage Grasses and Legumes

| | Adaption | | Seeding Rate (lbs/acre) | Planting Depth (inches) | Optimum Planting Date |
|---|-------------------|--|--|---|--|
| | Area ¹ | Soils | | | |
| Grasses | | | | | |
| Warm-Season Perennials | | | | | |
| Bahiagrass | C, S | Moist, sandy bottoms to droughty uplands | B ² : 15–20 | 1/4–1½ | Early spring after frost; S only: late summer and fall |
| Bermudagrass (seed propagated) | N, C, S | Well-drained, light sand to clay loam | Hulled B: 5–10 Unhulled B: 10–15 | 1/4–1½ | March 15 to early summer |
| Bermudagrass (Vegetatively propagated) | N, C, S | Well-drained, light sand to clay loam | Rows: 10 bushels sprigs B: 30–40 bushels sprigs | | Late Feb. to early summer when soil moisture is adequate |
| Dallisgrass | N, C, S | Moist, fertile, well-drained | B: 20 (10 lbs PLS [*]) | 1/4–1½ (Germination is often low; adjust rate accordingly.) | Feb. 15–March 15 |
| Johnsongrass | N, C, S | Medium to heavy | B: 20–30 D ³ : 10–15 | 1/2–1 | April–July |

¹N = north, C = central, S = south; ²B = broadcast; ³D = drilled; ⁴V = vegetatively propagated; ^{*}PLS = Pure Live Seed

Table 1. Forage Grasses and Legumes (cont.)

| | | Adaption | Seeding Rate (lb/acre) | Planting Depth (inches) | Optimum Planting Date |
|------------------------------|-------------------|---|----------------------------|----------------------------|--|
| Grasses | Area ¹ | Soils | | | |
| Warm-Season Annuals | | | | | |
| | | | | | |
| Crabgrass | N, C, S | Well drained pH: 5.8–7.5 | 3–5 lb PLS*/acre | ¼–½ | Late Feb.–April |
| Pearl Millet | N, C, S | Well drained, fertile (Avoid lime in Black Belt soils.) | D: 12–15 B: 25–30 | ½–1 | N: April 20–July 1 C: April 15–July 1 S: April 1–July 15 |
| Sorghum-sudan hybrids | N, C, S | Well drained, productive | D: 20–25 B: 30–35 | ½–1 | N: May 1–Aug. 1 C: April 15–Aug. 1 S: April 1–Aug. 15 |
| Sorghum, sweet and forage | N, C, S | Well drained | B: 15–20 Silage: D: 4–6 | 1 | Late April–May 15 S: as late as July 1 for forages sorghum |

¹N = north, C = central, S = south; ²B = broadcast; ³D = drilled; ⁴V = vegetatively propagated; *PLS = Pure Live Seed

Table 1. Forage Grasses and Legumes (cont)

| | | Adaption | | Seeding Rate (lb/acre) | Planting Depth (inches) | Optimum Planting Date |
|-------------------------------|-------------------|---|---------------------------|---------------------------|----------------------------|--|
| Grasses | Area ¹ | Soils | | | | |
| Cool-Season Perennials | | | | | | |
| Tall fescue | N, C | Moist, fertile bottoms; productive uplands | B: 15–20 D: 10–15 | 1/4–1/2 | | Sept.–Oct. |
| Orchardgrass | N | Well drained, medium to heavy, fertile | D: 15 | 1/4–1/2 | | Sept.–Oct. |
| Cool-Season Annuals | | | | | | |
| Oat, rye, wheat, triticale | N, C, S | Well drained, sandy to clay loams | Grain: 60–90 B: 90–120 | 1–2 | | N: Sept. 1–Oct. 1 C: Sept. 1–Oct. 15 S: Sept. 15–Nov. 1 Overseeded: 5 weeks later |
| Annual ryegrass | N, C, S | Clay loam to sandy | B: 25–30 D: 20–25 | 0–1/2 | | N: Sept. 1–Oct. 1 C: Sept. 1–Oct. 15 S: Sept. 15–Nov. 1 Overseeded: 5 weeks later |

¹N = north, C = central, S = south; ²B = broadcast; ³D = drilled; ⁴V = vegetatively propagated

Table 1. Forage Grasses and Legumes (cont)

| | | Adaption | Seeding Rate (lb/acre) | Planting Depth (inches) | Optimum Planting Date |
|-------------------------------|-------------------|--|-------------------------------|-------------------------------|--------------------------|
| | Area ¹ | Soils | | | |
| Legumes | | | | | |
| Warm-Season Perennials | | | | | |
| Sericea lespedeza | N, C, S | Well drained (Avoid lime soils of Black Belt.) | B: 20–30 D: 15–20 | $\frac{1}{4}$ | March–May |
| Perennial peanut | S | Well-drained sandy soils sprigs | V ⁴ : 60–80 bushel | | Dec.–early March |
| Annuals | | | | | |
| Alyceclover | S | Fertile, well drained | B: 15–20 | $\frac{1}{4}$ – $\frac{1}{2}$ | May 15–July 15 |
| Cowpea | N, C, S | Well drained | D: 30–40 B: 120 | 2–3 | May 1–June 15 |
| Sunn hemp | N, C | Well drained (Avoid lime soils of Black Belt.) | B: 25–35 | $\frac{1}{4}$ – $\frac{1}{2}$ | Feb. 15–March 15 |

¹N = north, C = central, S = south; ²B = broadcast; ³D = drilled; ⁴V = vegetatively propagated

Table 1. Forage Grasses and Legumes (cont.)

| | | Adaption | Seeding Rate (lb/acre) | Planting Depth (inches) | Optimum Planting Date |
|--|-------------------|---|---------------------------|----------------------------|--|
| | Area ¹ | Soils | | | |
| Legumes | | | | | |
| Cool-Season Perennials | | | | | |
| Alfalfa | N, C, S | Deep, fertile, well drained | B: 20–25 | 0–1/4 | N: Aug. 15–Oct. 1 C: Sept. 1–Oct. 1 S: Oct. 1–Nov. 1 |
| White and ladino clover | N, C, S | Moist bottoms and productive uplands | B: 2–4 | 0–1/4 | Sept.–Oct. (also Feb.–March in N,C) |
| Red clover (acts as annual in south Alabama) | N, C, S | Moist bottoms and productive uplands | D: 8–10 B: 12–15 | 1/4–1/2 | Sept.–Oct. |

¹N = north, C = central, S = south; ²B = broadcast; ³D = drilled; ⁴V = vegetatively propagated

Table 1. Forage Grasses and Legumes (cont.)

| | | Adaption | Seeding Rate (lb/acre) | Planting Depth (inches) | Optimum Planting Date |
|----------------------------|-------------------|--|---------------------------|----------------------------|---|
| | Area ¹ | Soils | | | |
| Legumes | | | | | |
| Cool-Season Annuals | | | | | |
| Black medic | Black Belt | Lime soils | B: 10 | 0-1/4 | Sept.-Oct. |
| Caley pea | Black Belt | All Black Belt soils; pH 6.5 or higher | B: 50 | ½-1 | Sept.-Oct. 15 |
| Arrowleaf clover | N, C, S | Well-drained, medium to highly fertile | B: 5-8 (scarified seed) | 0-1/2 | N: Sept. 1-Oct. 1 C: Sept. 15-Oct. 15 S: Sept. 15-Nov. 1 Overseed: 5 weeks later |
| Ball clover | N, C, S | Sandy loam to clay; tolerates moist soils | B: 2-3 | 0-1/4 | Sept.-Oct. |
| Crimson clover | N, C, S | Well drained (Avoid lime soils of Black Belt.) | B: 20-30 D: 15-20 | 0-1/2 | N: Sept. 1-Oct. 1 C: Sept. 15-Oct. 15 S: Sept. 15-Nov. 1 Overseed: 5 weeks later |

¹N = north, C = central, S = south; ²B = broadcast; ³D = drilled; ⁴V = vegetatively propagated

Table 1. Forage Grasses and Legumes (cont.)

| | | Adaption | Seeding Rate (lb/acre) | Planting Depth (inches) | Optimum Planting Date |
|----------------------------|---------|-----------------------------|---------------------------|----------------------------|--|
| Area ¹ | | Soil | | | |
| Legumes | | | | | |
| Cool-Season Annuals | | | | | |
| | | | | | |
| Subterranean clover | N, C, S | Well drained, productive | B: 8–10 | 1/4–1½ | Sept.–Oct. |
| Common vetch | N, C, S | Well drained | B: 30–40 | 1–1½ | N: Sept. 1–Oct. 15 C: Sept. 1–Oct. 15 S: Sept. 15–Nov. 1 |
| Hairy vetch | N, C, S | Well drained | B: 20–25 | 1–1½ | N: Sept. 1–Oct. 15 C: Sept. 1–Oct. 15 S: Sept. 15–Nov. 1 |

¹N = north, C = central, S = south; ²B = broadcast; ³D = drilled; ⁴V = vegetatively propagated

Table 2. Characteristics of Forage Grasses and Legumes

| | Seeding Vigor | Soil Acidity | Poor Drainage | Drought | Grazing |
|--------------------------------------|----------------------|---------------------|----------------------|----------------|----------------|
| Warm-Season Perennial Grasses | | | | | |
| Bahiagrass | P | E | G | E | E |
| Bermudagrass | F | E | P | E | E |
| Dallisgrass | P | F | E | G | G |
| Johnsongrass | G | F | E | G | P |
| Switchgrass | P | F | F | E | P |
| Warm-Season Annual Grasses | | | | | |
| Crabgrass | G | G | P | F | E |
| Pearl millet | E | E | P | E | F |
| Sorghum | G | P | P | E | F |
| Sorghum x sudan | E | P | F | G | F |

¹E = excellent, G = good, F = fair, P = poor; ²V = vegetatively propagated;

³Nongrazing tolerant varieties; grazing tolerant varieties are rated G.

Source: Adapted from D. M. Ball, C. S. Hoveland, and G. D. Lacefield, *Southern Forages*, 5th ed. International Plant Nutrition Institute, Peachtree Corners, GA.

Table 2. Characteristics of Forage Grasses and Legumes (cont.)

| | | | | Tolerance to | | |
|--------------------------------------|---------------|--------------|---------------|--------------|---------|---|
| | Seeding Vigor | Soil Acidity | Poor Drainage | Drought | Grazing | |
| Cool-Season Perennial Grasses | | | | | | |
| Orchardgrass | F | F | F | F | F | G |
| Tall fescue | G | G | G | G | E | E |
| Cool-Season Annual Grasses | | | | | | |
| Annual ryegrass | G | G | E | F | F | E |
| Oats | E | F | F | F | F | G |
| Rye | E | G | F | F | F | G |
| Triticale | E | F | F | F | F | G |
| Wheat | E | P | G | F | F | G |

¹E = excellent, G = good, F = fair, P = poor; ²V = vegetatively propagated;

³Nongrazing tolerant varieties; grazing tolerant varieties are rated G.

Source: Adapted from D. M. Ball, C. S. Hoveland, and G. D. Lacefield, *Southern Forages*, 5th ed. International Plant Nutrition Institute, Peachtree Corners, GA.

Table 2. Characteristics of Forage Grasses and Legumes (cont.)

| | | Tolerance to | | | | | |
|--------------------------------------|----------------|--------------|---------------|---------|---------|--|--|
| | Seeding Vigor | Soil Acidity | Poor Drainage | Drought | Grazing | | |
| Warm-Season Perennial Legumes | | | | | | | |
| Perennial peanut | V ² | G | P | G | F | | |
| Sericea lespedeza | P | E | F | E | P | | |
| Warm-Season Annual Legumes | | | | | | | |
| Annual lespedeza | F | E | F | G | G | | |
| Sunn hemp | G | G | P | G | F | | |

¹E = excellent, G = good, F = fair, P = poor; ²V = vegetatively propagated;

³Nongrazing tolerant varieties; grazing tolerant varieties are rated G.

Source: Adapted from D. M. Ball, C. S. Hoveland, and G. D. Lacefield, *Southern Forages*, 5th ed. International Plant Nutrition Institute, Peachtree Corners, GA.

Table 2. Characteristics of Forage Grasses and Legumes (cont.)

| | | Tolerance to | | | | Grazing |
|--------------------------------------|---|----------------|--------------|---------------|------------------|---------|
| | | Seedling Vigor | Soil Acidity | Poor Drainage | Drought | |
| Cool-Season Perennial Legumes | | | | | | |
| Alfalfa | G | P | P | E | P-G ³ | |
| Red clover | E | F | F | F | F | |
| White and ladino clover | F | F | G | P | E | |
| Cool-Season Annual Legumes | | | | | | |
| Arrowleaf clover | F | F | P | F | F | G |
| Ball Clover | P | F | E | F | F | |
| Berseem clover | G | P | E | F | F | |
| Caley pea | G | F | G | F | F | |
| Crimson clover | E | G | P | F | F | |
| Hairy Vetch | E | G | P | F | F | |
| Subterranean clover | G | G | G | F | E | |

¹E = excellent; G = good; F = fair; P = poor; ²V = vegetatively propagated;

³Nongrazing tolerant varieties; grazing tolerant varieties are rated G

Source: Adapted from D. M. Ball, C. S. Hoveland, and G. D. Lacatfield, *Southern Forages*, 5th ed. International Plant Nutrition Institute, Peachtree Corners, GA.

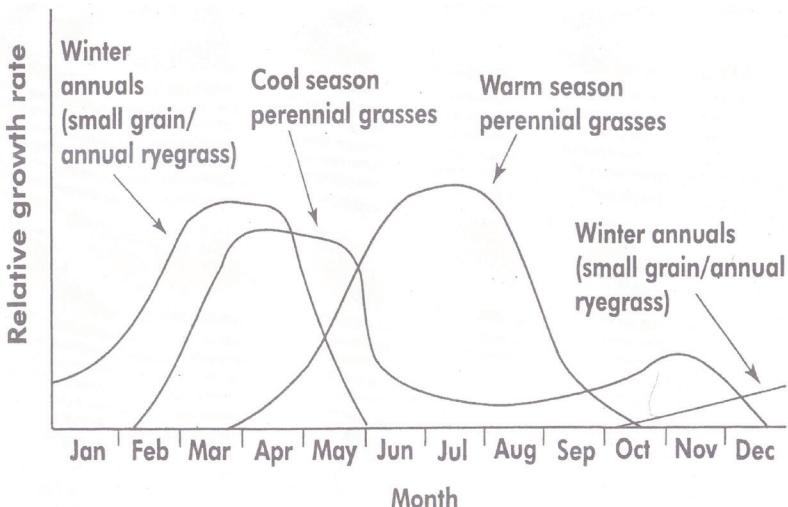


Figure 1. Usual distribution of growth of various categories of forage crops.

Source: Adapted from D. M. Ball, C. S. Hoveland, and G. D. Lacefield, *Southern Forages*, 5th ed. International Plant Nutrition Institute, Peachtree Corners, GA.

Definitions of Selected Grazing Terms

- **Grazing method:** A defined method of grazing management designed to achieve a specific objective
- **Grazing system:** An integrated combination of animal, plant, soil, and environment along with one or more grazing methods designed to achieve a specific goal
- **Stockpiling forages:** Deferring grazing and allowing forage to accumulate until a later period
- **Continuous stocking:** A grazing method where animals have unrestricted access to the entire unit of land throughout the grazing season
- **Forward grazing:** A grazing method where two or more groups of animals with different nutritional requirements graze sequentially on the same area (synonyms: first-last grazing, leader-follower, top and bottom grazer)
- **Rotational stocking:** A grazing method that rotates periods of grazing and periods of rest on the same unit of land, moving animals among two or more paddocks in the system
- **Set stocking:** Grazing a fixed number of animals on a fixed land area during the grazing season
- **Strip grazing:** A grazing method that confines animals to a small strip of area for a relatively short period of time before each rest period (synonym: intensive rotational grazing)

Table 3. Guidelines for Rotational Stocking of Selected Forage Crops¹

| Forage Crop | Target Height (inches) | | |
|---|------------------------|--------------------------|-----------------|
| | Begin Grazing | End Grazing ² | Usual Days Rest |
| Alfalfa (hay types) | 10–16 | 3–4 | 35–40 |
| Alfalfa (grazing types) | 10–16 | 2–3 | 15–30 |
| Bahiagrass | 6–10 | 1–2 | 10–20 |
| Bermudagrass | 4–8 | 1–3 | 7–15 |
| White and subterranean clovers ³ | 6–8 | 3–5 | 7–15 |
| All other clovers ³ | 8–10 | 3–5 | 10–20 |
| Dallisgrass | 6–8 | 3–4 | 7–15 |
| Tall fescue | 8–12 | 4–8 | 15–30 |
| Johnsongrass | 16–20 | 8–12 | 30–40 |
| Orchardgrass | 8–12 | 4–8 | 15–30 |
| Pearl millet | 20–24 | 8–12 | 10–20 |
| Annual ryegrass | 6–12 | 3–4 | 7–15 |
| Sericea lespedeza | 8–15 | 4–6 | 20–30 |
| Rye, wheat, oat, triticale | 8–12 | 3–4 | 7–15 |
| Forage sorghum | 20–24 | 8–12 | 10–20 |
| Sorghum x sundangrass hybrids | 20–24 | 8–12 | 10–20 |

Source: Adapted from D. M. Ball, C. S. Hoveland, and G. D. Lacefield, *Southern Forages*, 5th ed. International Plant Nutrition Institute, Peachtree Corners, GA.

¹These are merely guidelines. Stocking rates and growing conditions greatly affect forage growth. Also, the more closely pastures are grazed, the longer the rest period generally needs to be for forages that are sensitive to defoliation.

²When deciding when to end grazing, consider the nutritional requirements of the livestock being grazed. The closer a pasture is grazed, the lower the forage quality will be toward the end of that particular grazing cycle.

³Clovers are typically grown in pastures in mixtures with grasses. White clover and subterranean clover are quite tolerant of close defoliation; most other clovers are not.

Major Benefits of Improved Grazing Management¹

- Better cold tolerance of forage plants due to a better root system, resulting from the prevention of overgrazing.
- Better drought tolerance of forage plants due to a better root system, resulting from the prevention of overgrazing.
- Fewer weed problems due to reduced opportunity for selective grazing; livestock are forced to eat weeds, thus making it more difficult for weeds to survive and to make seed.
- Forage plants can be managed for reseeding in connection with other pasture management objectives.
- Forage plants are vigorous and regrow more quickly after being grazed, thus making them more competitive.
- Higher quality forage can be provided to animals that have the highest nutritional requirements. Techniques that can accomplish this include creep grazing and forward grazing (see Grazing Terms).
- Improved soil quality in pastures over time due to higher organic matter levels, better soil structure, and less compaction.
- Improved water quality resulting from reduced erosion in pastures or from grazing management that minimizes contamination of surface water by particulate matter or by bacteria and nutrients in waste.
- Less runoff due to presence of a sod that holds water, a higher water infiltration rate, and increased water-holding capacity of the soil.
- Livestock are gentler, easier to observe, less inclined to tear down fences, and easier to work.
- Livestock can be used to “trample in” seed by concentrating high numbers of animals in an area for a short period of time.
- Livestock have less opportunity to overgraze certain plants or pasture areas. Plants that are not tolerant of being grazed closely or frequently are ensured a rest.
- More efficient nutrient recycling due to more even distribution of dung and urine in pastures.
- Pasture height can be kept close to optimum more of the time, thus reducing leaf aging, leaf drop, and increased fiber content of forage. This results in a higher-quality diet for grazing animals (figure 2).
- Reduced internal parasite problems of livestock as a result of avoiding grazing pastures too closely.
- Utilization of a higher percentage of pasture growth than would otherwise be achieved. This means less feeding of hay or other expensive stored feed materials.

¹Listed in alphabetical order. Not all of these benefits will be realized at the same time, but all are possible.

Effect of plant maturity on forage intake and digestibility.

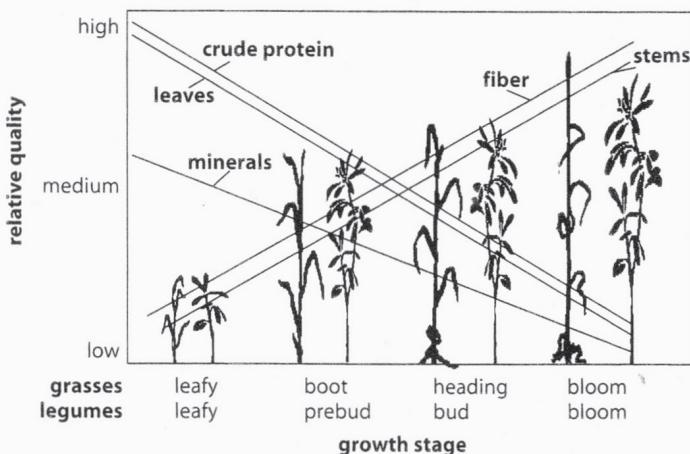


Figure 2. Effect of plant maturity on forage intake and digestibility

Source: Adapted from Blaser R., R. C. Hammes,Jr., J. P. Fontenot, H. T. Bryant, C. E. Polan, D. D. Wolf, F. S. McClaugherty, R. G. Klein, and J. S. Moore. 1986. *Forage-Animal Management Systems*. Virginia Polytechnic Institute, Bulletin 86-7. Used with permission of Virginia Cooperative Extension, Virginia Tech, and Virginia State University.

Key Concepts of Hay Storage

- Weathering of hay results in losses of dry matter, lowered forage quality, as well as reduced hay intake and greater refusal.
- The lowest losses occur when hay is stored inside a building. Building a hay storage facility may be economically justifiable if hay losses are otherwise high. The more valuable the hay, the easier it is to justify spending time and money to reduce storage losses.
- Hay/soil contact is usually the most important source of spoilage of hay stored outside and should be eliminated if possible. This and other outside hay storage tips are illustrated in figure 3.

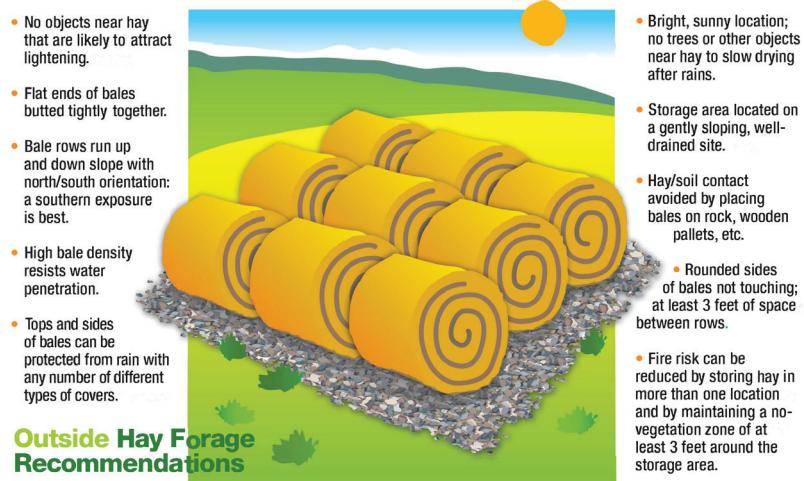


Figure 3. Outside hay storage recommendations

Table 4. Approximate Hay Storage Crude Protein and Total Digestible Nutrients (TDN) Content of Selected Forage Crops

| | Average Nutrient Level | |
|---|------------------------|-------------|
| | Crude Protein Percent | TDN Percent |
| Cool-Season Forage Crops | | |
| Alfalfa (early bloom) | 17–22 | 58–65 |
| Arrowleaf clover | 14–17 | 56–64 |
| Oats | 10–14 | 55–62 |
| Orchardgrass | 12–15 | 54–58 |
| Red clover | 14–16 | 57–62 |
| Rye | 8–12 | 54–60 |
| Annual ryegrass | 10–17 | 55–64 |
| Soybean | 12–16 | 54–58 |
| Tall fescue | 10–15 | 54–58 |
| Wheat | 8–12 | 54–60 |
| Warm-Season Forage Crops | | |
| Annual lespedeza | 12–16 | 52–58 |
| Bahiagrass | 8–11 | 50–54 |
| Coastal bermudagrass (4-week cutting interval) | 10–14 | 55–60 |
| Common bermudagrass | 9–11 | 50–58 |
| Dallisgrass | 8–12 | 55–56 |
| Johnsongrass | 10–14 | 55–58 |
| Pearl millet | 8–14 | 50–58 |
| Sericea lespedeza | 12–16 | 50–56 |
| Sundangrass | 9–12 | 55–60 |

Source: Adapted from D. M. Ball, C. S. Hoveland, and G. D. Lacefield, *Southern Forages*, 5th ed. International Plant Nutrition Institute, Peachtree Corners, GA.

Table 5. Recommended Stage to Harvest Various Forage Crops for Hay

| Forage Crop | Time of Harvest |
|---|--|
| Alfalfa | Bud stage for 1st cutting, 1/10 bloom for 2nd and latter cuttings. For spring seedlings, allow 1st cutting to reach full bloom. |
| Orchardgrass, timothy, or tall fescue | Boot to early head stage for 1st cutting; 2nd and latter cuttings at 4- to 6-week intervals. |
| Red, crimson, and arrowleaf clovers | Early bloom |
| Rye, oats, wheat, triticale, and annual ryegrass | Boot to early head stage (boot preferable for rye). |
| Sericea lespedeza | 15–18 inches high leaving 4-inch stubble; do not cut between mid-August and killing frost. |
| Annual lespedeza | Early bloom and before bottom leaves begin to fall. |
| White (ladino) clover | Cut at correct stage for companion plant. |
| Johsongrass, sudangrass, sorghum × sudangrass hybrids, and pearl millet | 40 inches high or early boot stage, whichever comes first; leave 4- to 6-inch stubble on johnsongrass; leave 6- to 8-inch stubble on sorghums. |
| Bermudagrass | 15–18 inches high for 1st cutting; 2nd and latter cuttings at 4- to 5-week interval or when 15 inches high. |

Source: Adapted from D. M. Ball, C. S. Hoveland, and G. D. Lacefield, *Southern Forages*, 5th ed. International Plant Nutrition Institute, Peachtree Corners, GA.

- Some heating of hay is normal.
- If heating is excessive soon after baling, monitor the temperatures over time.
- Maximum temperature is usually reached 1 week after baling but can occur up to 3 weeks later.
- Avoid placing freshly cut hay in an area where it is touching dry hay.
- 120° F = protein breakdown
- 140° F = sugar caramelization
- 150–180° F = fire (likely)

Sampling Forage for Laboratory Analysis

Identification of a Forage Lot

A forage lot is defined as forage taken from the same farm or field and cut under uniform conditions within a 48-hour period. A lot can represent several truck or wagon loads, but all forage should have been harvested and stored under identical conditions.

For accurate test results, store hay or silage by lots, and take separate samples from each lot.

Note any special conditions that result in quality differences in a lot, such as rain damage during harvest or excessive weed populations. Noting these conditions and differences will allow you to assess at a later time the reasons for quality variations.

How to Take a Hay Sample

Use a good probe. Use a hay probe with an internal diameter of $\frac{3}{8}$ to $\frac{5}{8}$ inch. The cutting edge should be at a right angle to the shaft. Keep cutting edge sharp; dull probes will not obtain a representative sample. Core samplers that cut through a cross-section of a bale provide the best representation of stems and leaves. Avoid using open augers as they selectively sample leaves.

Sample at random. Select bales at random from throughout the hay lot. Avoiding some bales and choosing others based on appearance will bias the sample. For stacked hay, take samples from bales at various heights in the stack.

Take enough core subsamples. Take at least twenty core samples from a hay lot to minimize sample variation.

Use the proper technique. For rectangular bales of all sizes, insert the hay probe 12 to 18 inches deep at a right angle into the center of the ends of the bales. For round bales, insert the probe at a right angle to the outside circumference of the bales.

Handle samples correctly. Combine core samples from a given lot into a single sample and store in a sealed plastic freezer bag. Samples should be protected from heat or direct sun and promptly sent to a laboratory for analysis. Each sample should weigh approximately $\frac{1}{2}$ to $\frac{3}{4}$ pound. Note that many labs will not grind entire larger samples, and samples that are too small will not adequately represent the hay lot.

Common Components of a Nutritive Value Analysis

- **Dry matter:** DM, % Forage samples are oven dried to determine the amount of water and dry matter in a sample. A goal of 85% dry matter is preferred for hay. Baleage may contain between 40 and 60% dry matter, and silage between 30 and 40% dry matter to ferment properly. Compare results on a dry matter basis for ration development purposes.
- **Crude Protein:** CP, % Crude protein is the total nitrogen in a forage sample multiplied by a 6.25 correction factor.
- **Neutral Detergent Fiber:** NDF, % The NDF value is the total cell wall, which consists of hemicellulose, cellulose, and lignin. As forage NDF increases, forage intake decreases.
- **Acid Detergent Fiber:** ADF, % Acid detergent fiber is an estimation of the component of the forage that is indigestible to the animal. This value refers to the cell wall portions of the forage that are made up of cellulose and lignin. The greater the ADF, the less digestible forages become to the animal.
- **Total Digestible Nutrients:** Energy value of forage is expressed as TDN. The greater the value, the more energy-dense the forage is considered.
- **Calcium and Phosphorous:** These are two key macrominerals required daily in beef cattle diets.
- **Relative Forage Quality:** This is a single number that can be used to compare the overall quality of one or more forage samples. In general, RFQ values range from 50 to 250, with the upper end representing the highest quality forage.

How to Take a Soil Sample

Fertilizer recommendations are only as good as the soil sample submitted for analysis. It is important that a soil sample accurately represent the area from which it is taken.

Generally, a sample should be a composite of subsamples taken with a soil probe from 10 to 20 spots in the field or sampled area. Depth of sampling is important: probe plowed fields to plow depth; probe sod or other unplowed areas to a depth of 2 to 3 inches.

A sample should normally represent no more than 10 acres or even less if cropping or fertilization history of various areas differ. Remember that fertilizer and lime recommendations vary for different crops. When submitting the sample for analysis, specify the type(s) of forage(s) to be grown.

Key Facts About Soil pH and Lime

- A soil pH of 7.0 is neutral. As soil reaction goes above or below this number, the soil is considered increasingly alkaline or acid, respectively.
- Soil pH is a logarithmic scale. For example, a soil pH of 5.0 is ten times more acid than a soil pH of 6.0.
- Most forage crops perform best when the soil pH is in the range of 6.0 to 6.5.
- Lime can be applied any time field conditions permit.
- Fineness of lime is important. To qualify as being high-grade lime, 90 percent or more of the material should be capable of passing through a 10-mesh sieve.
- Calcitic lime is composed primarily of calcium carbonate. Dolomitic lime contains at least 6 percent elemental magnesium.
- Application of lime corrects soil acidity, supplies calcium and/or magnesium, increases availability of some nutrients, and promotes desirable biological activity.
- Lime moves slowly through the soil and reacts slowly. Where possible, apply lime and till it into the top few inches of soil 3 or 4 months before planting.

Nutrition Management

Water

Water is the most important part of beef cattle diets. It influences feed intake, animal performance, and efficiency of production. Daily water requirements of beef cattle change based on animal age, size, stage of production, and the environment.

Table 1. Daily Water Requirements (Gallons Per Day) for Various Classes of Cattle from 40 to 90°F

| Animal Class/ Stage of Production | Mean Air Temperature (F°) | | | | | |
|---|---------------------------|------|------|------|------|------|
| | 40 | 50 | 60 | 70 | 80 | 90 |
| Growing Calves | | | | | | |
| 400 pounds | 4.0 | 4.3 | 5.0 | 5.8 | 6.7 | 9.5 |
| 600 pounds | 5.3 | 5.8 | 6.6 | 7.8 | 8.9 | 12.7 |
| 800 pounds | 6.3 | 6.8 | 7.9 | 9.2 | 10.6 | 15.0 |
| Pregnant cows | 6.0 | 6.5 | 7.4 | 8.7 | 9.8 | 11.5 |
| Lactating cows | 11.4 | 12.6 | 14.5 | 16.9 | 17.9 | 16.2 |
| Mature bulls | 8.7 | 9.4 | 10.8 | 12.6 | 14.5 | 20.6 |

Nutrition Terminology

- **Dry Matter Intake.** Dry matter refers to the portion of forage or feed remaining when water is removed. Intake defines how much dry matter the animal consumes per day. This amount determines the quantity of nutrients the animal is getting in the diet on a daily basis.
- **Total Digestible Nutrients.** A measure of daily energy requirements or energy provided by a forage or feedstuff. Lactating beef cows have a greater TDN requirement (62%) than dry, pregnant cows (48%).
- **Crude Protein.** An estimate of the total nitrogen in a forage or feed multiplied by a 6.25 correction factor. Daily crude protein requirements of cows generally range from 7 to 12% CP depending on their stage of production.
- **Calcium (Ca) and Phosphorus (P)**— These are two minerals required in the greatest amount daily by beef cattle. Ca and P are important for bone development, milk production, and maintenance.

Nutrient Requirements of Beef Cattle

Table 2. Daily Dry Matter Intake and Diet Nutrient Densities for Beef Cows—
Mature Weight = 1,000 pounds

| | Months Since Calving | | | | | | | | | | | |
|--|----------------------|------|------|------|------|------|------|------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1,000-pound cow weaning 7-month-old weighing 456 pounds | | | | | | | | | | | | |
| DM, lb/day | 21.6 | 22.1 | 23.0 | 22.5 | 22.1 | 21.7 | 21.1 | 21.0 | 20.9 | 20.8 | 21.0 | 21.4 |
| TDN, % | 55.8 | 56.6 | 54.3 | 53.4 | 52.5 | 51.8 | 44.9 | 45.7 | 47.0 | 49.1 | 52.0 | 55.7 |
| CP, % | 8.7 | 9.1 | 8.4 | 8.0 | 7.5 | 7.1 | 6.0 | 6.2 | 6.5 | 7.0 | 7.7 | 8.7 |
| Ca, % | 0.24 | 0.25 | 0.23 | 0.22 | 0.20 | 0.19 | 0.15 | 0.15 | 0.15 | 0.24 | 0.24 | 0.24 |
| P, % | 0.17 | 0.17 | 0.16 | 0.15 | 0.14 | 0.14 | 0.11 | 0.11 | 0.11 | 0.15 | 0.15 | 0.15 |
| 1,000-pound cow weaning 497-pound calf | | | | | | | | | | | | |
| DM, lb/day | 24.0 | 25.0 | 25.4 | 24.4 | 23.5 | 22.7 | 21.1 | 21.0 | 20.9 | 20.8 | 21.0 | 21.4 |
| TDN, % | 59.6 | 60.9 | 58.6 | 57.0 | 55.4 | 54.0 | 44.9 | 45.7 | 47.0 | 49.1 | 52.0 | 55.7 |
| CP, % | 10.5 | 11.2 | 10.4 | 9.6 | 8.9 | 8.2 | 6.0 | 6.2 | 6.5 | 7.0 | 7.7 | 8.7 |
| Ca, % | 0.30 | 0.32 | 0.30 | 0.27 | 0.24 | 0.22 | 0.15 | 0.15 | 0.15 | 0.24 | 0.24 | 0.24 |
| P, % | 0.20 | 0.21 | 0.19 | 0.18 | 0.17 | 0.15 | 0.11 | 0.11 | 0.11 | 0.15 | 0.15 | 0.15 |
| 1,000-pound cow weaning 535-pound calf | | | | | | | | | | | | |
| DM, lb/day | 26.4 | 27.8 | 27.8 | 26.4 | 24.9 | 23.7 | 21.1 | 21.0 | 20.9 | 20.8 | 21.1 | 21.4 |
| TDN, % | 62.8 | 64.5 | 62.1 | 60.1 | 57.9 | 55.9 | 44.9 | 45.7 | 49.1 | 52.0 | 55.7 | 55.7 |
| CP, % | 12.1 | 12.9 | 12.0 | 11.1 | 10.0 | 9.1 | 6.0 | 6.2 | 6.5 | 7.0 | 7.7 | 8.7 |
| Ca, % | 0.35 | 0.38 | 0.35 | 0.32 | 0.28 | 0.25 | 0.15 | 0.15 | 0.15 | 0.24 | 0.24 | 0.24 |
| P, % | 0.22 | 0.24 | 0.22 | 0.21 | 0.19 | 0.17 | 0.11 | 0.11 | 0.11 | 0.15 | 0.15 | 0.15 |

Table 3. Daily Dry Matter Intake and Diet Nutrient Densities for Beef Cows—
Mature Weight = 1,200 pounds

| | Months Since Calving | | | | | | | | | | | |
|--|----------------------|------|------|------|------|------|------|------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1,200-pound cow weaning 7-month old weighing 496 pounds | | | | | | | | | | | | |
| DM, lb/day | 24.4 | 24.9 | 26.0 | 25.6 | 25.1 | 24.8 | 24.2 | 24.1 | 24.0 | 23.9 | 24.1 | 24.6 |
| TDN, % | 55.3 | 56.0 | 53.7 | 52.9 | 52.1 | 51.5 | 44.9 | 45.8 | 47.1 | 49.3 | 52.3 | 56.2 |
| CP, % | 8.4 | 8.8 | 8.1 | 7.7 | 7.3 | 7.0 | 6.0 | 6.2 | 6.5 | 7.0 | 7.7 | 8.8 |
| Ca, % | 0.24 | 0.25 | 0.23 | 0.21 | 0.20 | 0.19 | 0.15 | 0.15 | 0.15 | 0.26 | 0.25 | 0.25 |
| P, % | 0.17 | 0.17 | 0.16 | 0.15 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.16 | 0.16 | 0.16 |
| 1,200-pound cow weaning 558-pound calf | | | | | | | | | | | | |
| DM, lb/day | 26.8 | 27.8 | 28.4 | 27.4 | 26.5 | 25.7 | 24.2 | 24.1 | 24.0 | 23.9 | 24.1 | 24.6 |
| TDN, % | 58.7 | 59.9 | 57.6 | 56.2 | 54.7 | 53.4 | 44.9 | 45.8 | 47.1 | 49.3 | 52.3 | 56.2 |
| CP, % | 10.1 | 10.7 | 9.9 | 9.2 | 8.5 | 7.9 | 6.0 | 6.2 | 6.5 | 7.0 | 7.7 | 8.8 |
| Ca, % | 0.29 | 0.31 | 0.29 | 0.26 | 0.24 | 0.22 | 0.15 | 0.15 | 0.15 | 0.26 | 0.25 | 0.25 |
| P, % | 0.19 | 0.21 | 0.19 | 0.18 | 0.17 | 0.15 | 0.12 | 0.12 | 0.12 | 0.16 | 0.16 | 0.16 |
| 1,200-pound cow weaning 598-pound calf | | | | | | | | | | | | |
| DM, lb/day | 29.2 | 30.6 | 30.8 | 29.4 | 27.9 | 26.7 | 24.2 | 24.1 | 24.0 | 23.9 | 24.1 | 24.6 |
| TDN, % | 61.6 | 63.2 | 60.8 | 59.0 | 57.0 | 55.2 | 44.9 | 45.8 | 47.1 | 49.3 | 52.3 | 56.2 |
| CP, % | 11.5 | 12.2 | 11.4 | 10.6 | 9.6 | 8.8 | 6.0 | 6.2 | 6.5 | 7.0 | 7.7 | 8.8 |
| Ca, % | 0.34 | 0.36 | 0.34 | 0.31 | 0.27 | 0.25 | 0.15 | 0.15 | 0.15 | 0.26 | 0.25 | 0.25 |
| P, % | 0.22 | 0.23 | 0.22 | 0.20 | 0.18 | 0.17 | 0.12 | 0.12 | 0.12 | 0.16 | 0.16 | 0.16 |

Table 4. Daily Dry Matter Intake and Diet Nutrient Densities for Beef Cows—
Mature Weight = 1,400 pounds

| | Months Since Calving | | | | | | | | | | | |
|--|----------------------|------|------|------|------|------|------|------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1,400-pound cow weaning 7-month old weighing 535 pounds | | | | | | | | | | | | |
| DM, lb/day | 27.1 | 27.6 | 28.9 | 28.5 | 28.0 | 27.7 | 27.2 | 27.0 | 26.9 | 26.8 | 27.0 | 27.6 |
| TDN, % | 54.9 | 55.5 | 53.3 | 52.5 | 51.8 | 51.2 | 45.0 | 45.8 | 47.3 | 49.5 | 52.6 | 56.6 |
| CP, % | 8.2 | 8.6 | 7.9 | 7.6 | 7.2 | 6.9 | 6.0 | 6.2 | 6.5 | 7.0 | 7.8 | 8.9 |
| Ca, % | 0.23 | 0.25 | 0.23 | 0.21 | 0.20 | 0.19 | 0.16 | 0.16 | 0.16 | 0.27 | 0.26 | 0.26 |
| P, % | 0.17 | 0.17 | 0.16 | 0.15 | 0.15 | 0.14 | 0.12 | 0.12 | 0.12 | 0.17 | 0.17 | 0.17 |
| 1,400-pound cow weaning 612-pound calf | | | | | | | | | | | | |
| DM, lb/day | 29.5 | 30.5 | 31.3 | 30.3 | 29.4 | 28.6 | 27.2 | 27.0 | 26.9 | 26.8 | 27.0 | 27.6 |
| TDN, % | 58.0 | 59.1 | 56.8 | 55.5 | 54.1 | 53.0 | 45.0 | 45.8 | 47.3 | 49.5 | 52.6 | 56.6 |
| CP, % | 9.8 | 10.3 | 9.6 | 8.9 | 8.3 | 7.7 | 6.0 | 6.2 | 6.5 | 7.0 | 7.8 | 8.9 |
| Ca, % | 0.28 | 0.30 | 0.28 | 0.26 | 0.24 | 0.22 | 0.16 | 0.16 | 0.16 | 0.27 | 0.26 | 0.26 |
| P, % | 0.19 | 0.20 | 0.19 | 0.18 | 0.17 | 0.16 | 0.12 | 0.12 | 0.12 | 0.17 | 0.17 | 0.17 |
| 1,400-pound cow weaning 656-pound calf | | | | | | | | | | | | |
| DM, lb/day | 31.9 | 33.3 | 33.7 | 32.3 | 30.8 | 29.6 | 27.2 | 27.0 | 26.9 | 26.8 | 27.0 | 27.6 |
| TDN, % | 60.7 | 62.2 | 59.8 | 58.1 | 56.2 | 54.7 | 45.0 | 45.8 | 47.3 | 49.5 | 52.6 | 56.6 |
| CP, % | 11.1 | 11.8 | 11.0 | 10.0 | 9.3 | 8.5 | 6.0 | 6.2 | 6.5 | 7.0 | 7.8 | 8.9 |
| Ca, % | 0.33 | 0.35 | 0.32 | 0.30 | 0.27 | 0.24 | 0.16 | 0.16 | 0.16 | 0.27 | 0.26 | 0.26 |
| P, % | 0.22 | 0.23 | 0.21 | 0.20 | 0.18 | 0.17 | 0.12 | 0.12 | 0.12 | 0.17 | 0.17 | 0.17 |

Expected Dry Matter Intake Requirements of Beef Cattle

An estimate of dry matter intake for various classes of beef cattle can be determined as a percentage of expected body weight intake per day. For example, a mature, dry cow is expected to consume between 2.0 to 2.5% of her body weight per day in dry matter. Using this example, a 1,300-pound cow consuming 2.0% of her body weight per day in dry matter is equivalent to 26 pounds.

Table 5. Daily Expected Dry Matter Intake of Various Classes of Beef Cattle

| Animal Class | Expected Dry Matter Intake Range (Percent of Body Weight Per Day) |
|---------------------|--|
| Beef cow (dry) | 2.0% |
| Beef cow with calf | 2.5% |
| Heifer, replacement | 2.5 to 3% |
| Stocker | 2.5 to 3% |

Source: Adapted from NRC (2016)

Forage Quality and Animal Intake

Forage quality is a major factor influencing the intake and nutrients received by beef cattle from grazed or conserved forages.

Greater forage quality increases intake potential, whereas low-quality forage may limit intake (table 6).

Table 6. Influence of Forage Quality on Expected Dry Matter Intake of Mature Beef Cows

| Hay Quality | Class of Cattle | Dry Matter Capacity, Percent of Animal Body Weight |
|--|-----------------|--|
| Low Quality (Less than 52% TDN, 8 percent CP) | dry cows | 1.5 |
| | lactating cows | 2.3 |
| Average Quality (52 to 56% TDN, 9 to 12% CP) | dry cows | 2.0 |
| | lactating cows | 2.3 |
| High Quality (Greater than 56% percent TDN, 12% CP) | dry cows | 2.5 |
| | lactating cows | 2.7 |

Supplementation Rules of Thumb

- Provide about 30 inches of linear bunk or trough space for each cow being supplemented.
- Balance supplemental feeding rations based on forage analysis results.
- Compare costs of supplemental feedstuffs based on cost per unit of energy or protein provided.
- A cost calculator is available at www.alabamabeefsystems.com.

Storage of Feeds

Table 7. Bulk Densities of Various Commodity Feeds

| Commodity | Pounds/Cubic Feet |
|--------------------------|-------------------|
| Broiler litter | 30 |
| Corn, shelled | 45 |
| Corn gluten feed | 33 |
| Cottonseed | 25 |
| Cottonseed meal | 38 |
| Distillers grain (dried) | 26 |
| Oats | 7 |
| Peanut hulls, loose | 11 |
| Peanut skins | 28 |
| Soybean hulls, loose | 40 |
| Soybean hulls, pelleted | 40 |

Selecting a Mineral Product

Trace mineral salt is not a complete mineral; it contains no calcium or phosphorus. When evaluating the composition tag on a bag of minerals, look for the following:

- 15 to 30% salt
- 6 to 12% calcium
- 6 to 12% phosphorus
- 1 to 4% magnesium (or 8 to 14% for high magnesium)
- 0.09 to 0.18% copper
- 0.18 to 0.36% zinc
- 0.0026 to 0.0052% selenium

If concentrations of these minerals are considerably outside of these ranges, look for another bag of minerals. Consumption levels are generally between 2 and 4 ounces of product per day. Remember that zinc and copper in the sulfate form are more available than the oxide form.

Mineral Additives

Many mineral formulations offer inclusion of additive technologies. Definitions of commonly included additives are described below:

- **Ionophores.** These are often added to mineral supplements to improve feed efficiency. Blending these products with minerals helps ensure more consistent consumption and can have positive effects on feed efficiency on grazed forage systems or in drylot settings.
- **Fly Control.** Many mineral packages may include the addition of insect growth regulators (IGR) or larvicides as fly control. These products work by providing control through manure. Product efficacy is based on cattle consuming the mineral product consistently containing these products and starting cattle on these products prior to fly issues reaching threshold levels of concern.
- **Combination of Ionophores and Fly Control.** Both of these products may be present in some mineral formulations. Additional feed antimicrobials or antibiotics may require a Veterinary Feed Directive.

Calf Management

Creep Feeding

The most common creep feed is high in energy and about 16% crude protein. High-energy creep feeds generally result in the greatest weight gain. Creep feeding can also be used to introduce calves to feed they will be fed at weaning time, which can smooth the transition to the new ration.

Creep feeding typically begins at 3 to 4 months of age when calf demands for growth are high.

Creep feeders should have openings 16 to 20 inches wide and 36 to 42 inches high. Creep-grazing programs can also support good calf gains rather than traditional grain-based creep diets. Use high-quality forages to provide supplemental nutrition to calves in creep-based programs.

Backgrounding Weaned Calves

When weaning calves, it is extremely important to provide a palatable feed. This will get calves consuming quickly. For the first 24 hours after weaning, feed good-quality hay at 2.0% of a calf's body weight and supplemental feed at 1% of the calf's body weight.

Calves should always have free-choice access to good-quality conserved forage or pasture to support rumen health.

Provide a minimum of 1.5 feet of linear bunk space in a backgrounding situation.

Water troughs should be highly visible and accessible. Small troughs may be more attractive to weaned calves because they can hear it being refilled quickly and the water supply may turn over more quickly in small troughs than in large ones, keeping the water clean and cool.

Replacement Heifer Nutrition

First-calf heifers require a diet that is at least 62% total digestible nutrients and 11% crude protein.

Depending on forage quality, choosing a supplement with a good combination of energy and protein is important for lactating females.

Several commonly used supplements in the Southeast include soybean hulls, distiller's grains, corn, corn gluten feed, whole cottonseed, and commercial blends. Look for commercial mixtures containing at least 12% CP and 65% TDN.

Ask feed dealers to provide an estimate of the TDN in bagged feeds to ensure adequate energy is being provided.

The following provides some example diets for replacement heifers (mature weight 1,300 lb):

Fall-Calving

| Pregnant Replacement Heifers (Last 60 Days Before Calving) | Lactating, First-Calf Heifers |
|--|--|
| <ul style="list-style-type: none">Warm-season grass pasture + 3 to 5 pounds of 50:50 soyhulls:corn gluten feed25 to 30 pounds of good-quality hay or baleage + 3 to 5 pounds of 50:50 soyhulls:corn gluten feed | <ul style="list-style-type: none">Limit grazing cool-season grass pastures (annuals or perennials)Stockpiled tall fescue + 5 pounds of 50:50 soyhulls:corn gluten feedStockpiled bermudagrass + 7 pounds of 50:50 soyhulls:corn gluten feed25 to 30 pounds of good-quality hay or baleage + 5 pounds of 50:50 soyhulls:corn gluten feed |

Winter/Spring Calving

| Pregnant Replacement Heifers (Last 60 Days Before Calving) | Lactating, First-Calf Heifers |
|--|--|
| <ul style="list-style-type: none">Limit grazing cool-season grass pastures (annuals or perennials)Stockpiled tall fescue + 3 pounds of 50:50 soyhulls:corn gluten feedStockpiled bermudagrass + 5 pounds of 50:50 soyhulls:corn gluten feed25 to 30 pounds of good-quality hay or baleage + 3 pounds of 50:50 soyhulls:corn gluten feed | <ul style="list-style-type: none">Actively growing cool-season grass pastures (annuals or perennials)25 to 30 pounds of good-quality hay or baleage + 5 pounds of 50:50 soyhulls:corn gluten feed |

Table 8. Daily Dry Matter Intake and Diet Nutrient Densities for Pregnant Replacement Heifers

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----------------------------------|------|------|------|------|------|------|------|------|------|
| Months Since Conception | | | | | | | | | |
| 1,000-pound mature weight | | | | | | | | | |
| DM, lb/day | 16.7 | 17.2 | 17.7 | 18.2 | 18.7 | 19.4 | 20.0 | 20.7 | 21.3 |
| TDN, % | 50.1 | 50.2 | 50.4 | 50.7 | 51.3 | 52.3 | 54.0 | 56.8 | 61.3 |
| CP, % | 7.2 | 7.2 | 7.2 | 7.2 | 7.3 | 7.6 | 8.0 | 8.7 | 10.0 |
| Ca, % | 0.22 | 0.22 | 0.22 | 0.21 | 0.21 | 0.20 | 0.32 | 0.31 | 0.31 |
| P, % | 0.17 | 0.17 | 0.16 | 0.15 | 0.15 | 0.16 | 0.23 | 0.23 | 0.22 |
| 1,200-pound mature weight | | | | | | | | | |
| DM, lb/day | 19.3 | 19.8 | 20.3 | 20.9 | 21.5 | 22.2 | 23.0 | 23.7 | 24.4 |
| TDN, % | 50.5 | 50.5 | 50.7 | 50.9 | 51.4 | 52.3 | 53.8 | 56.2 | 59.9 |
| CP, % | 7.2 | 7.2 | 7.2 | 7.2 | 7.3 | 7.5 | 7.9 | 8.5 | 9.6 |
| Ca, % | 0.23 | 0.23 | 0.22 | 0.22 | 0.22 | 0.21 | 0.31 | 0.31 | 0.30 |
| P, % | 0.18 | 0.18 | 0.18 | 0.17 | 0.17 | 0.17 | 0.23 | 0.22 | 0.22 |
| 1,400-pound mature weight | | | | | | | | | |
| DM, lb/day | 21.7 | 22.3 | 22.9 | 23.5 | 24.2 | 24.9 | 25.8 | 26.6 | 27.4 |
| TDN, % | 50.7 | 50.8 | 50.9 | 51.2 | 51.6 | 52.4 | 53.7 | 55.8 | 59.0 |
| CP, % | 7.2 | 7.2 | 7.2 | 7.2 | 7.3 | 7.5 | 7.8 | 8.4 | 9.3 |
| Ca, % | 0.24 | 0.24 | 0.23 | 0.23 | 0.22 | 0.22 | 0.31 | 0.31 | 0.30 |
| P, % | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.23 | 0.22 | 0.22 |

Body Condition Scores

Body condition scoring (BCS) is an on-the-hoof visual appraisal using numbers (1–9) to suggest the relative body fat of the beef cow. With this nine-point scale, a score of 1 represents a very thin body condition and a score of 9 represents extreme obesity. For mature cows, a target BCS score of 5 to 6 is recommended at calving.

Because heifers are still growing, however, their nutritional requirements are higher, so manage heifers to calve in BCS 6. It is important to remember that the single greatest factor influencing rebreeding performance of beef cows is body condition at calving.

Condition scoring cows and heifers allows us to properly plan and adjust forage and feeding programs. Key times to body condition score beef cattle are

- Weaning
- 60 to 90 days before calving
- At calving
- The beginning of the breeding season

Keep records of body condition scores to track changes in the herd throughout the calendar year. For most cows, an increase of one body condition score equates to gaining about 80 to 100 pounds of body weight. The accompanying photos and descriptions describe the nine body condition scores.

Steps to Evaluating Body Condition Score

- Evaluate fat cover from the front, side, and rear of the animal.
- Ask if the skeletal structure is visible or if the animal has a smooth appearance.
- Use Table 11 to determine relative condition.

Body Condition Score and Reproductive Implications

Body condition score relates to overall reproductive health of cows and first-calf heifers and represents a measure of energy reserve of the animal. Decreased conception rates and increased calving interval length is often observed in animals with too low or high body condition (tables 9 and 10).

Table 9. Relationship of Body Condition Score to Beef Cow Performance

| BCS | Pregnancy Rate (%) | Calving Interval (days) |
|-----|--------------------|-------------------------|
| 3 | 43 | 414 |
| 4 | 61 | 381 |
| 5 | 86 | 364 |
| 6 | 93 | 364 |

Adapted from Kunkle et al., 1998

Table 10. Problems Associated with Thin and Fat Body Condition

| Thin Condition BCS 1- 4 | Fat Condition BCS 8-9 |
|-------------------------------|------------------------|
| 1. Failure to cycle | 1. Costly to maintain |
| 2. Failure to conceive | 2. Increased dystocia |
| 3. Increased calving interval | 3. Impaired mobility |
| 4. Increased days to estrus | 4. Failure to cycle |
| 5. Decreased calf vigor | 5. Failure to conceive |

Table 11. Descriptions of Body Condition Scores for Beef Cattle

| Score | Description |
|-------|---|
| 1 | Emaciated. No palpable fat is detectable over the spinous processes, transverse processes, ribs, or hooks. The tailhead and ribs appear very prominently. |
| 2 | Poor. Animal is still somewhat emaciated but the tailhead and ribs are less prominent. Individual spinous processes are still sharp to the touch. Some tissue cover is present over the ribs toward the top of the back. |
| 3 | Thin. Beginning of fat cover over the loin, back, and foreribs. Backbone still highly visible. Processes of the spine can be identified individually by touch and may still be visible. Spaces between the processes are less pronounced. |
| 4 | Borderline. The foreribs are not noticeable, although the twelfth and thirteenth ribs are still noticeable to the eye, particularly in cattle with a big spring of rib and ribs wide apart. The transverse spinous processes can be identified only by palpation to feel rounded rather than sharp. Full but straightness of muscling in the hindquarters. |
| 5 | Moderate. The twelfth and thirteenth ribs are not visible to the eye. Areas on the side of the tailhead are filled but not mounded. |
| 6 | High Moderate. The ribs are not noticeable to the eye. There is fat around the tailhead. The hindquarters are full and plump. The skin has a smooth appearance. |
| 7 | Good. Abundant fat cover on either side of the tailhead. The cow appears in very good flesh, but not overconditioned. |
| 8 | Fat. The animal is very fleshy and appears overconditioned. Large fat deposits are present over the ribs and around the tailhead. Fat pones around tailhead are obvious. |
| 9 | Extremely fat. The overall appearance is blocky. Tailhead and hooks are buried in fatty tissue. Bone structure is no longer visible and barely palpable. |

Herd Health

Health Management

To protect the animal health and for efficient use of time, labor, money, and other resources, cattle herds should have a comprehensive herd health management program that involves, but is not limited to the following:

- Herd immunization (vaccination)
- Parasite control (internal and external)
- Proper culling guidelines
- Biosecurity
- Nutrition
- Reproductive management
- Beef Quality Assurance (BQA)

Contact your local veterinarian, Extension agent, state Extension specialists (nutritionists, geneticists, reproductive physiologists, environmental experts), and others to gather the information you need to develop an effective herd health management program that meets the specific needs of your operation.

Bovine Immunization Guidelines

A successful herd health program involves proper herd immunization (vaccination) to prevent and control a variety of infectious diseases. Selecting the proper vaccines for your herd, however, can be a difficult task, considering the large number of available vaccines. Some things to consider when developing a vaccination program for your herd are the following:

- Determine the goals of your vaccination program. What diseases do you want to prevent and control and in what type/age animal? Different herds will have different goals and vaccination protocols.
- Determine the type of vaccine to use such as killed, modified-live, or chemically altered.
- Discuss these goals with your herd health veterinarian and Extension agent.
- Understand a vaccine's expected level of protection.

Vaccines are generally categorized as killed vaccines (KV), toxoids, modified live vaccines (MLV), or chemically altered vaccines. Each category has its advantages and disadvantages.

Table 1. Killed Vaccines (KV) and Toxoids

| Advantages | Disadvantages |
|---|---|
| <ul style="list-style-type: none">• Available for many diseases.• No risk of the vaccine organism spreading between animals.• Minimal risk of causing abortion.• No on-farm mixing required. | <ul style="list-style-type: none">• More likely to cause allergic reactions and post-vaccination lumps.• Two initial doses required.• Slower onset of immunity. |

Table 2. Modified Live Vaccines (MLV)

| Advantages | Disadvantages |
|---|---|
| <ul style="list-style-type: none">• One initial dose may be sufficient, but boosters are sometimes required.• Stimulates rapid, strong, and long-lasting immunity.• Less likely to cause allergic reactions and post-vaccination lumps. | <ul style="list-style-type: none">• Potential risk of causing abortion or transient infertility if not used according to FDA-approved label directions.• Must be mixed on-farm and used within about 30 minutes. |

Table 3. Chemically Altered Vaccines

| Advantages | Disadvantages |
|---|---|
| <ul style="list-style-type: none">• Share many of the advantages of MLV products.• Minimal risk of causing abortion. | <ul style="list-style-type: none">• Two initial doses required.• Slower onset of immunity than MLV products.• Must be mixed on-farm and used within about 30 minutes. |

Vaccines are available for many diseases. Not all diseases, however, are a routine threat to many beef herds, and some vaccines are not sufficiently effective to justify their use. Therefore, every cattle operation will have unique vaccination requirements based on individual herd goals.

The following guidelines for vaccinating cattle may not be applicable in all situations. The best use of these guidelines is as a starting point to develop an effective vaccination protocol with your herd health veterinarian or Extension agent. When appropriate, ensure that products are safe for pregnant animals and for calves nursing pregnant cows.

Properly store and administer vaccines according to label directions, adhere to designated meat withdrawal times, and follow all other BQA guidelines.

Nursing Calves

- 7-way clostridial (blackleg)
- IBR/BVD/PI₃/BRSV
 - IBR = infectious bovine rhinotracheitis
 - BVD = bovine viral diarrhea
 - PI₃ = parainfluenza3
 - BRSV = bovine respiratory syncytial virus
- Calfhood vaccination for brucellosis if recommended by herd veterinarian
- Consider a leptospirosis 5-way vaccine for future replacement heifers and bulls. Leptospirosis 5-way vaccination may not be necessary for future feeder calves, depending on location.

Preconditioned Feeder Calves

- IBR/BVD/PI₃/BRSV
- 7-way clostridial (blackleg)
- *Mannheimia haemolytica*
- *Pasteurella multocida*
- *Histophilus somni*

Breeding Animals

Replacement heifers, cows, and bulls should generally be vaccinated at least 6 to 8 weeks before the breeding season so immunity is high during the breeding season.

- IBR/BVD/PI₃/BRSV
- Leptospirosis 5-way
- Vibriosis (*Campylobacter fetus*)

Understanding Protection Claims on Vaccine Labels

The Center for Veterinary Biologics (CVB), which is part of the Animal and Plant Health Inspection Service (APHIS) of the USDA, is the agency that grants the appropriate protection claims for vaccines based on a thorough analysis of supporting efficacy and safety data. Protection claims are available on all vaccine labels or product inserts. Understanding label claims is, therefore, one way to evaluate the expected efficacy of a vaccine. These claims only apply when products are administered according to label directions.

The USDA can grant one of five possible levels of protection statements:

- | | |
|------------------------------|-----------------------------|
| 1. Prevention of infection | Highest level of protection |
| 2. Prevention of disease | |
| 3. Aid in disease prevention | |
| 4. Aid in disease control | |
| 5. Other claims | Lowest level of protection |
- 

What Do These Label Claims Mean?

Prevention of infection. Prevents all colonization or replication of the challenge organism. A label statement such as "for the prevention of infection with [specific microorganism]" may be used. This claim is rarely granted.

Prevention of disease. Highly effective in preventing clinical disease. A label statement such as "for the prevention of disease due to [specific microorganism]" may be used.

Aid in disease prevention. Aids in preventing disease by a clinically significant amount. A label statement such as "as an aid in the prevention of disease due to [specific microorganism]" may be used.

Aid in disease control. Aids in the reduction of disease severity, duration, or onset. A label statement such as "as an aid in the control of disease due to [specific microorganism]" or a similar one stating the product's particular action may be used.

Other claims. Products with beneficial effects other than direct disease control.

These protection statements are outlined by the USDA, APHIS, Veterinary Services Memorandum No. 800.202, June 14, 2002.

Cattle Parasites

Effectively controlling internal and external cattle parasites is an economically important management practice.

Consequences of Internal Parasitism

- Reduced appetite
- Protein loss from damaged tissues
- Anemia (in some cases)
- Impaired immune function
- Decreased weight gain
- Decreased milk production
- Decreased reproductive performance
- Less beef per acre produced

Controlling Stomach, Lung, and Intestinal Parasites

- Many dewormers (anthelmintics) are available for controlling stomach, lung, and intestinal parasites in cattle. Consult your herd health veterinarian for product recommendations and treatment schedules specific to your operation.
- Always read product labels carefully for storage, dosage, route of administration, and withdrawal guidelines. Following FDA-approved label directions ensures product efficacy and safety and promotes the production of safe, wholesome beef.
- When applicable, always make sure the product used is safe for pregnant animals.

Common External Parasites

- Horn flies
- Stable flies
- Face flies
- Horse flies
- Lice
- Ticks
- A variety of other biting insects

Consequences of External Parasitism

- External parasites are a nuisance that cattle must spend time and energy warding off. The more time and energy devoted to fighting external parasites means less time and energy devoted to being productive.

- Anemia in some cases
- Decreased weight gain
- Decreased milk production
- Decreased reproductive performance
- Less beef per acre produced
- Damaged hides
- Transmission of diseases by many external parasites

Controlling External Parasites

- External parasites are a nuisance that cattle must spend time and energy warding off. The more time and energy devoted to fighting external parasites means less time and energy devoted to being productive.
- Many sprays, back rubs, dusts, feed additives, and ear tags are available for controlling external parasites. Some dewormers used for controlling internal parasites also control external parasites (endectocides). Consult individual product labels for specific information.
- Horn fly resistance to insecticides is a serious problem, but it can be managed with appropriate rotation between classes of insecticides. Do not just rotate product names as different product names may actually be in the same chemical class. Consult table 4 for help differentiating product ingredients by chemical class. In general, do not use different chemical classes of insecticides in the same year.
 - For example, do not use a pyrethroid ear tag with an organophosphate spray in the same year. When used together during the same year, flies develop resistance to both classes of insecticides simultaneously. It is appropriate, however, to use endectocides (e.g., Ivomec, Cydectin, Dectomax) along with another chemical class of insecticide.
- The products used and the treatment protocol depend on a number of factors such as the following:
 - What products have been used in the past?
 - Has resistance become a problem on your operation?
 - How close are neighboring herds, and what products are they using?
- With so many factors to consider, it is very important to consult your herd health veterinarian or Extension agent for product recommendations and treatment protocols specific to your operation.

Table 4. Categories of Insecticide Chemical Classes and Active Ingredients

| Insecticide Chemical Class | Representative Active Ingredients |
|----------------------------|---|
| Endectocides | milbemycin avermectin |
| Endosulphan | endosulfan |
| Organophosphates | chlorpyrifos coumaphos diazinon dichlorvos fenthion phosmet pirimiphos-methyl tetrachlorvinphos trichlorfon |
| Pyrethroids | cyfluthrin cypermethrin fenvalerate lambda-halothrin permethrin zeta-cypermethrin |
| Pyrethrins | pyrethrins |

Growth-Stimulating Implants

When used correctly, growth-stimulating implants offer the commercial cattle producer an effective, easy-to-use method of increasing the weaning weights of calves. If producers adhere to FDA-approved label directions, beef from cattle properly treated with implants is just as safe as beef from nonimplanted cattle.

Follow all label directions to maximize the safety and effectiveness of implants. Generally, male calves should be implanted when they are castrated.

Do not implant replacement heifers or bull calves that are intended for breeding. Implanting replacement heifers and bulls can retard the development of the reproductive organs, resulting in subfertility.

Correctly Administering Implants

See FDA-approved product labels for specific instructions.

1. Properly restrain the animal.
2. Determine which ear to implant. Implant all calves in the same ear to minimize confusion.
3. Clean the implant site with a disinfectant to reduce contamination of the needle wound.
4. Once the ear is clean, proceed with the implantation process. Do not implant a dirty ear as this greatly increases the chances for implant site infections.
5. Select the proper implant site on the back of the ear (figure 1).
6. Grasp the ear with one hand while using your other hand to position the implant gun parallel to and nearly flush with the ear.
7. Put the point of the needle against the ear with the beveled part facing outward.
8. Use the tip of the needle to prick the skin. Then, lift slightly to completely insert the needle under the skin. Place the implant needle between the skin and cartilage in the middle third of the ear.
9. Depress the plunger of the implant gun, and withdraw the needle. Some implant guns automatically withdraw the needle as the plunger is depressed, leaving a pocket for the implant. Other implant guns require manual withdrawal of the implant needle to create a small pocket prior to depressing the plunger.
10. Feel the ear for the implant under the skin to ensure proper placement.
11. Disinfect the implant gun needle between animals.

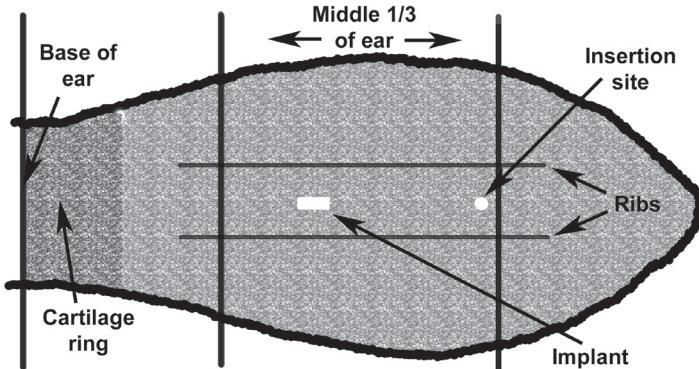


Figure 1. Proper Implant Site

Precautions to Take When Implanting Cattle

- The animal may throw its head when you grasp its ear and insert the needle. To prevent this, use a nose lead, halter, or a head gate equipped with a head and nose bar.
- Avoid piercing or cutting ear veins with the needle.
- Do not allow the needle to gouge or pierce through the cartilage. If resistance is felt when inserting the needle, the cartilage has probably been gouged. Pellets may be covered with scar tissue and walled off, resulting in poor drug absorption and decreased gain.
- Only implant a properly cleaned and disinfected ear and with a disinfected implant needle. Failure to properly disinfect the ear or implant needle increases the risk for implant site infection and abscess formation, both of which will greatly reduce or eliminate the effectiveness of the implant.
- Never sacrifice a careful implantation technique for speed.

Annual Cow Evaluation: “Seven Quality Checks”

Performing an annual cow evaluation allows producers to treat or cull less productive or undesirable cows. The seven quality checks below are a starting point for evaluating a cow's reproductive performance, as well as detecting physical abnormalities that may hamper its production. The performance of a cow's progeny should also be evaluated.

1. **Pregnancy:** Perform a pregnancy check every year, and cull open cows before spending extra money on feed.
2. **Eyes:** Bovine ocular neoplasia or “cancer eye” is a common cause of cow carcass condemnation. Cancer eye can rapidly become severe

(resulting in blindness) and spread to other parts of the body (resulting in carcass condemnation) if not detected early.

3. **Mouth:** Cows must have adequate teeth to harvest forage for body condition maintenance and milk production to support calf growth.
4. **Feet and legs:** Lame cows have a difficult time grazing as well as walking to feed bunks or water. As a result, they lose body condition, wean poor calves, and do not rebreed. Some causes of lameness are treatable.
5. **Udder:** It takes a good udder to produce sufficient milk to raise a good calf. Look for “blind quarters” (quarters that are not producing milk) and “bottle teats” (teats that are large and difficult to nurse).
6. **Body condition:** Thin cows lack energy reserves and usually do not rebreed.
7. **Disposition:** Cows with bad dispositions often produce excitable calves that do not gain as well in the feed yard and may produce undesirable “dark cutting” meat. They can also make working the herd difficult and dangerous.

Determining the Age of Cattle

A common method for determining the age of cattle is by examining the teeth, as illustrated in figure 2.

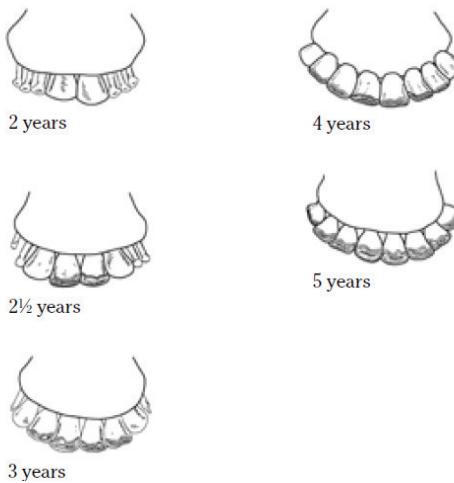


Figure 2. Aging cattle by teeth

Consider the following when aging cattle by their teeth:

- Mature cattle have thirty-two teeth, eight of which are incisors in the front of the mouth on the lower jaw. (There are no upper incisors.)
- Aging cattle by their teeth requires evaluating the time of appearance (eruption) and the degree of wear of the temporary and permanent incisors (table 5).

Table 5. Guidelines for Aging Cattle¹

| Teeth (permanent) | Eruption | In wear (typically 6 months after eruption) | Neck of tooth visible above gum line |
|---|---------------|---|--|
| First incisors (I ₁) (two central incisors) | 1½ to 2 years | 2 to 2½ years | 6 years |
| Second incisors (I ₂) | 2 to 2½ years | 2½ to 3 years | 7 years |
| Third incisors (I ₃) | 3 years | 3½ years | 8 years |
| Fourth incisors (I ₄) (two outer incisors) | 3½ to 4 years | 4½ years | 9 years |

¹ Based on when permanent incisors erupt and are “in wear” and when the neck of the tooth is visible above the gum line.

Biosecurity

A biosecurity plan is an innovative approach to managing the risk of disease introduction and spread on your livestock operation. It is designed to help livestock producers identify disease risks and manage them through practical measures for common, everyday infectious diseases as well as for new or unexpected diseases.

An effective biosecurity plan manages disease by evaluating and addressing the primary routes of disease transmission, therefore controlling several diseases at one time.

The five primary routes of disease transmission are aerosol, direct contact, fomite or traffic, oral, and vector.

- **Aerosol transmission** occurs when disease agents contained in droplets pass through the air from one animal to another. Close proximity of infected and susceptible animals is typically required for aerosol transmission.
- **Direct contact transmission** of disease agents occurs when a susceptible animal directly touches an infected animal or its open wounds, mucous membranes, blood, saliva, nose-to-nose contact, rubbing, or biting.
- **Fomite transmission** occurs when a disease pathogen is carried or spread from one animal to another by an inanimate object such as boots, buckets, and milking or grooming equipment. Vehicles, trailers, and even humans can also be considered fomites and can spread disease through traffic transmission.

- **Oral transmission** occurs when an animal licks or chews on contaminated environmental objects or consumes contaminated feed or water.
- **Vector-borne transmission** involves the spread of disease through an insect. Ticks and mosquitoes are biological vectors. These insects commonly become infected from a diseased animal, and then spread the disease by injecting the disease agent into another animal. Flies are a common mechanical vector, simply carrying the disease agent on their body and passing it from animal to animal.

A biosecurity plan involves multiple components and results in practical measures for implementation. The first step involves assessing the risk areas on a livestock facility based on a “routes of disease transmission” approach. After identifying risk areas, determine disease management measures, prioritize, and start them.

The following are examples of biosecurity practices that will greatly minimize the risk of disease transmission:

- Do not intentionally commingle animals from different herds.
- Provide a buffer between adjoining herds so no fence line contact is available.
- Isolate new herd additions for 4 to 6 weeks and have your veterinarian test for appropriate diseases before allowing new animals to commingle with your herd. Identify isolation areas prior to purchase.
- Isolate animals returning from livestock shows.
- Post signs indicating that a biosecurity plan is in effect.
- Educate all visitors about the biosecurity plan in effect.
- Ensure that all visitors are dressed appropriately. Provide coveralls and boots, or make sure visitors are wearing clothing free from contact with other cattle.
- Recognize that you are also a source of contamination for your herd. If you are around other cattle, shower and change clothes before working with your livestock.
- Clean and disinfect your truck and trailer after hauling cattle. Anyone hauling cattle for you should do the same.
- Clean and disinfect other equipment as necessary.
- Apply appropriate insect control.

Your Veterinarian's Role in Herd Health

Your veterinarian plays an important role in preventing, diagnosing, and treating disease. Selecting the right treatment depends on accurately diagnosing the problem.

Work with your local veterinarian to develop a health care program designed to fit your specific needs, and establish a valid veterinarian-client-patient relationship (VCPR).

Veterinarian-Client-Patient Relationship

- Your veterinarian is responsible for the health care of your herd.
- You follow your veterinarian's treatment and drug withdrawal instructions.
- Your veterinarian is familiar with the animals on your farm.
- Your veterinarian is available for follow-up visits.

The Decision to Treat

Even with superior herd management, some animals will become sick or injured. The decision to treat them should be based on specific criteria. Answering questions such as the following could be helpful as you make your decision:

- Will the animal return to a healthy, productive state without treatment?
- Will treatment return the animal to a healthy, productive state?
- What treatment best fits the disease and herd management?
- Should the animal be sold?
- Should the animal be euthanized?

Understanding, Storing, and Administering Drugs

Understanding Drug Labels

All products, including antibiotics, hormones, vaccines, dewormers, pain medications, and feed additives, should be used according to FDA-approved label directions to achieve maximum product efficacy and safety. Following label directions includes proper product storage, route of administration, reason for administration (indication), and dose administered. Any deviation from label directions will result in decreased product efficacy and is illegal in many situations.

You are ultimately responsible for any drug residues in your animals. Therefore, it is crucial that you become familiar with drug labels. All drugs, whether over-the-counter (OTC), prescription (Rx), or veterinary feed directive (VFD) contain the following basic information on the label:

- Name of drug
- Active ingredients
- Instructions for use
- Withdrawal times
- Quantity of contents
- Name of distributor
- Any other cautionary statements

Types of Drugs

Over-the-Counter (OTC)

- Can be administered by a producer without the order of a veterinarian.
- Can only be used according to the label directions. It is illegal for a producer to use an OTC product in any manner other than what is prescribed on the label. A veterinarian can prescribe “extra-label” use of an OTC product when necessary.

Prescription (Rx)

- Cannot be administered by producers unless prescribed by a veterinarian.
- Label contains the statement “Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian.”

Veterinary Feed Directive (VFD)

- All antibiotics administered through animal feed require a written veterinary feed directive (VFD) from a veterinarian.

To reduce the chance of adverse reactions and to minimize the risk of residues, read and follow all instructions on product labels. Instructions include the following:

- Dosage. Example: “1 mL or cc per 100 pounds”
- Timing (how often and how many times given). Example: “two doses, 3 days apart”
- Route of administration. Example: “intramuscular”
- Warnings or indications. Example: “Not for use in pregnant animals.”
- Withdrawal times, if any. Example: “Do not use within 28 days of slaughter.”
- Storage. Example: “Store at 2 degrees—7 degrees C.”
- Disposal. Example: “Burn container and all unused contents.”
- Shelf life. Expiration date

Failure to understand a product label is not a defense if meat from one of your animals is found to contain drug residues. Contact your local veterinarian or Extension agent if you have questions.

Extra-Label Drug Use

- Extra-label drug use can only be prescribed by a veterinarian.
- A cattle producer cannot use drugs (including OTC drugs) in an extra-label manner without a veterinarian’s prescription. This is off-label and illegal.
- Administering products according to label directions includes dosage, route of administration, reason for administration, and adherence to proper withdrawal times.

- A VCPR must exist for extra-label drug use:
 - The veterinarian knows the producer, is familiar with the farm or ranch and its practices, and is involved in the herd health practices on the operation.
 - The veterinarian and producer must make sure the animal is properly identified, assign meat and milk withdrawal times, and abide by these withdrawal times to ensure no illegal residues occur.
- Veterinarians are prohibited from using some antibiotics in an extra-label manner.
- Extra-label use of feed medications is prohibited.
- Extra-label use of hormones is prohibited.

Off-label use of vaccines may reduce the efficacy of the vaccine as well as release the manufacturer from any product liability. In other words, if a vaccine is stored and administered according to all label directions and supported by proper documentation, then in the case of an adverse event related to the product, the manufacturer might be liable. If, however, vaccines are used in an off-label manner, manufacturers are released from all product liability. Therefore, to maintain maximum product efficacy and product liability, it is strongly recommended to use all vaccines according to label directions.

Storing Drugs Correctly

Drug performance declines if the expiration date has passed, the storage temperature is too hot or too cold, or the drugs have been exposed to air or light. All the information you need to meet these requirements should be on the label of the drug container.

- Check the expiration date on the label.
- Do not save vaccines after the bottle has been partially used. They will likely not be effective for later use and may be contaminated.
- Some drugs, and most vaccines, need to be refrigerated at 35 to 45 degrees F and must not be frozen. Keep an accurate thermometer in your refrigerator to monitor the temperature.
- Use disposable syringes. Use clean needles to draw contents from multidose bottles. Change needles every animal or at least every ten to fifteen animals to minimize disease transmission. Do not store medication in syringes, which cannot be labeled easily.
- Avoid exposing vaccines and other medicines to direct sunlight. This may degrade the product. Use an insulated cooler for storing syringes and drugs while working on cattle to avoid sunlight and to maintain the proper temperature.
- Collect used needles in a rigid plastic container. Return used needles to your veterinarian for disposal. Destroy disposable syringes so they cannot be reused or misused. Read labels. Some drugs and vaccine containers require incineration before disposal. Used needles and scalpels are considered medical waste and must be handled and disposed of in accordance with laws which govern them.
- Consult your local veterinarian with questions on proper use of medications.

Administering Drugs Properly

Administering drugs properly is important for the proper action of the drug and for the prevention of injection site lesions and violative drug residues. The best way to avoid problems is to simply follow label instructions, identify each animal that receives the drug at the time it is administered, and administer the drugs correctly. Proper administration includes selecting the route of administration, choosing the correct needle, choosing the injection site, practicing good sanitation, handling drugs correctly, and applying proper restraint.

Select the best route of administration. Drugs can be administered many different ways, including the following:

- Oral
- Intravenous
- Topical
- Subcutaneous (SubQ = under the skin)
- Intramammary
- Intramuscular (IM = in the muscle)
- Intranasal

Most injections are administered either subcutaneously (SubQ, under the skin) or intramuscularly (IM, into a muscle) as illustrated in figures 3, 4, and 5. The product label provides the acceptable route(s) of administration. If the label allows for either subcutaneous or intramuscular administration, give the drug subcutaneously to reduce the chances of violative residues and injection site lesions in the muscle.



Figure 3. Use the tenting method for subcutaneous injections.

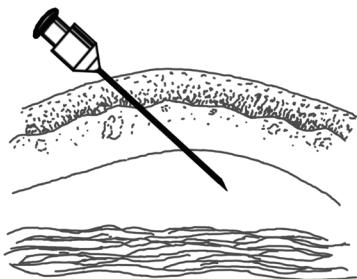


Figure 4. For subcutaneous injections, insert the needle through the skin and into the gap at a 45-degree angle.

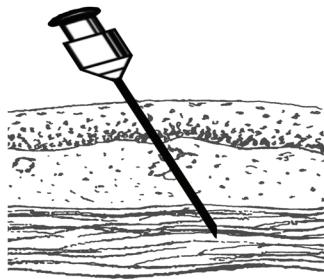


Figure 5. For an intramuscular injection, insert the needle through the skin and into the muscle.

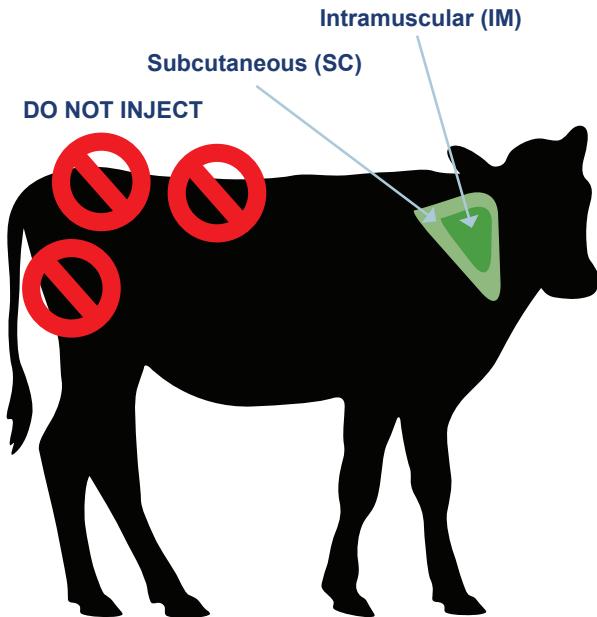


Figure 6. Never inject cattle in the loin, top butt, or rump. For cattle health products, the triangular mass of neck muscle is the only acceptable site for both intramuscular and subcutaneous injections.

Choose the proper location for the injection (figure 6). The proper location for an injection is not necessarily the most convenient one. It is the site where the product will be most beneficial without damaging expensive cuts of meat.

- Keep all injections in front of the shoulder.
- **Never inject in the loin, top butt, or rump.**
- For both vaccines and antibiotics, the triangular mass of neck muscle is the only acceptable site for IM and SubQ injections (figure 3).
- Never inject more than 10 ml (cc) into one site.
- When making multiple injections, keep injection sites at least 5 inches apart, being careful not to reuse injection sites.
- To minimize the risk of an injection site lesion, avoid injecting in wet or manure-covered areas.

Choose the correct needle. The correct needle size and length is important to ensure that the entire dose of the drug gets into the animal properly with the least amount of tissue damage. Selecting the proper needle size will also reduce the chances of needle breakage. See table 6 for proper needle size selection.

Table 6. Needle Selection Guide

| | Intramuscular (IM) | | Subcutaneous (SubQ) | |
|----------------------|--------------------|--------|---------------------|--------------------------------|
| Weight | Gauge | Length | Gauge | Length |
| Less than 300 pounds | 18 | 1 | 18 | $\frac{1}{2}$ to $\frac{3}{4}$ |
| 300–700 pounds | 16–18 | 1 | 16–18 | $\frac{1}{2}$ to $\frac{3}{4}$ |
| More than 700 pounds | 16–18 | 1–1½ | 16–18 | $\frac{1}{2}$ to $\frac{3}{4}$ |

Livestock Carcass Disposal

An unfortunate consequence of raising livestock is the inevitable death of some animals, despite even the best animal husbandry and veterinary care. Livestock owners must, therefore, understand responsible carcass disposal to protect their herds from various infectious diseases, protect the environment, and maintain the reputation of the livestock industry.

Proper carcass disposal first and foremost ensures the safety of your herd by potentially removing the source of a variety of infectious diseases as well as protecting wildlife from the same diseases. Proper carcass disposal also helps avoid environmental problems and the bad publicity the livestock industry receives when carcasses are found in inappropriate places such as creeks, ponds, along the side of the road, etc.

Alabama law requires carcass disposal within 24 hours by one of the following approved methods:

- Burial
 - Animals must be buried at least 2 feet below the surface of the ground.
 - Burial is not an option in those parts of Alabama with a high water table.
 - The Natural Resources Conservation Service (NRCS) is available to help identify appropriate livestock burial sites that meet Alabama Department of Environmental Management (ADEM) regulations.
- Burning/incineration
 - If you use an incinerator to burn mortalities, use one approved by the ADEM Air Division.
- Dispose of the carcass in an approved landfill. Contact your local landfill for more information.
- Four Alabama Department of Agriculture Veterinary Diagnostic Laboratories are available to perform an examination into the cause of death (necropsy), and then dispose of the carcass. See appendix A for locations and contact information. Use Alabama Veterinary Diagnostic Laboratories only when the cause of death needs to be determined.

Failure to properly dispose of a carcass is against the law, irresponsible, and potentially detrimental to herd health and the environment. Take care not to contaminate the water table, creeks, ponds, rivers, and watersheds when disposing of a carcass.

If you need assistance, contact ADEM at (334) 271-7700, your local NRCS district office, or the Alabama Cooperative Extension System.

Animal Identification, Performance Records, and Genetics

Unique individual animal identification is necessary for proper herd management. Recording and using information on individual animals enables producers to make informed selection or culling decisions, track medication usage and withdrawal periods, and identify specific animals. Without identification, it becomes difficult to manage the cowherd effectively.

Temporary identification is any type of identification that can be removed or lost. This will include ear tags, electronic ear tags and neck chains. Permanent identification is with the animal forever. Permanent identification will include tattoos, hot brands, and freeze brands. Permanent identification must be applied properly, or individual identification will not be readable.

All identification starts with a system. There should never be two individuals in the herd with the same permanent identification. Many unique livestock numbering systems are available. The two most common livestock numbering systems are the International Lettering System (table 1) or use of the last digit of the year of birth as the first digit of the identification number, followed by the calf birth order (e.g., 9001).

The International Lettering System allows 22 years before another animal has the potential for the same identification number. Each year has a specific letter assigned to that particular birth year. Using the last digit of the birth year system provides 10 years of identification before the same identification number could be used again.

Another simple livestock numbering system is to consecutively number the cattle (e.g., 1 to 999). A producer, however, would not be able to quickly identify birth year with this system.

The number of digits used in an individual identification number depends on the numbering system. The calf order of birth can compose the next digits in an individual identification number. Producers with fewer than 100 cows can use two additional digits (e.g., G25 or 925). Producers with more than 100 cows will have

to use three additional digits (e.g., G025 or 9025). Other systems use the dam identification number as the additional digits. This is useful to the producer who wants to quickly identify cow families in the pasture.

Table 1. International Lettering System and Corresponding Birth Year

| Letter | Year | Letter | Year |
|------------------------------------|------|--------|------|
| 2008 | U | 2019 | G |
| 2009 | W | 2020 | H |
| 2010 | X | 2021 | J |
| 2011 | Y | 2022 | K |
| 2012 | Z | 2023 | L |
| 2013 | A | 2024 | M |
| 2014 | B | 2025 | N |
| 2015 | C | 2026 | P |
| 2016 | D | 2027 | R |
| 2017 | E | 2028 | S |
| 2018 | F | 2029 | T |
| Letters I, O, Q and V are not used | | | |

Source: https://beefimprovement.org/wp-content/uploads/2018/03/BIFGuidelinesFinal_updated0318.pdf

Temporary Identification Ear Tags

The most common form of identification is the ear tag. There are several different types of ear tags. Ear tags are generally inexpensive ranging in price from \$0.80 to \$3.00 per tag. Blank tags or preprinted tags can be purchased. The appropriate tagger to match the brand of ear tag is needed to apply the tag.

To Tag an Animal

- Place the ear tag and ear tag back (if applicable) into the appropriate tagger.
- Dip the tag and tagger into disinfectant to minimize incidence of infection or warts.
- Restrain the animal
- Apply the tag in the middle rib of the ear at least halfway between the tip of the ear and the base of the ear (figure 1).
- Make sure you have a supply of ear tags, a tagger, and an ear marking pen every time you work cattle through the chute to replace needed ear tags.

Electronic ear tags work the same way, only they are applied much closer to the base of the ear to minimize loss.

Ear tags are easy to read, but can fade after time or get lost. If there is not a permanent form of identification and the tag is lost, the animal can no longer be positively identified.

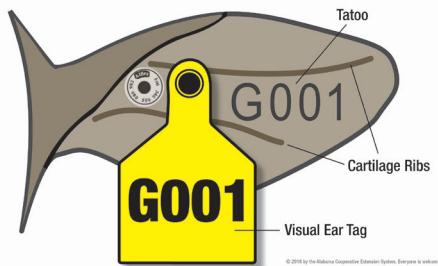


Figure 1. Ear tag

Permanent Identification

Tattooing

A good method for permanent identification is tattooing the ear. Tattooing is simple, but care must be taken to ensure a readable tattoo.

Materials needed to tattoo an animal include a tattoo gun, numbers 0–9, letters A–Z if using the International Lettering System, and tattoo ink.

Animals should be tattooed at birth or weaning. If the calf loses its ear tag, however, between birth and weaning, time will be spent determining exact identity.

To Tattoo an Animal

- Load tattoo gun with appropriate letters and/or numbers. Clamp the tattoo gun onto a piece of paper or cardboard to ensure that letters are loaded correctly before tattooing an animal.
- Dip the tattoo gun and letters into disinfectant to prevent spread of warts.
- Properly restrain the animal.
- If needed, clean the ear. Make sure all wax is removed by using an alcohol pad or rubbing alcohol. Leaving wax in the ear will cause the tattoo to fade over time.
- Rub tattoo ink into the animal's ear in the middle rib. Note the location of the tattoo in figure 1. Ensure that the tattoo will not be placed into the hair of the outer ear. Use green ink for black-hided animals. Black or green ink is okay for nonblack-hided animals.
- Firmly clamp the tattoo gun into the ink on the ear. One good squeeze is all that is needed.
- Rub more ink into the tattoo with a toothbrush or your finger and make sure you can read the tattoo.

- Make sure you do not apply an ear tag through the tattoo.
- Between tattooing each animal, dip the tattoo gun and letters into disinfectant to prevent the spread of warts or potential infection.

Animals must be restrained to read a tattoo and are generally paired with a visual ear tag. Using tattoos as permanent identification is cost effective.

Two other forms of permanent identification are hot branding and freeze branding. Both branding methods can cause permanent damage to the hide.

Hot or freeze branding should be used only when no other suitable form of permanent identification is available. The ideal location for either type of brand is high on the hip.

Hot Branding

Today, most hot brands are electric. These branders are plugged into an outlet and allowed to heat up for 90 seconds. Electric branders will keep a constant temperature.

Extreme care must be used around electric branders to eliminate accidental burning of workers or pets.

To Hot Brand an Animal With Electric Branders

- Optimal hot brand width is $\frac{3}{8}$ ".
- Properly restrain and squeeze the animal into a chute. You do not want to reapply the brand in the same spot. This can cause blotching or be hard to read.
- Do not hot brand wet cattle. It will cause an uneven brand.
- Do not brand cattle on which you just poured a dewormer or an alcohol-based product, as it creates a fire hazard.
- Place the brander firmly on the animal for 15 to 20 seconds. Rock the brand back and forth to get even coverage. Watch the color of the hide closely. Some animals will need less time, others more.
- When the brand becomes the deep brown color of well-worn saddle leather, take the brander off. Do not leave it on so long that you burn through the hide and expose the white tissue underneath the hide.
- Repeat for each number or letter.
- You should be able to see the brand immediately.

Freeze Branding

Freeze branding generally does not cause as much hide damage to cattle and is less painful than hot branding. If done improperly, however, freeze brands are illegible. Materials needed to freeze brand cattle include freeze branding irons, liquid nitrogen or dry ice, denatured alcohol (95% or higher pure alcohol), coolers, clippers, rice-root brush, squeeze bottle, gloves, and safety goggles.

Freeze branding irons are made of heavy copper or bronze with slightly rounded faces. The letters and numbers should be 3 to 4 inches tall, $\frac{3}{8}$ to $\frac{1}{2}$ inch thick and 1 inch deep. Coolers used to hold brands and coolant (liquid nitrogen or dried ice) need to be resistant to extreme cold and alcohol. Use gloves when freeze branding to prevent frostbite.

To Freeze Brand an Animal

- Cool irons for 20 minutes in the liquid nitrogen or a dry ice/alcohol combination. The coolant should cover the head of the iron by at least one inch. Frost lines on the handles of the irons indicate that they are ready for use. Recool irons for 2 minutes between each use. Add more coolant as needed to keep the iron heads covered.
- Restrain and squeeze the animal in a chute. Clip the hair from the area to be branded, preferably with surgical blades. (Regular clippers will work. Make sure to clip closely). Use a rice-root brush to remove clipped hair, dirt, and debris.
- Using the squeeze bottle, saturate the clipped area with 95 to 99% denatured alcohol.
- Immediately and firmly place the freeze branding iron on the animal. Leave the brand on the animal for 35 to 60 seconds. Rock the iron back and forth and top to bottom for an even brand. Application of one iron at a time is recommended until you are experienced.
- You will have to experiment with times at first to get the best brands. In most instances, 45 seconds is enough. Keep track of times so you can perfect timing with your cattle.
- Place the iron back into the coolant to recool before the next use.
- Immediately after freeze branding, you will see a frozen indentation of the brand in the animal's skin. In 5 to 10 minutes, the brand site will begin to swell and remain swollen up to 5 days. In 1 month, the top layer of skin will shed. Watch to see if any do not shed. You may have to rebrand. In 2 months, white hair should begin growing where the brand was applied. Sometimes reclipping the area will allow the brand to be clearly visible.
- Freeze branding does not work well on white-haired cattle.
- If you must use an electric cattle prod, do not use it around the brand area saturated in alcohol. Again, this can create a fire hazard.

If you want to brand animals with a farm brand, the brand must be registered with the Alabama Department of Agriculture and Industries. For more information, go to www.agi.alabama.gov or call (334) 240-7263. This does not apply if you are just branding the animal with its individual identification.

Beginning January 1, 2013, the Alabama Department of Agriculture and Industries Animal Disease Traceability rule (80-3-6-40) went into effect. Official ID is required for the following classes of cattle:

- All cattle 18 months of age or older at change of ownership
 - Exceptions are cattle 18 months of age or older sold for slaughter purposes
- All female dairy cattle, regardless of age
- All cattle and bison used in rodeo, show, exhibition, or recreational events regardless of age

For the state of Alabama, official ID can be one of the following:

- Original brucellosis silver metal ear tag
- Brucellosis vaccination orange metal ear tag for heifers
- Official electronic identification (EID) purchased through an approved animal identification (AIN) manager or distributor. These tags should begin with the numbers 840 and are 15 digits in length.

For cattle traveling out of state, it is important to check with the appropriate states to determine their official ID requirements. Many states no longer accept tattoos or brands as official identification.

For current information concerning official ID requirements for Alabama, visit www.agi.alabama.gov/divisions/animal-industries/animal-disease-traceability/cattle-tag-info or call the Alabama State Veterinarian at (334) 240-7253.

Beef Cattle Breeds

Beef cattle are classified into two species: *Bos Taurus* and *Bos Indicus*. Since man domesticated cattle, people have bred certain types and kinds of cattle together to form breeds. Today, there are over 80 recognized breeds of beef cattle in the world.

In the United States, the most popular beef breeds can be classified as English, Continental, American or *Bos Indicus*. Each of the breeds in these classifications have certain trait similarities.

Producers should realize individual animals within a breed or breed type can be very different from the general classifications listed in the table. That is one reason to examine performance and expected progeny difference (EPD) records before making selection decisions.

A website developed by Oklahoma State University, www.ansi.okstate.edu/breeds/cattle, can provide a history and short description of most breeds of cattle in the world. This is an excellent beginning resource for those still deciding which breed(s) to use.

Before settling on a breed or breeds, a farm marketing plan should be developed. In many instances, the marketing plan will provide a good direction on which breeds to use in the breeding program.

Today, all beef breed associations have websites. These websites are extremely useful for current pedigree and EPD information. Breed association websites also provide a variety of information relating to the breed and breed activities.

Table 2. Breed Traits and Classification

| Breed Classification | | | | |
|---------------------------|-----------------------|-----------------|------------------|------------------|
| Trait | American ¹ | Bos Indicus | Continental | English |
| Calving Ease | Moderate to High | Low | Moderate to High | Moderate |
| Growth | Moderate | Moderate | High | Moderate |
| Milking Ability | Moderate | Moderate | Low to High | Low to High |
| Age at Puberty | High | High | Moderate to High | Low to Moderate |
| Carcass Traits | Moderate | Low to Moderate | Moderate to High | Moderate to High |
| Beef Tenderness | Moderate | Low | Moderate | High |
| Heat and Insect Tolerance | High | High | Low | Low |

¹American breeds are breeds developed in America with a $\frac{3}{8}$ Bos Indicus and $\frac{5}{8}$ Bos Tarus breeding percentage makeup.

Table 3. Partial List of Beef Breed Associations and Contacts

| Breed Association | Telephone | Web Address |
|--|----------------|--|
| American Angus Association | (816) 383-5100 | www.angus.org |
| American Belgian Blue Breeders, Inc. | (936) 652-2550 | www.belgianblue.org |
| American Brahman Breeders Association | (713) 349-0854 | www.brahman.org |
| American-International Charolais Association | (816) 464-5977 | www.charolaisusa.com |
| American Chianina Association | (816) 431-2808 | www.chicattle.org |
| American Galloway Breeders Association | (701) 219-4815 | www.americangalloway.com |
| American Gelbvieh Association | (303) 465-2333 | www.gelbvieh.org |
| American Hereford Association | (816) 842-3757 | www.hereford.org |
| American Highland Cattle Association | (303) 659-2399 | www.highlandcattleusa.org |
| American Maine Anjou Association | (816) 431-9950 | www.maine-anjou.org |
| American Pinzgauer Association | (361) 296-5093 | www.pinzgauers.org |
| American Red Poll Association | (765) 425-4515 | www.americanredpolls.com |
| American Salers Association | (303) 770-9292 | www.salersusa.org |
| American Senepol Association | (800) 736-3765 | www.senepolcattle.com |
| American Shorthorn Association | (816) 599-7777 | www.shorthorn.org |
| American Simmental Association | (406) 587-4531 | www.simmental.org |
| American Wagyu Association | (208) 262-8100 | www.wagyu.org |

Table 3. Partial List of Beef Breed Associations on Contacts (cont.)

| Breed Association | Telephone | Web Address |
|--|----------------|--|
| Beefmaster Breeders United | (210) 732-3132 | www.beefmasters.org |
| Belted Galloway Society | (608) 220-1091 | www.beltie.org |
| Braunvieh Association of America | (210) 561-2892 | www.braunvieh.org |
| North American Limousin Foundation | (303) 220-1693 | www.nalf.org |
| North American South Devon Association | (303) 770-3130 | www.southdevon.com |
| Piedmontese Association of the United States | (816) 284-5258 | www.pauscattle.org |
| Red Angus Association of America | (940) 387-3502 | www.redangus.org |
| Romagnola & RomAngus Cattle Association | (913) 594-1080 | www.romagnola.net |
| Santa Gertrudis Breeders International | (361) 592-9357 | www.santagertrudis.com |
| South Poll Grass Cattle Association | (256) 996-3142 | www.southpoll.com |
| United Braford Breeders | (540) 272-1682 | www.brafords.org |

If a breed association is not listed, try a quick search of the internet for contact information.

Beef Cattle Conformation

Visual appraisal of beef cattle is extremely important in maximizing longevity and functionality of the cow herd. Without correct structure, especially feet and legs, productivity and lifespan can be significantly decreased.

Each year, the cow herd needs to be evaluated for the following:

1. Feet and legs
2. Overall structure and muscling

Feet and leg structure should be initially evaluated at selection. Correct conformation of feet and legs (figures 2 and 3) and how they blend into the shoulder and hip structure directly impact how well animals can forage and walk to water.

When you watch cattle walk, you should observe that their back foot steps into the footprint of the front foot. Observing from behind, look for the same distance between the hocks at the pasterns. Any decrease in the ability to forage will have direct impacts on body condition score and production.

Both the front and rear feet should be facing forward with no evidence of toes pointing in (pigeon toes) or toes pointing out (splay footed). Also a correct set or angle (45°) of the front and rear legs into the shoulder or hip is needed. Evaluate animals for being sickle hocked (too much angle from pastern to hock to hip; figure 4) or post-legged (too little angle from pastern to hock to hip; figure 5).

Watch for cattle that are also straight in the front shoulder (figures 6 and 7).

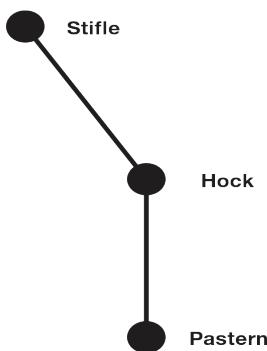


Figure 3. Correct structure desired for angle between stifle, hock, and pastern



Figure 2. Proper hoof structure

Evaluate toe structure.
Make sure each toe is the same width and length. If toes are of uneven width, weight will not be distributed evenly. This is especially important for bulls as it will affect weight distribution on

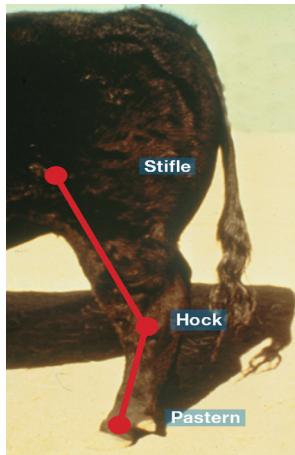


Figure 4. Sickle-hocked steer



Figure 5. Post-legged female

legs and hips during breeding. Problems with the hoof, such as excessive or uneven toe growth, may be caused by genetic, nutritional, or environmental factors or may be indicative of other structural concerns.

The ideal hoof is free of cracks and other abnormalities and has two symmetrical claws that both point forward. Look for signs of screwclaw (figure 8). One toe will be thinner and will grow over the other toe. This will eventually lead to lameness and loss of production. This condition is heritable and should not be allowed to stay in the cow herd.

No matter what breed or type of cattle being raised, you can score foot and pasterns using the American Angus Association scoring chart at www.angus.org/performance/footscore/footscoreposter.pdf.



Figure 6. Steer exhibiting a steep or straight shoulder

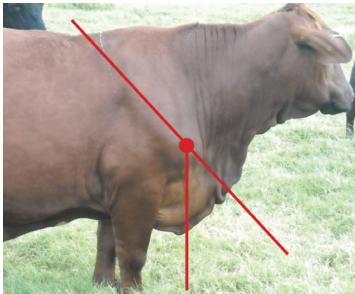


Figure 7. Female with the correct amount of slope to her shoulder



Figure 8. Female exhibiting clinical signs of corkscrew claw

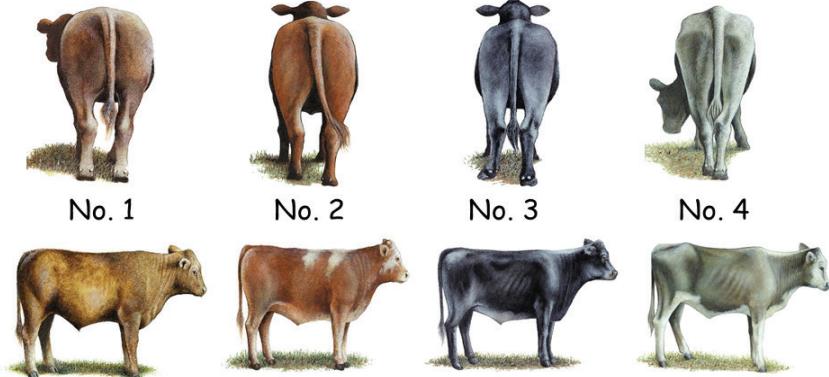
Evaluate cattle for adequate muscling. Beef cattle are raised for beef production. Make sure beef bulls, cows, and calves exhibit average or above average muscling. Generally and on average, bulls and steers should exhibit more muscling than females.

Use the USDA muscling score chart (figure 9) as a guide to evaluate muscling. The target for beef cattle should be USDA 1 or 2 muscling categories. Muscling score will not impact longevity per se in the herd, but will have economic impacts as calves are sold.

Calves with USDA muscle scores 1 and 2 will sell for higher prices than calves with USDA muscle scores 3 and 4.

USDA Feeder Cattle Grades

Muscle Thickness Scores



Source: USDA/MRP/AMS

Figure 9. Feeder cattle muscle thickness scores

Frame Scores of Cattle

Frame scores in cattle are a way to evaluate skeletal size. Frame scores can be used to predict final mature weights of cattle, which will affect stocking rates and nutrient requirements for the cow herd.

To determine frame score, measure height of cattle over the hip (figure 10). Make sure the animal is standing level and naturally. You can purchase a frame score stick through a farm catalog. You must be able to get the stick close enough to the animal to read the measurement.

Another method is to use a sheet of plywood or piece of lumber at least 70 inches tall. Beginning 30 inches from the ground, mark each half-inch and inch increments until reaching 70 inches (or as tall as your tallest animal). Fasten the piece of plywood or lumber to the scale box or working chute ensuring that the bottom measurement matches the height from the bottom of the scale box or chute to that mark.

Weaning and yearling age are typical times to measure cattle for frame score. Mature cattle can also be measured. With appropriate nutrition, most animals should maintain the same frame score throughout their lifetime. Frame scores can change if animals mature earlier or later than average.

To determine frame score, you also need the age and sex of the animal. Using the age of the animal, find the height measurement in the table and read the corresponding frame score (table 4).

For example, if a heifer at 7 months of age has a hip height measurement of 45.0 inches, the heifer would have a frame score of 6.

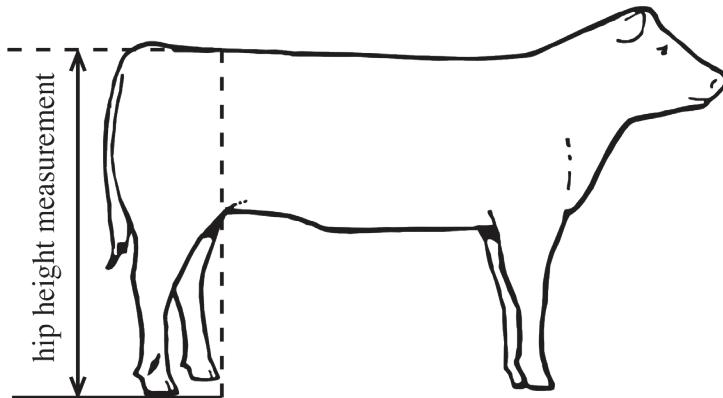


Figure 10. Measuring hip height to determine frame score

Table 4. Hip Heights (inches) and Associated Frame Scores for Growing Bulls

| Age (months) | Hip Height (inches) and Associated Frame Scores for Growing Bulls | | | | | | | | |
|-----------------|---|------|------|------|------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 5 | 33.5 | 35.5 | 37.5 | 39.5 | 41.6 | 43.6 | 45.6 | 47.7 | 49.7 |
| 6 | 34.8 | 36.8 | 38.8 | 40.8 | 42.9 | 44.9 | 46.9 | 48.9 | 51.0 |
| 7 | 36.0 | 38.0 | 40.0 | 42.1 | 44.1 | 46.1 | 48.1 | 50.1 | 52.2 |
| 8 | 37.2 | 39.2 | 41.2 | 43.2 | 45.2 | 47.2 | 49.2 | 51.3 | 53.3 |
| 9 | 38.2 | 40.2 | 42.3 | 44.3 | 46.3 | 48.3 | 50.3 | 53.3 | 55.3 |
| 10 | 39.2 | 41.2 | 43.3 | 45.3 | 47.3 | 49.3 | 51.3 | 53.3 | 55.3 |
| 11 | 40.2 | 42.2 | 44.2 | 46.2 | 48.2 | 50.2 | 52.2 | 54.2 | 56.2 |
| 12 | 41.0 | 43.0 | 45.0 | 47.0 | 49.0 | 51.0 | 53.0 | 55.0 | 57.0 |
| 13 | 41.8 | 43.8 | 45.8 | 47.8 | 49.8 | 51.8 | 53.8 | 55.8 | 57.7 |
| 14 | 42.5 | 44.5 | 46.8 | 48.5 | 50.4 | 52.4 | 54.4 | 56.4 | 58.4 |
| 15 | 43.1 | 45.1 | 47.1 | 49.1 | 50.1 | 53.0 | 55.0 | 57.0 | 59.0 |
| 16 | 43.6 | 45.6 | 47.6 | 49.6 | 51.6 | 53.6 | 55.6 | 57.5 | 59.5 |
| 17 | 44.1 | 46.1 | 48.1 | 50.1 | 52.0 | 54.0 | 56.0 | 58.0 | 60.0 |

Source: Adapted from the Beef Improvement Federation's *Guidelines for Uniform Beef Improvement Programs*, 9th Edition. www.beefimprovement.org.

Table 5. Hip Heights (inches) and Associated Frame Scores for Growing Heifers

| Age (months) | Hip Heights (inches) and Associated Frame Scores for Growing Heifers | | | | | | | | |
|-----------------|--|------|------|------|------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 5 | 33.1 | 35.1 | 37.2 | 39.3 | 41.3 | 43.4 | 45.5 | 47.5 | 49.6 |
| 6 | 34.1 | 36.2 | 38.2 | 40.3 | 42.3 | 44.4 | 46.5 | 48.5 | 50.6 |
| 7 | 35.1 | 37.1 | 39.2 | 41.2 | 43.3 | 45.3 | 57.4 | 49.4 | 51.5 |
| 8 | 36.0 | 38.0 | 40.1 | 42.1 | 44.1 | 46.2 | 48.2 | 50.2 | 52.3 |
| 9 | 36.8 | 38.9 | 40.9 | 42.9 | 44.9 | 47.0 | 49.0 | 51.0 | 53.0 |
| 10 | 37.6 | 39.6 | 41.6 | 43.7 | 45.7 | 47.7 | 49.7 | 51.7 | 53.8 |
| 11 | 38.3 | 40.3 | 42.3 | 44.3 | 46.2 | 48.2 | 50.4 | 52.4 | 54.4 |
| 12 | 39.0 | 41.0 | 43.0 | 45.0 | 47.0 | 49.0 | 51.0 | 53.0 | 55.0 |
| 13 | 39.6 | 41.6 | 43.6 | 45.6 | 47.5 | 49.5 | 51.5 | 53.5 | 55.5 |
| 14 | 40.1 | 42.1 | 44.1 | 46.1 | 48.0 | 50.0 | 52.0 | 54.0 | 56.0 |
| 15 | 40.6 | 42.6 | 44.5 | 46.5 | 48.5 | 50.5 | 52.4 | 54.4 | 56.4 |
| 16 | 41.0 | 43.0 | 44.9 | 46.9 | 48.9 | 50.8 | 52.8 | 54.8 | 56.7 |
| 17 | 41.4 | 43.3 | 45.3 | 47.2 | 49.2 | 51.1 | 53.1 | 55.1 | 57.0 |

Source: Adapted from the Beef Improvement Federation's *Guidelines for Uniform Beef Improvement Programs*, 9th Edition. www.beefimprovement.org.

Table 6. Hip Heights (inches) and Associated Frame Scores for Mature Bulls

| Hip Heights (inches) and Associated Frame Scores for Mature Bulls | | | | | | | | | |
|---|-------------|------|------|------|------|------|------|------|------|
| Age (months) | Frame Score | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 24 | 46.4 | 48.3 | 50.3 | 52.3 | 53.9 | 56.0 | 58.0 | 60.0 | 62.0 |
| 30 | 57.3 | 49.3 | 51.3 | 53.2 | 54.9 | 57.0 | 59.0 | 61.0 | 63.0 |
| 36 | 48.0 | 50.0 | 51.9 | 53.8 | 55.5 | 57.5 | 59.5 | 61.5 | 63.5 |
| 48 | 48.5 | 50.4 | 52.3 | 54.1 | 55.9 | 58.0 | 60.0 | 62.0 | 63.9 |

| Hip Heights (inches) and Associated Frame Scores for Mature Cows | | | | | | | | | |
|--|-------------|------|------|------|------|------|------|------|------|
| Age (months) | Frame Score | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 24 | 43.1 | 45.0 | 46.9 | 48.8 | 50.7 | 52.5 | 54.5 | 56.4 | 58.2 |
| 30 | 43.8 | 45.8 | 47.5 | 49.4 | 51.3 | 53.1 | 55.1 | 57.0 | 58.9 |
| 36 | 44.2 | 46.1 | 48.0 | 49.8 | 51.8 | 53.6 | 55.5 | 57.2 | 59.2 |
| 48 | 44.6 | 46.5 | 48.2 | 50.0 | 52.0 | 53.9 | 55.8 | 57.5 | 59.4 |

Approximate Harvest and Mature Weights of Cattle Based on Frame Score

| Type of Animal | Frame Score | | | | | | |
|-----------------------------|-------------|-------|-------|-------|-------|-------|--|
| | 3 | 4 | 5 | 6 | 7 | 8 | |
| Steer harvest weight (lbs) | 1,010 | 1,105 | 1,200 | 1,295 | 1,390 | 1,485 | |
| Heifer harvest weight (lbs) | 860 | 940 | 1,020 | 1,100 | 1,180 | 1,260 | |
| Mature bull weight | 1,590 | 1,740 | 1,890 | 2,040 | 2,190 | 2,340 | |
| Mature cow weight | 1,010 | 1,105 | 1,200 | 1,295 | 1,390 | 1,485 | |

Source: Adapted from the Beef Improvement Federation's Guidelines for Uniform Beef Improvement Programs, 9th Edition. www.beefimprovement.org.

Measures of Performance

Performance records on beef cattle are essential for informed selection and culling decisions. Written records may also allow participation in beef alliances, source and age verification programs, or sales.

When using performance records for selection or culling decisions, make sure the genetics are matched with the environment. Maximization of traits generally does not match up well with environmental conditions. Set levels of performance to hit environmental limits and marketing targets without significant additional inputs. Fertility and reproductive rates generally are the first to suffer if production is exceeding the environment.

Never take records on traits you will not use in decision making or marketing. Keep written records in safe places to minimize loss. Records can be kept in many ways including Red Books, notebooks, tablets, and computers.

The minimum information to record on each animal is individual identification, birth date, and dam and weaning weight. For many commercial producers, recording birth dates can be difficult. Birth dates can be recorded as actual birth dates, the first birth date that is used for all calves, or the first day the calf is seen. Purebred producers must record the actual birth date of the calf. Birth dates will verify age of an animal and be useful in selecting replacements in a commercial operation.

Purebred producers are given a set of guidelines to follow in recording performance information. This includes individual identification guidelines and what traits to measure. The national breed associations are the repositories for the information, and they generate adjusted weights, ratios, and expected progeny difference (EPD) values for a number of traits used by both purebred and commercial producers.

At the current time, commercial producers are in charge of deciding what traits to measure, how to record the information, and how to analyze and interpret the information from their herd. Performance records can be maintained by using the Integrated Resource Management (IRM) Red Book, worksheets, desktop or laptop computers, tablets, smart phones or other electronic devices, or a combination of these methods. Others use available programs, such as Alabama BCIA, for performance record keeping. Alabama BCIA provides a specialized commercial record keeping system and consultation. For more information, contact Alabama BCIA at www.albcia.com.

For those commercial producers interested in having EPD values predicted on heifers, the American Simmental Association now has a program for commercial cattle. The cattle do not need to contain Simmental genetics for them to be enrolled in this program. It does require that data be submitted for every cow in the herd.

Calving Ease

Calving ease is recorded at birth for each calf born. It is an indication of how easily a calf can be born. This can be analyzed to help predict which bulls will produce daughters that calve easily. A five-point scale is used to record calving ease.

In a commercial herd in need of minimizing calving difficulty (dystocia), selection should be based on calving ease EPD values. While many producers are more comfortable using birth weight EPD values for selection of calving ease bulls, birth weight is just an indicator of calving ease.

Table 7. Calving Ease Scores

| Calving Ease Scores | |
|---------------------|---|
| Score | Description |
| 1 | No difficulty or assistance |
| 2 | Minor difficulty; some assistance |
| 3 | Major difficulty; usually mechanical assistance |
| 4 | C-section |
| 5 | Abnormal presentation (breech; upside down, etc.) |

Birth Weight

Birth weight is an indication of calving difficulty. Birth weights should be adjusted for sex of calf and age of dam. In general, bull calves are 7% heavier than heifer calves. Also calves born to young cows (younger than 5) are generally 3 to 8 pounds lighter than calves born to mature cows (5 to 10 years of age).

Measure and record birth weights within 24 hours of birth.

Using actual birth weights to select herd bulls will be the least accurate method of ensuring minimal calving difficulty. Birth weight EPD values are most effective in selecting bulls that will sire low birth weight calves if calving ease EPD values are not available for that breed.

Weaning Weight

Weaning weight of the calf is an indication of the preweaning growth of the calf and the milking ability of the dam. Weaning weights should be adjusted for the age and sex of the calf and age of the dam. Again, bull calves are generally heavier than heifer calves. Younger dams generally wean lighter calves because some nutrition is needed for growth in younger dams, which does not allow maximum milk production to be expressed.

In a normal production environment, weigh calves between 160 and 240 days of age. This allows the weaning weight to be adjusted to a 205-day weight. Height measurements to determine frame score can also be taken. Calves do not need to be physically weaned at this time. They can remain with the cows until feed resources become limiting or 60 days before calving will begin again.

For calves to be correctly compared, it is best if all calves are weighed on the same day and the range of ages is between 160 and 240 days of age. If the age range is wider than this, break the weigh dates into two or more groups. Just make sure that the age range of each group is between 160 and 240 days of

age. If calves come from multiple pastures, also record the pasture each calf was raised in.

In extreme drought or limited resources, wean calves early. Typically, an early weaned calf is physically weaned and weighed from 90 to 120 days. Early weaning means less feed resources are needed for the cow herd.

Adjusted 205-day weights and ratios are a good indication of cow production. In a commercial herd, these records can be useful in culling unproductive females.

Yearling Measurements

Yearling measurements are an indication of post-weaning growth of the individual. Typical yearling measurements include weight, height, scrotal circumference (in breeding bulls), and carcass ultrasound traits.

Take all yearling measurements between 330 and 400 days of age. Again, measure and record calves on the same day in the proper age range.

Yearling weights are adjusted for age of the calf with yearling and weaning adjustment factors. Besides ranking animals based on growth from weaning to yearling, yearling weights also ensure that replacement heifers are on schedule to reach target breeding weight (65% of mature weight) at 15 months of age. Body condition scores should also be taken at yearling. Animals with good yearling weights but with poor body condition scores probably indicate “hard-keepers” and should not be kept as replacements.

For formulas and age and dam adjustment factors for birth, weaning, or yearling weight, consult the Beef Improvement Federation’s Guidelines for Uniform Beef Improvement Programs at www.beefimprovement.org.

Yearling ultrasound measurements for carcass merit should be taken by a certified ultrasound technician (<http://www.ultrasoundbeef.com>). Measures include rump fat, 12th rib fat, ribeye area, and percent intramuscular fat. Independent laboratories interpret the ultrasound images with purebred cattle data reported to the appropriate breed association for incorporation into EPD analyses. For commercial cattle, adjusted data and ratios are returned to the owner for selection/culling decisions.

Cattle should not be selected based on a single piece of information or trait. For commercial females, information available will be in the forms of adjusted weights and ratios, unless enrolled in the American Simmental Association Commercial Herd program. For the selection of purebred or composite bulls, EPD values in concert with the environmental conditions should be used in making selection decisions. For most producers, maximization of production traits (using weights, ratios, or EPDs) is not the solution. Performance information should be coupled with structural soundness and farm environment to arrive at final selection or culling decision.

Reproductive Management

Control of Reproduction

The success of a cow-calf operation depends on the number of calves raised, weaned, and marketed each year. The following are some of the important production factors influencing profits in the cow-calf business:

- Calving and weaning percentages
- The percentage of cows and heifers bred early in the breeding season
- Proper growth and development of replacement heifers

Understanding the factors affecting reproductive performance in a cowherd can potentially increase profitability.

Table 1. General Reproductive Information

| | Average | Range | Comments |
|--------------------------------------|--------------|--------------------------------|--|
| Age at puberty | 10–12 months | 6–24 months | <ul style="list-style-type: none">• Varies with breed.• Brahmans and continental breeds usually reach puberty later than British breeds. |
| Gestation | 283 days | 273–290 days | <ul style="list-style-type: none">• Bull calves are often carried slightly longer.• Brahman type cattle often have longer gestation. |
| Length of estrous cycle | 21 days | 18–24 days | <ul style="list-style-type: none">• Heifers often have slightly shorter cycles than cows. |
| Length of estrus (heat) | 18 hours | 6–30 hours | <ul style="list-style-type: none">• Signs include restlessness, clear mucous vaginal discharge, and mounting other animals, but the main sign is “standing to be mounted.” |
| Interval to first heat after calving | 45 days | 16–90+ days | <ul style="list-style-type: none">• Retained afterbirth and uterine infection delay onset.• Adequate body condition is critical. |
| Reproductive Life | 10 years | Up to 15 years (rarely longer) | <ul style="list-style-type: none">• Management, death loss, culling, etc., play a large part in determining reproductive lifespan. |

Normal Estrous Cycle

Estrus: standing heat.

Estrous: the 21-day cycle from one estrus (heat) to the next

The average estrous cycle, from one standing heat (estrus) to the next, is 21 days in the cow (figure 1), with a range of 18 to 24 days. The cycle begins on day 1 when the egg is ovulated from a follicle on the ovary. The egg moves into the uterine tube where, if viable sperm from the bull are present, it is fertilized and moves into the uterus.

Regardless of whether the egg is fertilized, by approximately day 5, the site of ovulation on the ovary develops into a corpus luteum (CL), a gland that secretes the hormone progesterone into the cow's blood. While the CL is secreting progesterone, sometimes called the "hormone of pregnancy," the animal does not come into estrus.

Around day 17, if the animal is not pregnant, the uterus secretes the hormone prostaglandin F2 alpha (PGF2 α) that causes the CL to regress in about 3 to 5

days. While the CL is regressing, a new egg-containing follicle is developing that secretes the hormone estrogen, causing the cow to come into standing heat on about day 20 or 21 of the estrous cycle. Cows should be inseminated near the end of standing heat to provide enough time for the sperm to undergo a process called capacitation before they

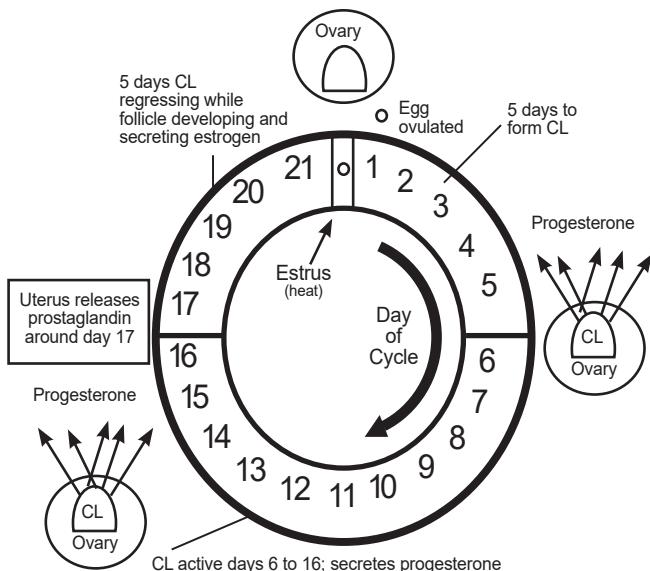


Figure 1. Cyclicity: the normal 21-day cycle

encounter the egg. Capacituation gives sperm the ability to fertilize the egg. Cows ovulate approximately 4 to 16 hours after the end of standing heat. (See section on Timing of Artificial Insemination for maximum conception.)

If a cow becomes pregnant, the embryo in the uterus prevents the release of PGF2 α . When this happens, progesterone secretion by the CL continues, cycling ceases, and the pregnancy is maintained. If no problems occur during pregnancy, the embryo develops into a fetus, which is born as a calf about 283 days after the egg was fertilized.

Developing Replacement Heifers from Weaning to Breeding

- Determine your target weight at breeding.
- Sort replacement heifers by size, giving the most feed to heifers that need it the most.

Note: Start of puberty is affected by age, weight, and breed. Of these three factors, weight is the one that producers can change.

Following is an example worksheet for calculating your required heifer gains before the start of the first breeding season.

| | Alabama Example | Your Herd |
|---|-----------------|-----------|
| Mature cow size | 1,100 pounds | |
| Target weight at breeding (65% of mature weight) ¹ | 715 pounds | |
| Current weight | 550 pounds | |
| Current date | August 1 | |
| Start of breeding season | December 1 | |
| Development period | 120 days | |
| Total gain needed | 162 pounds | |
| ADG needed | 1.37 pounds/day | |

¹Calculate target weight based on your mature adult cow weight in the herd. Avoid underestimating the target weights for heifers.

Table 2. Recommended Height and Body Weight of Breeding Females

| Frame Score | 205 Days | | 426 Days | | Maturity | |
|-------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | Height ¹ | Weight ² | Height ¹ | Weight ² | Height ¹ | Weight ² |
| 1 | 35 | 356 | 41 | 580 | 44 | 880 |
| 2 | 37 | 375 | 43 | 618 | 46 | 953 |
| 3 | 39 | 396 | 45 | 653 | 48 | 1,027 |
| 4 | 41 | 418 | 47 | 693 | 50 | 1,100 |
| 5 | 43 | 438 | 49 | 728 | 52 | 1,172 |
| 6 | 45 | 458 | 51 | 766 | 54 | 1,247 |
| 7 | 47 | 480 | 53 | 803 | 56 | 1,320 |
| 8 | 49 | 499 | 55 | 838 | 58 | 1,393 |
| 9 | 51 | 521 | 57 | 880 | 60 | 1,467 |

Source: Adapted from D. G. Fox, C. J. Sniffen, and J. D. O'Connor, "Adjusting Nutrient Requirements of Beef Cattle for Animal and Environmental Variations," *Journal of Animal Science* 66 (1988):1475.

¹Hip height (inches) based on Beef Improvement Federation standards.

²Weights (pounds) are expected averages for flesh condition (body condition score 5).

Breeding Soundness Evaluation of Replacement Heifers

Performing breeding soundness evaluations approximately one month before breeding allows for selection of heifers with the best reproductive potential.

Heifers with poor reproductive potential can be culled before incurring additional costs associated with their maintenance. Heifers that conceive early during their first breeding will calve earlier and wean older, heavier calves than heifers that conceive later in the breeding season. In addition, heifers that conceive and calve early with their first calf tend to continue to conceive and calve early throughout their productive lives.

Two important aspects of heifer breeding soundness examinations are reproductive tract scoring and pelvic area measurements. This is in addition to an overall physical assessment (conformation, physical soundness, body condition score, udder, etc.).

Reproductive Tract Scores

Reproductive tract scoring is a method for evaluating reproductive tract maturity and cyclicity in pubertal heifers. This evaluation is done via transrectal palpation or ultrasound to determine a heifer's reproductive tract development. Heifers are assigned a reproductive tract score (RTS) of 1–5 based on uterine size, uterine tone, ovarian size, and ovarian structures (table 3). Reproductive tract scores are moderately heritable.

Table 3. Heifer Reproductive Tract Scores

| Heifer Reproductive Tract Scores | | | | | |
|----------------------------------|-----------------------------|------------------------------------|-------------|------------|--|
| | | Ovaries (Size and Characteristics) | | | |
| Reproductive Tract Scores | Uterine Horns (diameter) | Length (MM) | Height (mm) | Width (mm) | Ovarian Structure |
| 1 | Immature Less than 20 mm | 15 | 10 | 8 | No palpable follicles, no tone |
| 2 | 20–25 mm | 18 | 12 | 10 | 8 mm follicle, no tone |
| 3 | 25–30 mm | 22 | 15 | 10 | 8–10 mm follicle, slight tone |
| 4 | 30 mm | 30 | 16 | 12 | Greater than 10 mm follicle, good tone, corpus luteum possible |
| 5 | Greater than 30 mm | Greater than 32 | 20 | 15 | Greater than 10 mm follicle, good tone, corpus luteum present |

Pelvic Area Measurements

One of the potential reasons for calving difficulty (dystocia) in cows and heifers is disproportion between fetal size and heifer/cow pelvic area (i.e., the fetus is too large or the cow's pelvis is too small). Larger, heavier heifers do not always have the largest pelvic areas.

Measuring the pelvis before the breeding season allows selection of heifers with larger pelvic areas and culling of heifers with smaller pelvic areas. A 12- to 14-month-old heifer's pelvis will continue to grow. However, heifers with smaller pelvic areas during prebreeding soundness evaluations will continue to have proportionally smaller pelvic areas as cows.

Pelvic area is calculated in square centimeters (cm^2) by multiplying the width of the pelvis \times the height of the pelvis.

Pelvic width and height are measured in centimeters transrectally with a pelvimeter. Dividing pelvic area by a conversion factor (table 4) based on heifer age and weight will then estimate the birth weight of a calf that a heifer should be able to deliver without difficulty. This does not estimate the birth weight of a heifer's calf, but rather provides an estimate of how big of a calf she could safely deliver.

Divide pelvic area (pelvic height \times pelvic width) by the appropriate conversion factor based on heifer weight and age to estimate the birth weight of a calf that a heifer should be able to deliver without difficulty. Example for estimating the deliverable calf birth weight of a 12-month-old heifer that weighs 800 pounds:

- Measured pelvic height = 15 cm
- Measured pelvic width = 12 cm
- Calculated pelvic area = $15 \text{ cm} \times 12 \text{ cm} = 180 \text{ cm}^2$
- Ratio from chart = 2.3
- Estimated deliverable calf weight = $180 \div 2.3 = 78 \text{ pounds}$

Table 4. Conversion Factors for Various Heifer Weights and Ages to Calculate an Estimated Deliverable Calf Birth Weight

| Heifer Pelvic Measurement | | | | |
|---------------------------|-----------------------------------|--------------|--------------|--------------|
| Heifer Weight | Heifer Age at Time of Measurement | | | |
| | 8–9 months | 12–13 months | 18–19 months | 22–23 months |
| 500 pounds | 1.7 | 2 | | |
| 600 pounds | 1.8 | 2.1 | | |
| 700 pounds | 1.8 | 2.2 | 2.6 | |
| 800 pounds | | 2.3 | 2.7 | 3.1 |
| 900 pounds | | 2.4 | 2.8 | 3.2 |
| 1,000 pounds | | 2.5 | 2.9 | 3.3 |
| 1,100 pounds | | | | 3.4 |

Estrus Synchronization Programs

Artificial insemination (AI) is a reproductive tool that allows cattle producers to use at an affordable price sires that have superior genetics. Part of a successful AI program is estrus synchronization, which typically involves administering a series of hormones to induce a group of cows or heifers to be fertile at a chosen time period, which makes it easier to determine when the cows are in heat.

The majority of estrus (heat) synchronization programs use one or a combination of three basic methods that work with the physiology of the cow's normal estrous cycle.

- Prostaglandin (PGF_{2α}) injections cause CL regression (see section on Normal Estrous Cycle) and standing heat in 1 to 5 days, unless the cow or heifer is in the first 5 to 7 days of her estrous cycle when her CL is not responsive PGF_{2α}.
- Progesterone or progestins, released from controlled internal drug release (CIDR) inserts or ingested in feed (MGA), respectively, mimic the effects of the cow's natural progesterone by preventing heat from occurring as long as they are present in the body. Once removed, the cow or heifer typically comes into heat in 1 to 3 days. These products are often used in conjunction with a PGF_{2α} injection.
- Gonadotropin-releasing hormone (GnRH) injections promote and synchronize follicle growth and induce ovulation. A GnRH injection administered approximately 48 hours after a prostaglandin injection provides a more concise synchrony of ovulation.

To review recommended estrus synchronization protocols for both cows and heifers, refer to the Beef Reproduction Task Force, a multistate Extension activity in cooperation with the North Central Agriculture and Natural Resources Program Leaders Committee and the National Institute of Food and Agriculture (NIFA), at www.beefrepro.unl.edu/. Recommended protocols are updated frequently and provide a comparison of both cost and labor resources to help beef producers select the appropriate estrus synchronization protocol for their operations.

Federal law restricts the majority of reproductive hormones to use by or on the order of a licensed veterinarian. Contact your veterinarian to learn about specific recommendations and products for an estrus synchronization program.

Two Main Reasons Estrus Synchronization Programs Fail

1. The animals were not cycling.
 - Cows must be in sufficient body condition at calving and have adequate nutrition available to begin cycling postpartum.
 - Heifers must be at approximately 65 percent of their mature body weight to initiate cycling.

- The animals were cycling, but heat was not detected after injection of PGF2α or removal of progesterone/progestin.
 - The signs of heat may have been present but just not detected. Cows are usually in estrus for only 12 to 24 hours and may only show signs of standing heat a few times. Observe for standing heat at least 30 minutes twice a day. Early morning and late afternoon are the best times for heat detection.
 - The cow or heifer did not respond to the PGF2α injection because she was in the first 5 to 7 days of her estrous cycle when her CL was not responsive to PGF2α.

Things to Remember

- Always be careful when handling reproductive hormones because they can be absorbed through the skin and affect humans.
- Women of childbearing age, asthmatics, and people with bronchial or other respiratory problems should exercise extreme caution when handling reproductive hormones.**
- Always follow label directions and adhere to all other BQA guidelines.

Timing of Artificial Insemination for Maximum Conception

Figure 2 offers general guidelines for timing of artificial insemination (AI) based on observed standing heat (estrus). Actual times will vary depending on the length of standing heat, but the goal is to inseminate near the end of a heat period.

Cows ovulate approximately 4 to 16 hours after the end of standing heat. Inseminating near the end of heat provides time for the sperm to undergo capacitation before they encounter the egg. The process of capacitation gives sperm the ability to fertilize the egg. In general, it is better to have the sperm waiting on the egg, rather than the egg waiting on the sperm, because the egg has a shorter lifespan.

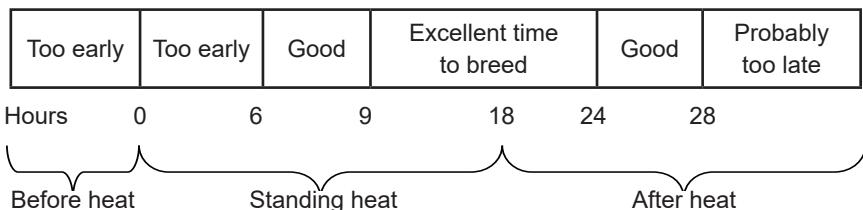


Figure 2. Timing of artificial insemination for maximum conception

Things to Consider

- Good heat detection is critical for successful artificial insemination. Observe for standing heat at least 30 minutes twice a day. Early morning and late afternoon are the best times for heat detection.
- Maximum conception rates for artificial insemination occur if animals are bred near the end of standing heat. Traditional artificial insemination has, therefore, followed the AM-PM rule. An animal first observed in heat in the AM should be inseminated that PM. An animal first observed in heat in the PM should be inseminated the next AM.
- Some producers may also consider using fixed-timed AI (FTAI), in which insemination occurs at a predetermined time following an appropriate synchronization program. FTAI allows for a more regimented schedule. Recent improvements in FTAI and estrus synchronization protocols have increased pregnancy rates while allowing for easier scheduling of labor resources and less cattle handling. If an FTAI program is used with estrus synchronization, the need for heat detection can be eliminated.

Parturition

Observation of cows and heifers before and during the calving season is necessary to ensure a good calf crop. Cows should be checked at least daily during the calving season, and heifers should be checked more frequently (perhaps several times a day). Producers need to be familiar with the signs of impending parturition as well as the sequence of events associated with normal labor and delivery to determine if and when assistance is necessary.

Signs of Impending Parturition

- The udder and vulva will often enlarge 1 to 3 weeks before parturition.
- Cows and heifers often become more nervous (restless) and will isolate themselves from the rest of the herd just before parturition.
- Cows and heifers may show signs of abdominal discomfort by kicking at their belly. They may also glance to the rear nervously.
- The tail-head appears raised as ligaments around the rump of the cow or heifer relax.

Assistance may be needed when parturition does not proceed as described, and early intervention is the key. Waiting too long to provide assistance unnecessarily risks the life of the cow or heifer and her calf. Seek the help of a veterinarian or experienced herdsman if you need assistance, and keep the following guidelines in mind:

- Calving takes time, and it often takes longer for heifers than for cows. So, be patient, but don't wait too long. Progress should be steady and generally fit within the time frames mentioned. In other words, once the water sac (placental membrane) is seen protruding from the vulvar lips, a cow should deliver her calf within an hour, and a heifer should deliver her calf in less than 2 hours. Once the delivery stage begins, a cow or heifer should make visible progress about every 15 to 20 minutes.

- Use the 2+1 rule to help determine when to call for help. Upon examination, 2 feet and 1 head (or 2 feet and 1 tail) should be felt or seen for a normal delivery to proceed. If adequate time has elapsed and 2+1 is still not seen or felt, assistance is necessary.
- If the cow or heifer becomes exhausted and quits trying to calve, assistance is necessary.
- No more than two strong people should pull on a calf at the same time. When pulling on a calf to assist with a delivery, try to pull only when the cow or heifer is actively contracting. This will facilitate progress and minimize the risk of uterine prolapse.

Three Stages of Normal Parturition

Table 5. Three Stages of Parturition

| Stage | Duration | Comments |
|---|--|---|
| Stage I Preparatory | Cows (4–8 hours) Heifers (6–12 hours) | <ul style="list-style-type: none"> • Cow or heifer may become nervous and isolate herself from the rest of the herd. • Uterine contractions begin. • Colostrum/milk drops into the teats. • The fluid-filled placental membranes (water sac) appears toward the end of this stage. Stage II begins when the water sac breaks. |
| Stage II Delivery of the calf | Cows (less than 1 hour) Heifers (1–2 hours) | <ul style="list-style-type: none"> • Cow or heifer is now actively straining. • In normal parturition, the calf's forelegs and head protrude first about 70% of the time, and the hind legs and tail come first about 30% of the time. • The calf is delivered. |
| Stage III Expulsion of the placenta (afterbirth) | Cows (1–12 hours) Heifers (1–12 hours) This usually occurs within the first few hours. | <ul style="list-style-type: none"> • Cow or heifer straining decreases. • Uterine contractions continue and the placenta is expelled. • If the placenta is not expelled soon after birth, do NOT manually remove the placenta by pulling it out (see section on Retained Placenta). |

Supplies Needed to Assist with a Calf Delivery

- Obstetrical (OB) chains or ropes. Chains are preferred because they can be easily disinfected after use. OB chains and ropes are used for pulling on the calf's legs (figure 3). Never attach OB chains or ropes to the calf's jaw to pull on a calf as the jaw will almost always fracture.
- OB handles for pulling on the chains or ropes.
- Mechanical calf puller, also known as a "calf jack." **USE WITH CAUTION, AND DO NOT APPLY EXCESSIVE FORCE.** Calf jacks can exert substantial force on the cow or heifer and the calf. When used improperly, the cow, heifer, and calf can be injured or killed. Never attempt to deliver a calf with any type of vehicle.
- OB lubricants
- Plastic gloves
- Buckets
- Towels and paper towels
- Iodine or other appropriate disinfectant/drying agent for the calf's navel.

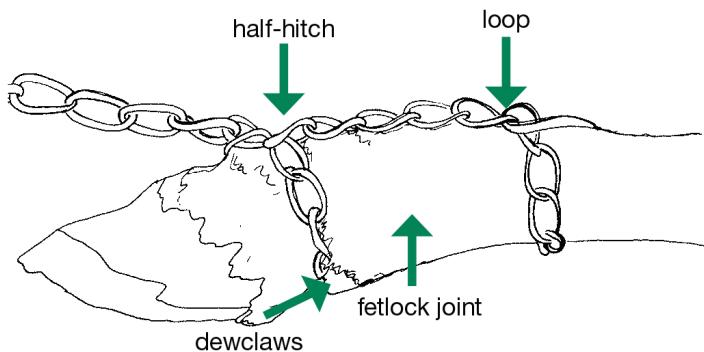


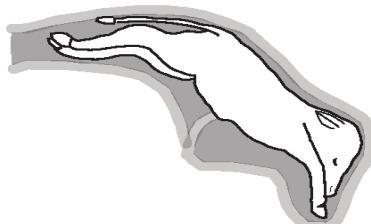
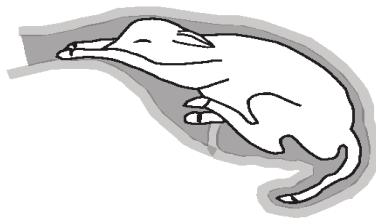
Figure 3. Place a loop above and a half-hitch below the fetlock joint with the connecting chain on the top of the leg.

Providing Assistance During Calving

The first step in providing assistance during parturition is assessing the problem. Several common situations encountered when delivering a calf are illustrated and described below.

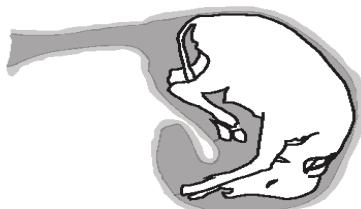
1. Normal delivery

- The calf's forelegs and head protrude first about 70% of the time.
- The hind legs and tail come first about 30% of the time. Always make sure the tail is protruding with the hind legs in this situation.



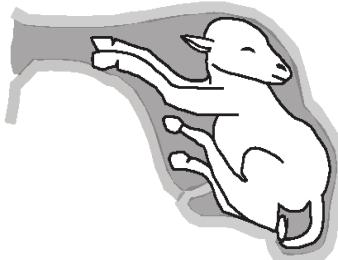
2. Calf too big (not illustrated)

- Most frequently encountered in heifers, but it can occur in cows.
- Applying excessive force to attempt delivery of a calf that is too big is detrimental to the health of the heifer and the calf, and wastes precious time.
- Call a veterinarian as soon as you decide the calf is too big. The calf can be saved if assistance is provided promptly. Even if the calf cannot be saved, a veterinarian can dismember the calf or perform a C-section to save the heifer.



3. Breech: hindquarters first with both hind legs retained

- Both hind legs and the tail must be straightened out and placed correctly within the birth canal for delivery to proceed.

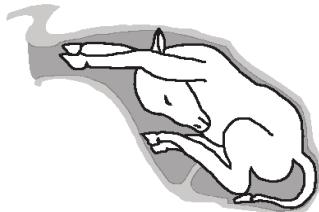
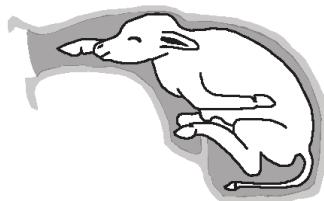


4. Head turned to the side

- The neck must be straightened out and the head placed on top of the forelegs for delivery to proceed.

5. Retained foreleg(s)

- Occasionally one or both forelegs are retained. If both forelegs are retained then only the head will be in the birth canal.
- The forelegs must be straightened out and delivered simultaneously with the head resting on top of the forelegs.



6. Head underneath both forelegs

- The head must be placed on top of the forelegs, and then delivery can proceed.

Reproductive Tract Prolapses

- Vaginal prolapse
- Cervical prolapse
- Uterine prolapse

Vaginal and Cervical Prolapses

- Usually occur prepartum (before calving) during the last half of pregnancy; occasionally occur postpartum (after calving).
- Usually occur in cows; occasionally occur in heifers.
- Vaginal and cervical prolapses are classified as follows:
 - **1st degree** – intermittent protrusion of the floor of the vagina. This type of prolapse occurs when the cow is lying down, and it corrects itself when the cow stands up.
 - **2nd degree** – continuous protrusion of the vagina.
 - **3rd degree** – continuous protrusion of the vagina and cervix (cervical prolapse).
 - **4th degree** – a 2nd or 3rd degree prolapse that has been prolapsed so long the tissue is becoming necrotic (dead).
- Vaginal and cervical prolapses reoccur and are heritable; therefore, it is probably best to have your veterinarian temporarily fix the prolapse with the intent of eventually culling the cow and her heifer offspring.

Uterine Prolapse

- **EMERGENCY!** Cows with a uterine prolapse will die without prompt medical attention.
- Contact your veterinarian immediately.
- Do not overly stress a cow with a uterine prolapse, and do not attempt to move her very far. A cow with a prolapsed uterus is often in shock and at great risk for fatal hemorrhaging.
- Always occurs postpartum.
- It is best to treat the cow on the farm if possible. If transport is necessary, be extremely cautious.
- If the cow survives treatment, she will likely develop a temporary uterine infection and be slower to breed back. She is not at any greater risk for uterine prolapse in subsequent years.
- This is not a heritable condition, and it is not likely to reoccur. Therefore, there is no need to cull the cow as long as she breeds back.

Differentiating Between Vaginal/Cervical and Uterine Prolapses

- If a reproductive tract prolapse occurs prepartum, it is a vaginal/cervical prolapse.
- If a reproductive tract prolapse occurs postpartum, it can either be a vaginal/cervical prolapse or a uterine prolapse, but it is most likely a uterine prolapse.
- If carnules are present on the prolapsed tissue, the cow has a uterine prolapse. The carnules are darker than the surrounding tissue, circular to oval in shape, and approximately 2 to 4 inches in diameter.

Retained Placenta

The bovine placenta, or afterbirth, is normally expelled within a few hours after calving. A “retained placenta” occurs if the afterbirth is not expelled within 12 hours. Retained placentas normally occur in a small percentage of all calvings. Closely evaluate your herd’s nutrition if you are experiencing frequent occurrence of retained placentas. Cows with retained placentas will often be slower to breed back.

Predisposing Factors for Retained Placenta

- Inducing parturition (calving) prematurely greatly increases the incidence of retained placentas. Fortunately, there is rarely a need to induce parturition in cattle.
- Abortions or premature births
 - No retained placenta before 120 days of gestation
 - 15 percent if 121 to 150 days of gestation
 - > 50 percent if 240 to 270 days of gestation

- Dystocia (difficult births)
- Nutritional deficiencies, especially hypocalcemia (low blood calcium). Poor nutrition results in weak uterine contractions that are necessary to expel the placenta.

Treatment

- Do not forcefully pull out the placenta as this will often leave pieces of the placenta in the uterus that will further delay the cow from rebreeding.
- Time. The recommended treatment for a retained placenta is to “let mother nature take its course,” and eventually the placenta will fall out. This may take up to a week (and will smell bad), but be patient. If the placenta is hanging extremely low, it may be advisable to twist the placenta into a knot around the cow’s hocks to prevent her from stepping on it or catching it on some object. Watch the cow closely to ensure that she is eating, drinking, and feeling healthy.
- When in doubt, call your veterinarian. Veterinarians will occasionally prescribe hormonal treatment if indicated. Your veterinarian will also prescribe antibiotics if the cow becomes systemically ill.

Reproductive Measurements

You can only manage what you measure. The most important measures of reproductive efficiency are below.

- **Pregnancy percent (PP)** is a measure of the success of the breeding season. Make your calculations based on the number of cows exposed to breeding. To produce a marketable product, each cow must conceive and give birth each year.
 - $PP = (\text{number palpated pregnant} \div \text{number of cows exposed}) \times 100$
- **Percent birth calf crop (PBCP)** measures the collective results of the breeding and calving seasons. Not only must cows conceive, but they must also give birth to live, healthy calves. If cows are losing calves between breeding and calving, there could be a problem with reproductive disease.
 - $PBCP = (\text{number of live calves} \div \text{number of cows exposed to breeding}) \times 100$
- **Weaning percent (WP)**, also called “percent calf crop weaned,” is the single most descriptive measure of reproductive performance of a cowherd.
 - $WP = (\text{number of live calves weaned} \div \text{number of cows exposed to bulls}) \times 100$
- **Calving interval (CI)** is the number of days between successive calving. CI is one measure of a cow’s reproductive performance for the past year. Ideally, calving interval should be 365 days or less. A late-breeder cow with a long CI may sooner or later fail to rebreed during a controlled breeding season.
 - $CI = [\text{age (in days) at first calving} - \text{age at last calving} + 365] \div \text{number of calvings}$

General Causes of Poor Reproductive Performance

There are many causes of poor reproductive performance in cows and heifers, but in general, all causes can be categorized as infectious or noninfectious.

Infectious Causes of Infertility or Abortion

- Anaplasmosis
- Bovine viral diarrhea virus
- Brucellosis
- Infectious bovine rhinotracheitis (IBR)
- Leptospirosis
- Neosporosis
- Trichomoniasis
- Vibriosis (campylobacter)
- Others

Noninfectious Causes of Infertility or Abortion

- Nutrition
 - Poor body condition score
 - Improper mineral supplementation
- Heat stress
- Improper handling of frozen semen for artificial insemination (Improper handling can occur during the thawing and insemination process or while the semen is stored in the liquid nitrogen tank.)
- Improper artificial insemination technique
- Unobserved standing heats (estrus) due to poor heat detection, leading to poor artificial insemination results
- Insufficient bull power (i.e., not enough bulls) or subfertile bulls
- Nonpuberty in replacement heifers
- Toxins
- Fetal genetic defects

With so many causes of poor reproductive performance, it is often advisable to contact your herd health veterinarian or Extension agent for help. A herd check, including various diagnostic tests, may be necessary to determine the exact cause of poor reproductive performance.

If an Abortion Occurs

- Contact your veterinarian.
- Keep other cattle away from the aborted tissues and the animal that aborted in case the cause of the abortion is infectious.
- Keep scavengers away from the aborted tissues so your veterinarian can examine them for the cause of the abortion. Your veterinarian may also want to submit the aborted tissues to one of the Alabama Department of Agriculture and Industries veterinary diagnostic laboratories.
- Be careful if handling the aborted tissues because some causes of abortion in cattle are also infectious to humans.

Consequences of Nutritional Mismanagement on Reproduction

- Increased age at puberty
- Lower conception rates
- Greater degree of calving difficulty
- Increased calf morbidity and mortality
- Calves born later in calving season
- Lighter weaning weights
- First calf heifers with poor reproductive performance during rebreeding
- Later rebreeding of first calf heifers
- Reductions in lifetime productivity
- Increased rate of culling

Fundamental Ingredients for Improving the Reproductive Performance of Your Beef Herd

- Permanently identify cows and calves.
- Avoid an extended calving season. Establish a controlled breeding and calving season of 60 to 90 days.
- Ensure that every bred female weans a calf with acceptable weaning weight every year.
- Match breeding/calving seasons to nutritional resources based on what forages are available before and after breeding.
- Monitor body condition scores for rebreeding.
- Implement a breeding system that utilizes heterosis.
- Select and use superior bulls for traits important to you.

- Use bulls with appropriate calving ease or birth weight EPDs.
- Conduct breeding soundness exams for your bulls 60 days before the beginning of your breeding season.
- Select early born replacement heifers.
- Select replacement females based on performance.
- Develop replacement heifers to reach the target weight of 65% of their mature body weight before breeding.
- Breed replacement heifers 2 to 4 weeks before mature cows.
- Calve heifers at 2 years of age.
- Calculate average calving date, calving interval.
- Calculate pregnancy rate and weaning rate.
- Cull cows based on performance.
- Cull cows with significant structural, eye, tooth, or udder problems.
- Cull open cows and those with late calves or extended postpartum intervals.
- Develop an effective health program.

How to Optimize the Breeding Performance of Your Bulls

- Select bulls that will complement the genetics of your herd in terms of growth, carcass, and maternal ability.
- Cull all bulls with structural problems, an inability to breed, an inadequate scrotal circumference, and poor semen quality.
- Sort bulls by age into breeding pastures to minimize the effect of the dominant bull hurting or crippling a younger, less dominant bull in the pasture.
- Observe bulls at the start of the breeding season to determine that each bull has the ability to breed. Observe pastures for cows that have been bred earlier and are returning to heat.
- Use only bulls that pass an annual breeding soundness evaluation (BSE) 60 days before the start of the breeding season. Retest bulls that previously failed the examination. Cull bulls that fail the BSE. (See section on Breeding Soundness Evaluation.)
- Ensure that an appropriate herd health program is in place.
- Use the an appropriate bull to cow ratio (table 6).

Table 6. Recommended Number of Females Per Bull Based on the Bull's Age for Single-Sire Units¹

| Bull's Age | Number of Females |
|---------------------|-------------------|
| 12 to 15 months | 10 to 12 |
| 15 to 18 months | 12 to 18 |
| 18 to 24 months | 18 to 25 |
| 24 months and older | 25 to 35 |

¹In multisire units, decrease the number of females by approximately ½ for each additional bull.

Breeding Soundness Evaluation (BSE)

Failure to properly evaluate your bulls can result in huge economic losses. Yet, performing bull BSEs prior to the breeding season is one of the most neglected reproductive management practices in cattle operations.

A bull's fertility can be considered fertile, subfertile, or sterile. Subfertile bulls may eventually get cows pregnant if left together for sufficient time, but they will take much longer to get cows pregnant than fertile bulls. As a result, calves will be born later and will, therefore, be younger and lighter at weaning.

Subfertile bulls also produce fewer calves during a breeding season, leading to fewer pounds at weaning. Fewer pounds at weaning equals fewer pounds to market, which translates to fewer dollars in your pocket.

A bull BSE is a uniform method of assessing a bull's likelihood of accomplishing pregnancy in an appropriate number of open, healthy, cycling cows or heifers in a defined breeding season.

The minimum requirements for scrotal circumference, sperm motility, and sperm morphology are outlined by the Society for Theriogenology.

Additional factors influencing the number of cows a bull can breed in a season include pasture size and terrain, physical soundness, age of the bull, libido, and number of bulls in the group.

Components of a Bull BSE

Physical exam: Evaluates the physical characteristics of the bull necessary for mobility and athleticism in the pasture, including structural soundness and overall internal and external reproductive development.

Scrotal circumference: Evaluates testicular size and health and estimates the bull's sperm-producing capacity. See table 7 for the minimum recommended scrotal circumference as outlined by the Society for Theriogenology. Bulls must meet minimum scrotal circumference measurements based on age in order to pass a BSE.

Sperm motility: Ensures that the bull is producing sufficient numbers of live sperm. Bulls must have at least 30% motility to pass a BSE.

Sperm morphology: Ensures that the bull is producing sperm that are properly shaped and capable of fertilization. Bulls must produce at least 70% normal sperm to pass a BSE.

Based on the results of the BSE, the bull is then assigned to one of three classifications:

1. Satisfactory potential breeder (fertile). This classification indicates that the bull:
 - Passed a physical exam
 - Met the minimum requirements for scrotal circumference
 - Has at least 30% sperm motility
 - Produces at least 70% normal sperm
2. Unsatisfactory potential breeder (subfertile or sterile). This classification indicates that the bull did not pass at least one of the four components of the BSE.
3. Deferred. This classification indicates that the bull did not pass at least one of the four components of the BSE due to a condition that may resolve with time. A “deferred” bull should be rechecked at a later date.

A BSE does not evaluate a bull's libido, nor does it ensure that a bull will remain a satisfactory potential breeder the entire breeding season. If a bull suffers injuries to his feet, legs, or reproductive tract, such an injury may render him incapable of breeding your cows; therefore, it is still extremely important to observe your bulls regularly to ensure that they are doing their job.

A BSE also does not guarantee that bulls are free of infectious diseases, so consult your veterinarian on what diagnostic tests may be appropriate for your bull. The extra pounds of beef per exposed cow will more than pay for the BSE, so contact your veterinarian for a bull BSE prior to next breeding season.

Table 7. Minimum Recommended Scrotal Circumference (SC)

| Minimum Recommended Scrotal Circumference (SC) | |
|--|---------|
| Age (months) | SC (cm) |
| ≤ 15 months | 30 |
| > 15 ≤ 18 months | 31 |
| > 18 ≤ 21 months | 32 |
| > 21 ≤ 24 months | 33 |
| > 24 months | 34 |

Source: Adapted from “Bull Breeding Soundness Evaluation” form, Society for Theriogenology.

Measuring Scrotal Circumference

- Testicles must be descended into the scrotum. Hold testicles to the bottom of the scrotal sack by placing your fingers on the side of the scrotum and above the testicles (figure 4). Do not place fingers between the testicles.
- Slip loop formed by the scrotal tape over the scrotum around the widest point.
- Pull tape up snugly.
- Take circumference reading, in centimeters, at the index formed by the small stainless steel crossbar on the scrotal circumference tape thumb piece.

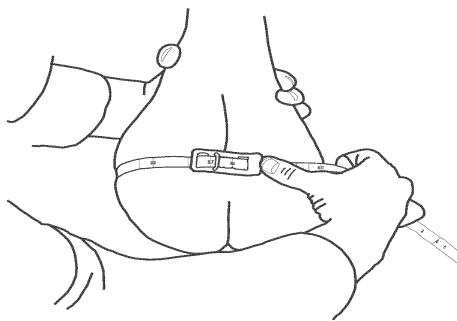


Figure 4. Proper method for measuring scrotal circumference

Management and Marketing Economics

Introduction

Beef cattle production in Alabama is primarily a system that produces feeder calves that will be shipped to feedlots for finishing.

Alabama's large cow-calf industry helps to provide calves that will produce either heavy weight feeders that will move directly to feedlots or lighter weight calves that will have weight added by utilizing forages (stockering) before moving to the feedlot.

While the majority of Alabama operations fall under the umbrella of conventional production, there are also producers who have successfully filled specialty or niche markets, such as seedstock producers, locally finished producers, and organic producers.

The long growing seasons, variety of forages, and abundant moisture in the state give producers an excellent opportunity to attain profitability by utilizing these competitive advantages.

Beef cattle production is a business, and just as in other businesses, proper planning, management, and evaluation are necessary to ensure sustainability. Successful beef cattle producers do the following:

1. Have a business plan in place with long- and short-term objectives
2. Use tools such as budgets to evaluate current and future business options
3. Use production and financial record keeping systems to monitor both physical and fiscal health of their operation

The following beef cattle management and marketing economic tables and figures are provided to help you make wise economic decisions.

Costs and Budgeting

Fixed or Variable Costs?

We often hear about fixed and variable costs, but what are they and why are they important to beef cattle producers?

Variable costs are what typically come to mind when a producer is asked to consider his or her costs. These are the costs that you will receive a bill for at

some point during the year and that are directly associated with production (cattle, forage, etc.). Variable costs change as the quantity of production changes. Fertilizer, seed, chemicals, medicines, and feed are all examples of variable costs. These costs will be incurred only if a producer undertakes production.

Fixed costs refer to the costs that will not change (at least in the short term) whether you produce or not. Examples of fixed costs would be land, equipment, taxes, and building/facilities. If you own land, you have an expense whether you farm it or not. Land payments, taxes, and opportunity costs (what you could be doing with the land or money you paid for the land if you weren't farming it) are all costs of owning land.

So, why is the concept of fixed cost important? There are a couple of reasons. First, if you still owe for the land, there are considerations that must be made to pay the long-term note. Second, there are opportunity costs associated with farming your own land.

Opportunity cost is an economic term that refers to the value you could be receiving for an asset if you weren't using it as you currently are. Could you be making more money from the land if you rented it out rather than farmed it yourself? These are costs that should be considered when making production decisions.

A third consideration with fixed costs is the depreciation associated with the asset. Depreciation refers to the fact that many of our fixed costs (facilities, equipment) have a useful lifespan, after which they become obsolete or are no longer functional. (You don't calculate depreciation on land—it doesn't have a definable usable lifespan) Factoring depreciation into your budget can help you plan for future investment (or reinvestment) in assets.

Many producers assume that if they make profit above variable costs they are sustainable or profitable in the long term, but if they don't account for their fixed costs in the evaluation process, they will find that is not the case. Producers must account for aging equipment, aging facilities, and the fact that there is an inherent value for assets that could be claimed if they were not using the assets to farm.

Table 1. Beef Enterprise Investment for 100 Cow Herd (Owned Real Estate)

| Item | Number | Units | Dollars/ Unit | Percent Charged | Total Dollars | Dollars/ Cow | Dollars/ Acre |
|--|--------|-------|------------------|--------------------|---------------------|-------------------|-------------------|
| Land | 200 | Acres | \$2,230.00 | 100 | \$446,000.00 | \$4,460.00 | \$2,230.00 |
| Well and pump | 1 | Each | \$7,320.00 | 100 | \$7,320.00 | \$73.20 | \$36.60 |
| Water trough pad (concrete) | 4 | Each | \$1,206.00 | 100 | \$4,824.00 | \$48.24 | \$24.12 |
| Water pipeline | 2,500 | Feet | \$1.60 | 100 | \$4,000.00 | \$40.00 | \$20.00 |
| Water troughs | 4 | Each | \$286 | 100 | \$1,144.00 | \$11.44 | \$5.72 |
| Cows | 100 | Head | \$500.00 | 100 | \$150,000.00 | \$1,500.00 | \$750.00 |
| Bulls | 3 | Head | \$4,500.00 | 100 | \$13,500.00 | \$135.00 | \$22.50 |
| Commodity barn | 1 | Each | \$7,500 | 100 | \$7,500.00 | \$75.00 | \$37.50 |
| Equipment barn | 1 | Each | \$5,199.00 | 100 | \$5,199.00 | \$51.99 | \$26.00 |
| Tractor and implements | 1 | Each | \$55,000.00 | 100 | \$55,000.00 | \$550.00 | \$275.00 |
| Pickup | 1 | Each | \$39,031.00 | 50 | \$19,515.50 | \$195.16 | \$97.58 |
| Fences | 4 | Miles | \$15,682.00 | 100 | \$62,728.00 | \$627.28 | \$313.64 |
| Corral | 1 | Each | \$20,400.00 | 100 | \$20,400.00 | \$204.00 | \$102.00 |
| Total Beef Enterprise Investment Cost | | | | | \$797,130.50 | \$7,971.31 | \$3,940.65 |

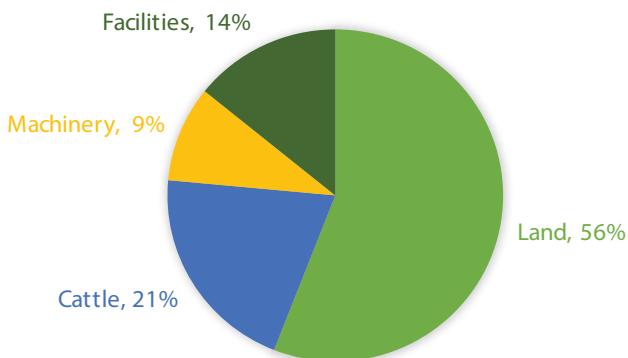


Figure 1. Beef enterprise investment cost

Table 2. 2017 Cow Calf Budget. (30 Brood Cows, 1 Bull, Grazing 60 Acres)

| Cow-Calf Enterprise Sensitivity Budget Weaning 625 lb versus 750 lb Calf | | |
|--|------------|------------|
| Returns Per Cow Per Year | 625 Weight | 750 Weight |
| Average calf weight, lbs/calf | 625 | 750 |
| Weaning percent | 85% | 85% |
| Total calf weight, lbs | 26,563 | 31,875 |
| Average calf weight, lbs/cow-unit | 531 | 638 |
| Average calf price, \$/lb | \$1.40 | \$1.30 |
| Total cull cow weight, lb | 7,700 | 7,700 |
| Average cull cow weight, lb/cow | 1,100 | 1,100 |
| Average cull cow weight, lb/cow-unit | 154 | 154 |
| Average cull cow price, \$/lb | \$0.65 | \$0.65 |
| Gross returns, total \$ | \$42,193 | \$46,443 |
| Average calf return, \$/cow-unit | \$743.75 | \$828.75 |
| Average cull cow return, \$/cow-unit | \$100.10 | \$100.10 |
| Gross returns, \$ per cow-unit | \$843.85 | \$928.85 |

Table 2. 2017 Cow Calf Budget. (30 Brood Cows, 1 Bull, Grazing 60 Acres) (cont.)

| Cost Per Cow Per Year | | |
|--|-------------------|-------------------|
| Variable Costs | 625 Weight | 750 Weight |
| Pasture | \$294.97 | \$294.97 |
| Purchased feed | \$109.96 | \$109.96 |
| Animal health | \$38.72 | \$38.72 |
| Management | \$12.00 | \$12.00 |
| Labor | \$37.50 | \$37.50 |
| Custom hire | \$9.60 | \$9.60 |
| Farm records | \$7.20 | \$7.20 |
| Professional fees | \$8.00 | \$8.00 |
| Utilities | \$7.30 | \$7.30 |
| Marketing fees | \$33.75 | \$37.15 |
| Supplies | \$0.00 | \$0.00 |
| Replacement heifer capital cost | \$150.00 | \$150.00 |
| Insurance and tax on breeding stock | \$0.00 | \$0.00 |
| Interest on operating costs | \$26.07 | \$26.16 |
| Fixed Costs | | |
| Machinery and equipment | \$97.10 | \$97.10 |
| Buildings/improvements/facilities-DIRT | \$26.25 | \$26.25 |
| Buildings/improvements/facilities-Interest | \$15.00 | \$15.00 |
| Annual bull cost depreciation | \$33.00 | \$33.00 |
| Interest on breeding stock capital | \$67.65 | \$67.65 |
| Total cost per cow per year | \$974.06 | \$977.56 |
| Returns Over Costs Per Cow Per Year | | |
| Returns over variable costs per cow per year | \$108.79 | \$190.29 |
| Returns over total costs per cow per year | -\$130.21 | -\$48.71 |
| Average Feeder Calf Price Needed Per Cwt. | | |
| To cover feed costs, \$/cwt. | \$76.22 | \$63.52 |
| To cover total costs, \$/cwt. | \$164.51 | \$137.64 |
| Asset turnover ratio (A/Investment) | 52% | 57% |
| Net return on investment | -1.3% | 3.7% |

Feed Costs

Pasture establishment and maintenance along with purchased feed costs are some of the largest costs for cattle producers, often ranging from 40 to 60% of total per-cow costs. Managed forage production can cut down on purchased feed costs; though pasture maintenance is costly, producers must evaluate the costs and benefits of various practices.

For pasture-based operations in Alabama, a lack of adequate rainfall can be very costly. Producers may have to purchase more feed than anticipated and could lose investments they have made in pasture establishment or maintenance. The USDA Risk Management Agency offers an insurance product that helps insure cattle producers against low rainfall. For more information, see the Rainfall Index Insurance for Pasture, Rangeland, and Forage at

www.rma.usda.gov/policies/pasturerangeforage.

Table 3. Estimated Establishment Costs Per Acre Fescue
for Grazing (Novel Endophyte)

| Item | Unit | Quantity | Price or Cost/Unit | Total/Acre |
|--|--------|----------|--------------------|---------------|
| Variable Costs | | | | |
| Soil test | Acre | 1.00 | 1.00 | 1.00 |
| Seed | Lb | 20.00 | 1.79 | 35.80 |
| Fertilizer | | | | |
| Nitrogen | Lb | 80.00 | 0.45 | 36.00 |
| Phosphate | Lb | 50.00 | 0.40 | 20.00 |
| Potash | Lb | 50.00 | 0.30 | 15.00 |
| Lime | Tons | 1.00 | 35.00 | 35.00 |
| Herbicide* | Acre | 2.00 | 6.00 | 12.00 |
| Labor (wages and fringe) | Hour | 6.09 | 12.50 | 77.34 |
| Land rent | Acre | 1.00 | 22.00 | 22.00 |
| Tractors and equipment | Acre | 1.00 | 15.86 | 15.86 |
| Interest on op. cap. | Dollar | 135.00 | 0.06 | 7.43 |
| Total variable cost | | | | 277.43 |
| Fixed Cost | | | | |
| Tractor and equipment | Acre | 1.00 | 13.05 | 13.05 |
| General overhead | Dollar | 277.43 | 0.07 | 19.42 |
| Total Fixed Cost | | | | 32.47 |
| Total Costs of All Specified Expenses | | | | 309.90 |

Following Best Management Practices, Alabama 2017-2018

These estimates should be used as guides for planning purposes only.

Fertilizer rates used (80-50-50) based on medium level of soil fertility.

*NOTE: The conversion of an existing toxic endophyte tall fescue pasture to a novel endophyte (nontoxic, friendly) tall fescue pasture will require 2 broadcast applications of a nonselective herbicide to kill the existing fescue and other plants present and/or the addition of a summer annual cover crop to smother the existing stand (either spray-spray-plant or spray-smother-spray-plant techniques are both acceptable methods to eliminate existing stands). The production of seed by toxic endophyte plants should be prevented during the season prior to planting a novel-endophyte stand in the fall. The dry matter yield of any newly established tall fescue stand will be significantly less during the establishment year.

Table 4. Estimated Annual Costs Per Acre Fescue for Grazing

| Item | Unit | Quantity | Price or Cost/Unit | Total Per Acre |
|--|--------|----------|--------------------|----------------|
| Variable Costs | | | | |
| Soil test | Acre | 1.00 | 0.33 | 0.33 |
| Fertilizer | | | | |
| Nitrogen | Lb | 120.00 | 0.45 | 54.00 |
| Phosphate | Lb | 50.00 | 0.40 | 20.00 |
| Potash | Lb | 50.00 | 0.30 | 15.00 |
| Lime (prorated) | Tons | 0.33 | 35.00 | 11.55 |
| Herbicide | Acre | 0.33 | 9.00 | 2.97 |
| Labor (wages and fringe) | Hour | 2.47 | 12.50 | 30.93 |
| Land Rent | Acre | 1.00 | 3.50 | 3.50 |
| Tractors and Equipment | Acre | 1.00 | 35.0 | 3.50 |
| Interest on Op. Cap. | Dollar | 80.14 | 0.06 | 4.41 |
| Total Variable Cost | | | | 164.69 |
| Fixed Costs | | | | |
| Tractor and equipment | Acre | 1.00 | 2.19 | 2.19 |
| Prorated established costs | Dollar | 309.90 | 0.10 | 30.99 |
| General overhead | Dollar | 164.69 | 0.07 | 11.53 |
| Total Fixed Costs | | | | 44.71 |
| Total Costs of All Specified Expenses | | | | 209.40 |

Following recommended best management practices, Alabama 2017-2018

Fertilizer rates used (120-to-50) based on medium level of soil

Fertility (nitrogen applied in split applications, 60# fall and 60# spring)

These estimates should be used as guides for planning purposes only.

Marketing

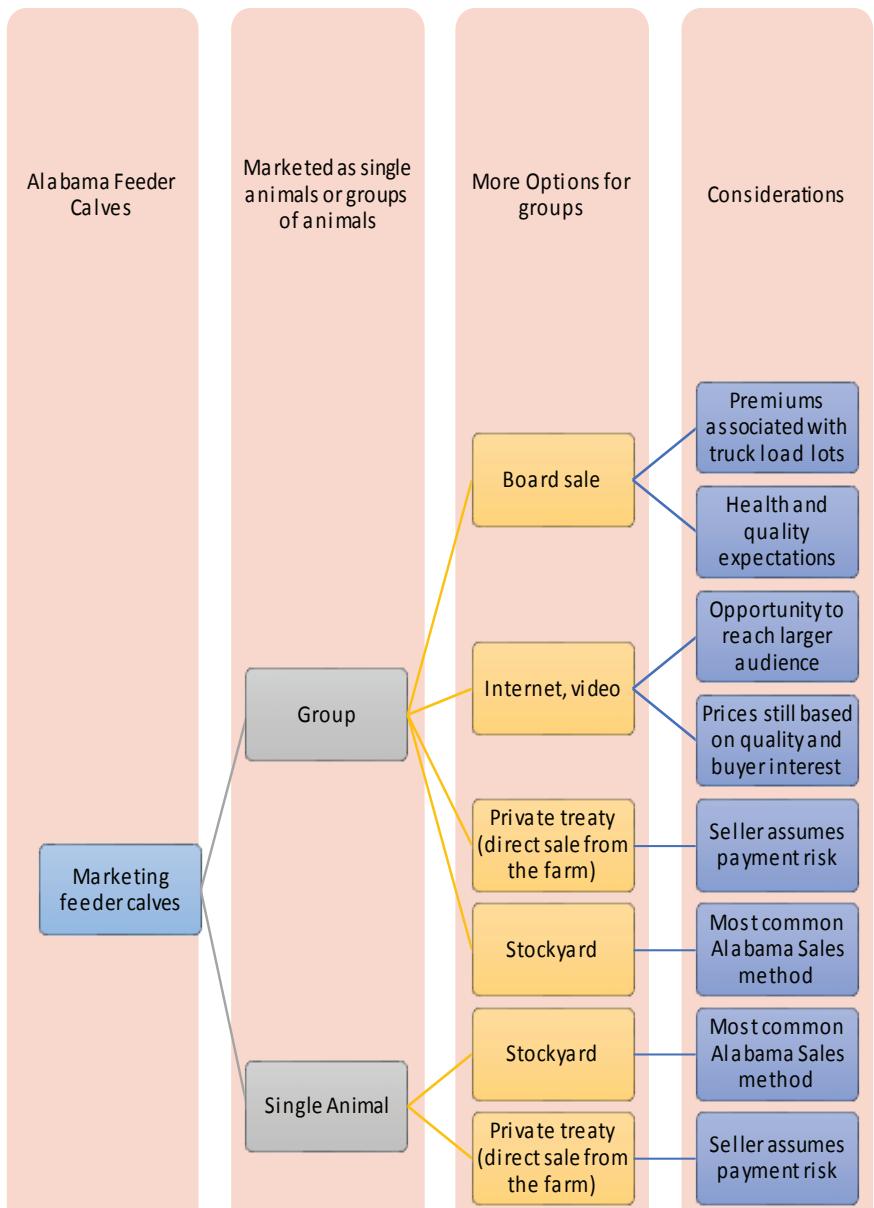


Figure 2. Marketing avenues for Alabama feeder calves

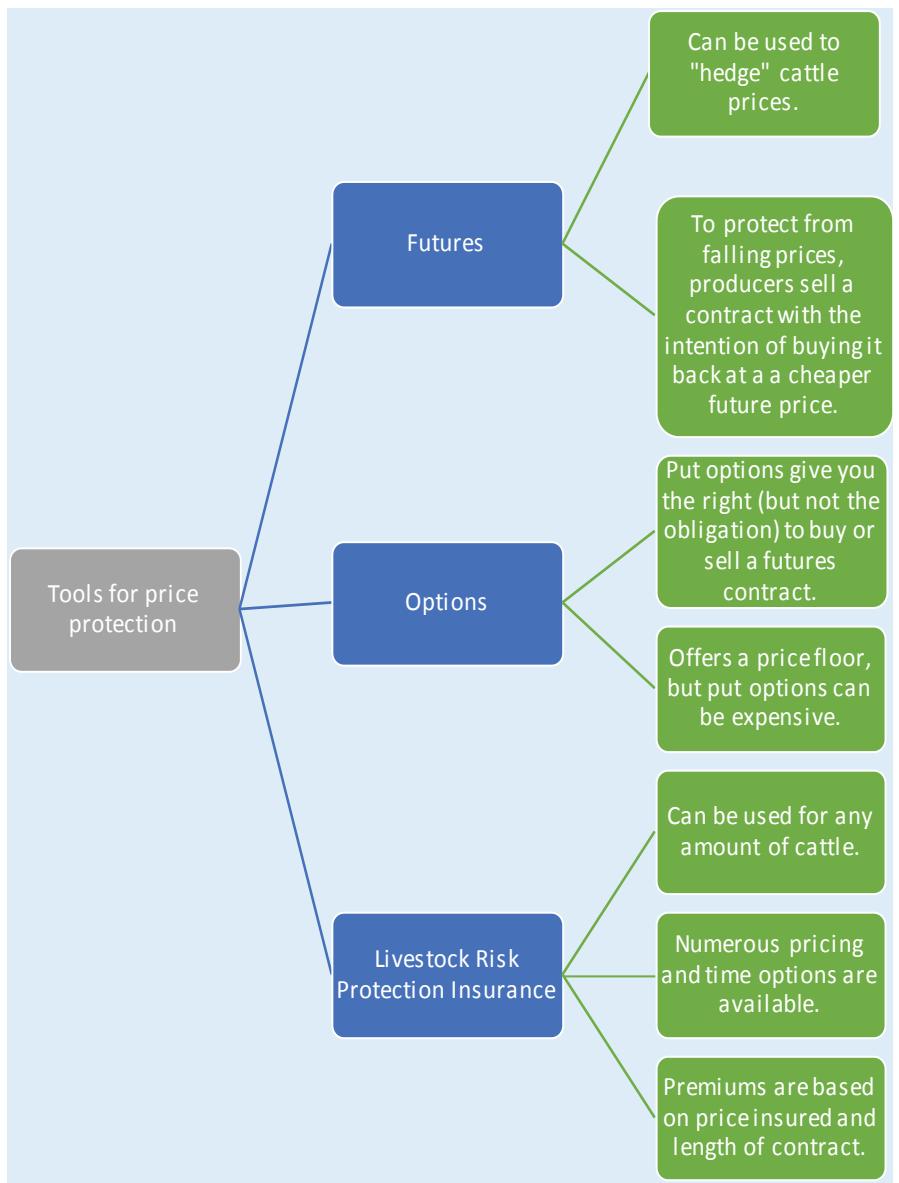


Figure 3. Tools for cattle market price protection

Marketing Terminology

Futures Contracts

A **futures contract** is an agreement to buy or sell a commodity at a certain time in the future at a certain price. Futures contract quality and sizes are standardized for convenience and transparency.

For example, a feeder cattle futures contract traded on the Chicago Mercantile Exchange is 50,000 pounds of cattle based on a sample of steers of specific weight and grades.

A percentage of the value of the futures contracts must be deposited and maintained in a **margin account** when trading futures. Margin accounts can be prohibitive for small producers.

Options Contracts

Options contracts give you the right, but not the obligation, to buy or sell a commodity by a certain date for a certain price. There are two types of options contracts.

A **put option** gives the holder a right to sell at a certain price, while a **call option** gives the holder a right to buy at a certain price. The price in the options contract is known as the **strike price**.

The right to buy or sell comes at a cost, so an up-front price must be paid for an option, known as the **option premium**. Options contracts are also standardized in the same way as **futures contracts**.

Options contracts can be used to set a minimum selling price for the commodity you are producing or a maximum buying price for an input to commodity production that you must purchase.

Hedging

A **hedge** is a strategy that involves having a commodity position (producing or buying) and taking a futures position to reduce price risk. There are two basic types of hedges.

A **short hedge** is appropriate when a producer owns a commodity that will be sold at a later date, while a **long hedge** is appropriate when a producer will buy a commodity at a later date.

Short hedges are what most cattle producers in Alabama would use, so an example of a short hedge follows.

Short Hedge Example:

In January, cattle producer John knows that he will have feeder cattle ready for market in April, and he is concerned about what the cash price will be at that time.

On January 15, John sells one Feeder Cattle Futures Contract for delivery in April at \$145/cwt.

On April 15, John sells his feeder cattle on the cash market for \$125/cwt. Also on April 15, John buys an April Feeder Cattle Futures Contract at \$135/cwt to cancel out his futures position.

John's Futures Market Profit = Price Sold-Price Bought

- $\$145/\text{cwt} - \$135/\text{cwt} = \$10/\text{cwt}$

John's Feeder Cattle Price After Hedge = Cash Price+Futures Profit

- $\$125/\text{cwt} + \$10/\text{cwt} = \$135/\text{cwt}$

Note: If the market had moved in the opposite direction with rising prices, John's futures profit would have been negative, so his ending cash price would have been lower than the actual cash price he received. Short hedges set a minimum price when markets take a downturn, but limit gains when markets are favorable.

Interpreting Cattle Market Reports

Market reports contain valuable information for Alabama cattle producers. But to use this information, it is essential to know how to interpret prices based on the different classifications of cattle. Below are the basics of market reporting for cull cows and bulls and feeder cattle.

Cull Cows

Cull cows, also called slaughter cows, are graded on the approximate dressing percent and body condition score (BCS). See page 37 for BCS explanation.

High dressing designation leads to more available products to sell and results in a higher price per pound than the low dressing designation.

Table 5 shows the marketing class specifications for cull cows.

Cull Bulls

Cull bulls are graded similarly to beef cows based on the estimated amount of retail cuts that can be made from the carcass, otherwise known as yield grading.

Yield grades range from 1 to 5 with 1 having the highest amount of salable beef. See page 117 for more on yield grades.

Feeder Cattle

Feeder cattle are classified into 12 grades based on frame size (small, medium, and large) (see page 111) and muscle thickness from thickest to thinnest No. 1. No. 2, No. 3, and No. 4 (see page 117).

These combinations of frame size and muscle thickness provide buyers with expectations regarding how the cattle will translate in yield and quality grades for carcasses and ultimately how they will affect the prices feeder producers receive.

Table 5. Approximate Associations Between Cull Cow Marketing Classification, Carcass Quality Grade, and Cow Body Condition Score for Young Cows

| Marketing Class | Red Meat Yield | Dressing Percentage | Approximate Carcass Quality Grade* | Body Condition Score |
|-----------------|----------------|---------------------|------------------------------------|----------------------|
| Breaker | 75–80% | High | Commercial | 8–9 |
| | | Average | Commercial | 8 |
| | | Low | Commercial/Utility | 7–8 |
| Boner | 80–85% | High | Utility | 6–7 |
| | | Average | Utility | 6 |
| | | Low | Utility | 5.5–6 |
| Lean | 85–90% | High | Utility/Cutter | 4.5–5.5 |
| | | Average | Cutter | 4–4.5 |
| | | Low | Cutter | 3–4 |
| Light | 75–90% | High | Cutter | 2–3 |
| | | Average | Cutter/Canner | 2 |
| | | Low | Canner | 1–2 |

* Quality grade depends on maturity. Grades presented in the table are approximately correct for young cows and would likely be lower for old cows.

Source: Peel, Darrell S., and Damona G. Doye. *Cull Cow Grazing and Marketing Opportunities*. Division of Agricultural Sciences and Natural Resources, Oklahoma State University, 2008.

References for Cattle Marketing Options

- Alabama Livestock Markets: www.aces.edu/agriculture/livestock-poultry/beef/organizations.php
- Livestock Risk Protection Insurance Program: www.rma.usda.gov/livestock/
- Livestock Futures and Options Contract Quotes: www.cmegroup.com/trading/agricultural/#livestock
- Cattle Market Reports: www.ams.usda.gov/market-news/livestock-poultry-grain#Cattle

Cattle Cycle

The cattle cycle refers to price fluctuations that happen within the domestic (and international) cattle markets.

Cattle cycles are influenced by a number of factors, with supply and demand being the primary drivers.

Other factors affecting cattle cycles include natural disasters, trade issues, animal health issues, and perceived food safety issues.

Alabama Feeder Steer Prices 500-600 lb. #1 Feeder Steers 2008-2017

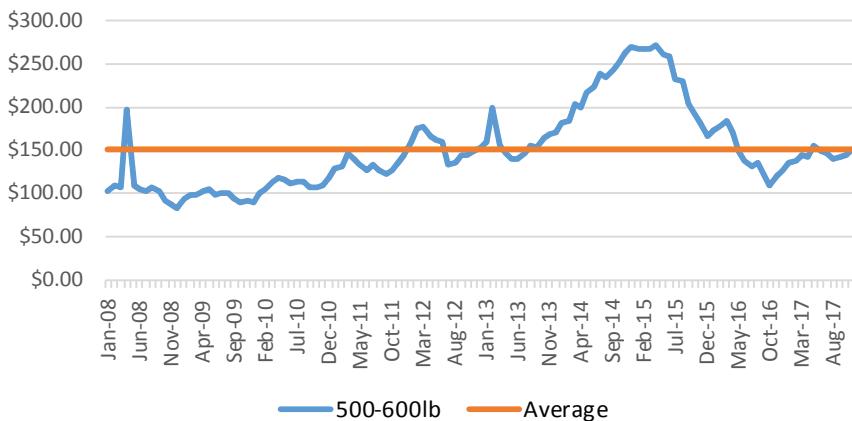


Figure 4. Alabama cattle cycle 2008–2017

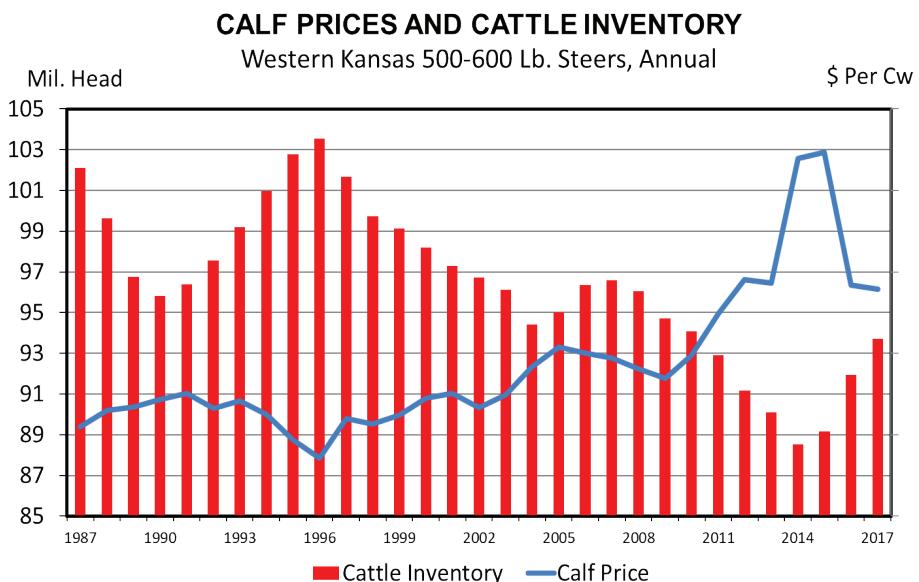


Figure 5. Calf prices in comparison to cattle inventory 1987–2017

Price Seasonality

Price seasonality refers to the fluctuations that happen yearly in feeder cattle markets. Price seasonality, like the cattle cycle, is greatly influenced by supply and demand.

Feeder cattle supplies are often highest in the fall (due to both calving season decisions and the natural grouping of calves due to environmental conditions).

Prices in Alabama tend to increase from December until March as feeders are needed in the feedlots and stocker operations to meet the demand from summer grilling season. Prices then tend to decrease from May until October as the demand for stockers and feeders diminishes seasonally.

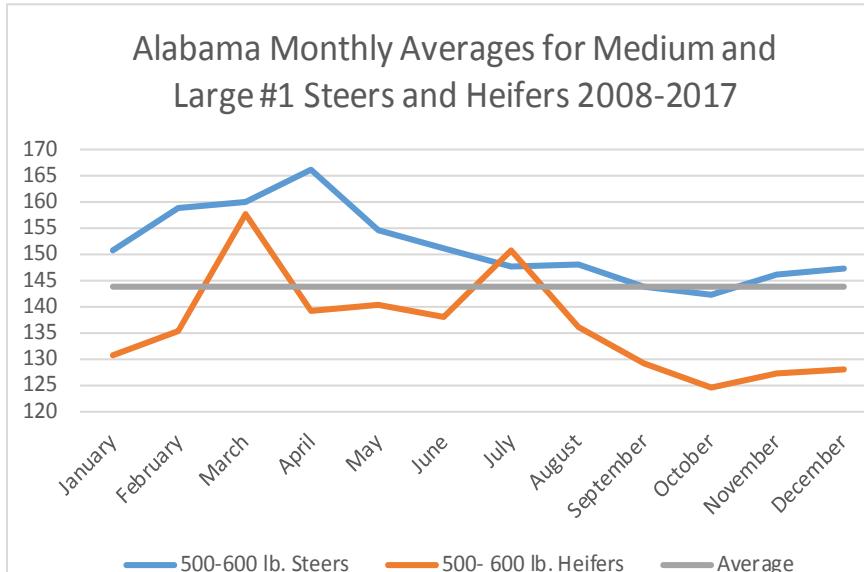


Figure 6. Alabama feeder price seasonality (10-year average 2008–2017)

Meat Yield, Quality, and Value

Freezer Beef Requirements

Many producers may consider growing and harvesting home-raised calves for beef. The following provides some guidelines on potential diets, animal gain goals, and adaptation of calves to finishing diets for beef.

Grower Diets: Goals and Guidelines

Calf is weaned at 7 to 9 months of age (550 pounds).

Goal: Average daily gain of 2.0 to 2.25 pounds per day until 800 pounds

Diet composition: Commonly 60 percent grain/concentrate and 40 percent roughage

Feeding Guidelines: 1.5 percent of body weight per day of an 85 percent cracked or rolled corn and 15 percent cottonseed meal mix

Moderate to high-quality long-stem hay fed free choice

OR

2.5 percent of body weight per day of 50:50 soyhulls/corn gluten feed mix

Moderate to high-quality long-stem hay fed free choice

To start calves on this mixture, gradually increase the amount of concentrate mixture being fed by 1 to 2 pounds every 2 to 3 days until on full-feed. Feed two times per day. Make sure calves clean up feeding troughs before providing additional grain/concentrate mix.

Finishing Diets: Goals and Guidelines

Goal: Average daily gain of > 3.0 pounds per day until 1,100 pounds

Diet composition: Commonly 80 percent grain/concentrate and 20 percent roughage

Feeding Guidelines: 2.0 to 2.25 percent of body weight per day of cracked or rolled corn (may consider adding 5 to 10% cottonseed hulls to improve texture and palatability)

At least 0.5% of body weight per day as moderate- to good-quality long-stemmed hay

Increase amount of grain in diet by 3 to 4 pounds every 3 days until on full feed. Providing long-stem roughage during this period is critical for proper digestive system function and animal health.

Requirements Prior to Slaughter

- Documentation of age
 - Research has shown that animals older than 30 months of age at harvest are at risk of carrying bovine spongiform encephalopathy (BSE). As a result, packing plants must remove all specified risk material such as spinal column, brain, and nerve ganglia of undocumented cattle and cattle older than 30 months. Large packers have a qualified person to age animals by oral dentition. Small packers require only a signed affidavit stating that the producer knows the animals are younger than 30 months of age.
- Withdrawal times for medications
 - Most packing plants require a signed affidavit stating that all withdrawal times have been followed and no residuals should be present since label directions were followed.
- Management and nutritional requirements to ensure meat quality
 - Withdraw feed (but not water) 12 to 24 hours before harvest. Minimizing gut fill reduces the chances of gut rupture during dressing and of contamination to the carcass.
 - Minimize stress on the animal during transport and handling. Longer term stress from excessive transport can cause cattle to use energy stores in the muscle, resulting in a condition called “dark cutter,” which causes a large price discount to the carcass.
 - Document feed and feed additives. Documentations of everything included in an animal’s diet is essential for proper tracing to contamination sources.

Dressing and Dressing Percentages

Dressing is the process of removing the hide, head, feet, and internal organs during harvest (slaughter). What is left is the carcass, which contains the bones, muscle, meat, and fat. The first measure of yield is calculated as a dressing percentage:

$$\text{Dressing percentage} = (\text{hot carcass weight} \div \text{live weight}) \times 100$$

Hot carcass weight (HCW) is the weight of the carcass after removal of the items listed above. Live weight is the weight of the animal just prior to harvest. The more weight on the carcass, the higher the dressing percentage. Table 1 provides estimates of dressing percentages.

Table 1. Estimates of Dressing Percentages

| Animal | Factor | Typical Dressing Percentage |
|--|---------------------------|-----------------------------|
| Cull cow | Low amount of muscle/fat | 47 to 50 |
| Grass-fed/short-fed | Low amount of fat | 58 to 62 |
| Typical YG3 feedlot steer | Mostly fat | 62 to 64 |
| Overly fat (YG percent)/double muscled | High amount of muscle/fat | 63 to 67 |
| Bulls | High muscle | 65 to 69 |

Grading Beef Carcasses

Finished cattle are often purchased by the processor based on certain carcass qualities. For example, processors will pay premiums for carcasses that have desirable characteristics such as marbling and tenderness and those that will generate more pounds of salable product. As such, carcasses are graded in two ways: quality grading and yield grading.

Quality Grading

The goal of quality grading is to identify carcasses that will produce beef cuts with a better eating experience. For beef this means more tenderness. Two of the major factors that affect tenderness are age of the animal and intramuscular fat, or marbling. As such, these are the two factors used to assign a quality grade to a beef carcass.

There are four quality grades assigned to finished cattle: standard, select, choice, and prime. To qualify for these grades, cattle must be under 42 months of age. Cull breeding stock and other animals that are more than 42 months can also be graded into a different set of grades, but they typically are not.

The reason cattle must be young to qualify for the four quality grades is that meat becomes less tender as animals age. During the aging process, muscles begin to create more and more connective tissue between the muscle fibers. These cross bridges make the meat more difficult to chew. This even affects young cattle. Cattle in the A maturity group (9 to 30 months of age) can have less marbling to reach the same quality grade as cattle in the B maturity group (30 to 42 months of age).

The other half of quality grading is marbling. Marbling scores are determined by looking at the face of the ribeye where it is exposed after the carcass is ribbed between the 12th and 13th ribs. USDA graders compare the marbling present at that surface to marbling standards and assign a marbling score. These scores range from "practically devoid of marbling" to "abundant marbling." Once a marbling score and an age are determined, the USDA grader uses a quality grading chart to assign a grade (figure 1).

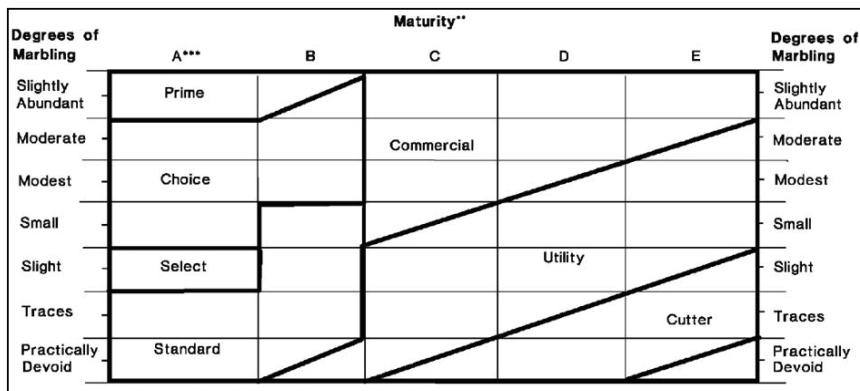


Figure 1. USDA quality grading chart

*Assumes that firmness of lean is comparably developed with the degrees of marbling.

**Maturity increase from left to right in the chart (A to E).

***The A maturity portion is the only section applicable to bullock carcasses.

Yield Grading

Unlike quality grading, which determines eating quality, USDA yield grading measures the quantity of meat that we can expect to get from a carcass. It is expressed as the yield of boneless, closely trimmed retail cuts (BCTRC) from the round, loin, rib, and chuck. Yield grading is calculated as follows:

$$2.5 + (0.0038 \times \text{HCW}) + (2.5 \times \text{fat}) + (0.2 \times \text{percent KPH}) - (0.32 \times \text{rib eye area})$$

HCW = hot carcass weight

Fat = subcutaneous fat measured opposite the ribeye at the 12th rib

KPH = kidney, pelvic, and heart fat as a percentage of the HCW

Ribeye area = the area of the longissimus muscle at the 12th rib in square inches

The result of the above equation is expressed as a number rounded to the nearest tenth and is expressed on a scale of 1 to 5.

Relative Yield and Value of Meats

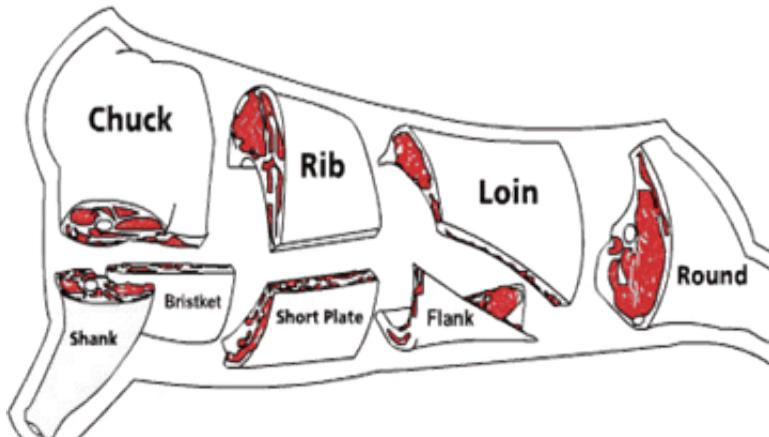


Figure 2. Relative yield of various cuts

| Subprimals | Percentage of the Carcass by Weight ¹ | Percentage of the Carcass by Value ² |
|-----------------------------------|--|---|
| Chuck | 29 | 26 |
| Rib | 9 | 16 |
| Loin | 16 | 23 |
| Round | 22 | 19 |
| Shank, brisket, plate, and flank | 19 | 16 |
| Miscellaneous (kidney, fat, etc.) | 5 | 0 |

¹Based on a 1,300 lb Choice, Yield Grade 3 Steer

²Based on Choice cutout values from USDA-AMS

Environmental Stewardship

Environmental Stewardship in Beef Cattle Production

Beef cattle ranks second after poultry in cash receipts in Alabama. According to the Alabama Agriculture Statistics Service, there are 1.3 million heads of cattle and calves on Alabama farms in 2018. With improved genetics, better nutrition, and management, the carcass weights have increased from 550 pounds to more than 825 pounds per head. This is an important achievement and a matter of pride for the beef producers who are contributing to the food production systems and helping to feed a growing global population. Protecting the environment and conserving natural resources, however, are also of high importance to cattle producers.

Because of increasing pressure on our natural resources, such as water, land, and air, it is increasingly important to protect them and prevent them from degradation.

For example, when soil nutrients, such as nitrogen and phosphorus, leave the farm via runoff or leaching and enter into the creek or underground water systems, they stimulate algae blooms (figure 1). These algal blooms create a barrier preventing the sunshine from reaching aquatic life under the surface of the water leading to a condition known as eutrophication.

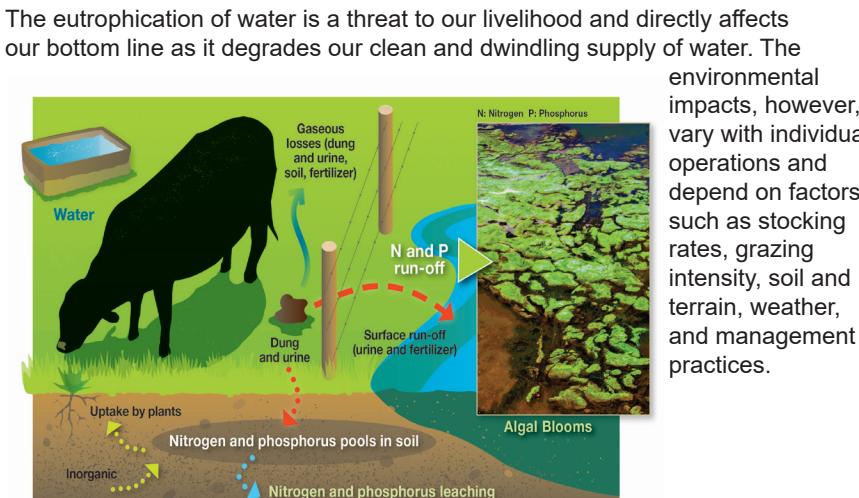


Figure 1. Nitrogen and phosphorus runoff into the water systems triggers algal bloom.

To learn more about Alabama environmental laws and regulations related to manure application, visit www.adem.state.al.us/programs/water/waterforms/CAFORule12-1-00.pdf.

To become a better steward of the environment, cattle men and women should consider these stewardship practices:

1. If you store manure, store and manage in a way that effectively prevents contamination of waterways (creeks, rivers, or streams) on your farm (figure 2). For example, keep manure in a covered area and protect it from washing during rainfall events. If manure continuously enters the waterways, they become a point source discharge and could be scrutinized by regulatory agencies. Store litter on surface that will prevent leaching of nutrients into groundwater.
2. Do not allow animals to have a direct access to waterways. Fencing keeps cattle away from the waterways (figure 3). This is especially important to prevent fecal or urine contamination into the waterways. Install self-watering systems or an alternative water supply, which can prevent direct access to waterways.
3. Maintain a grassed waterway to control effluents running into waterways (figure 3).



Figure 2. Manure storage in covered system.



Figure 3. Fencing prevents animals from having direct access to waterways and prevents fecal or urine contamination into the waterways.

4. Animal heavy-use areas such as hay rings, shade, or watering areas do not maintain dense vegetation and often accumulate manure. If manure is not removed routinely from these areas, it

can emit dust and odor and attract flies and other disease-carrying vectors (figure 4). Clean the accumulated manure routinely to avoid public opinions and environmental concerns.

5. Rotation-based grazing systems prevent overgrazing and allow adequate grass cover. This is important because it prevents runoff to surface water (figure 5).



Figure 4. Animal heavy-use areas tend to accumulate manure and attract flies and other disease-carrying vectors.

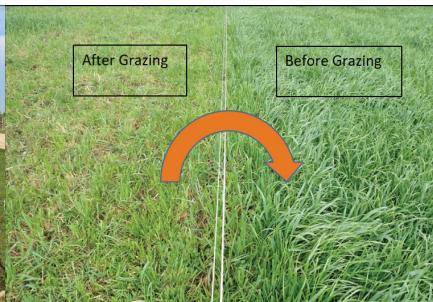


Figure 5. Rotation-based grazing systems prevent overgrazing and allow grass regrowth.



Figure 6. The first step in planning manure application is soil sampling and testing.

6. Send soil and manure/chicken litter for testing to a state-certified laboratory on a regular basis, and use the reports for planning manure application on pasture lands (**Figure 6**).
7. Overapplication of manure can result in phosphorus accumulation in the soil. Once the phosphorus-holding capacity of soil is exhausted,

additional manure application can result in phosphorus movement to creeks and waterways via erosion and runoff, polluting the water bodies. That's why it is also important to monitor the amount of manure applied to each field.

8. The manure applications should be catered to fit the crop or pasture needs against the soil tests for nitrogen, phosphorus, and potassium. Excess nutrients can leach into groundwater, especially if the soils at the farm are sandy and the depth of groundwater is shallow.
9. It is always a good idea to maintain records of manure application rates, crop yield (if any), manure transfer, and the manure storage facility. This information is helpful in planning manure applications.
10. Develop an emergency plan for cattle in case of flash flood or extreme rainfall events.
11. Manure application setbacks: identify environmentally sensitive areas. Look at the application setbacks for animal feeding operations in table 1. Do not apply manure within 200 feet of an active private

Table 1. Manure Application Setbacks

| | Setbacks for Land Application for Animal Feeding Operation |
|---|---|
| Property line | Cannot cross property line |
| Public use area or nonowner existing occupied dwelling, church, school, hospital, or park | 100 feet for dry waste 200 feet for liquid waste 500 feet for spray |
| Water or sinkholes | 200 feet public supply water 200 feet outstanding water |
| Well | 100 feet nonpotable well or water supply 200 feet potable well or water supply |
| Road | Cannot be applied in road |

or public water supply or outstanding national resource water. Similarly, do not apply manure within the channel of a nonvegetated concentrated water flow area such as a swale, gully, or ditch.

12. Testing well water or cattle drinking water sources: test your farm's water for the presence of pathogenic bacteria (total coliform bacteria) and nitrate. Collect water from the pump or water storage area in clean plastic bottles and keep it cool until you return the bottle to the closest certified laboratory. Call ahead to the lab and notify them. Sometimes the lab will send you collection bottles for coliform bacteria and nitrates. If the water tests positive, discontinue using the water and work on a corrective action. After following a disinfection procedure, retest the water treatment to ensure that water returns to safe levels.

13. Matching forage production with nutrient removal rates: good pasture management is considered good environmental management since a good stand of forages prevents erosion and nutrient runoff. Applying fertilizer as recommended by a soil test report or crop removal rate will help maintain a quality pasture and eliminate overapplication of fertilizer. To calculate the plant nutrient removal rate, multiply the dry matter yield with percent nutrient contained in the crop. See table 2 for typical nutrient removal rates.

Table 2. Nutrient Removal Rates of Major Forage or Silage Crops

| | Yield (lb or tons per acre) | Nutrient Percent | Total Removal by Crop (lb/acre) |
|-------------|------------------------------------|----------------------------------|---|
| Alfalfa | 4 (tons/acre) | N = 2.25 P = 0.22 K = 1.87 | 180 N 40 P ₂ O ₅ 180 K ₂ O |
| Corn silage | 200 (bu/acre) | N = 1.61 P = 0.28 K = 0.40 | 180 N 72 P ₂ O ₅ 54 K ₂ O |
| Bahiagrass | 3 (tons/acre) | N = 1.27 P = 0.13 K = 1.73 | 76 N 18 P ₂ O ₅ 125 K ₂ O |
| Tall fescue | 3.5 (tons/acre) | N = 1.97 P = 0.20 K = 2.0 | 138 N 32 P ₂ O ₅ 168 K ₂ O |
| Ryegrass | 5 (tons/acre) | N = 1.67 P = 0.27 K = 1.42 | 167 N 62 P ₂ O ₅ 170 K ₂ O |
| Red clover | 2.5 (tons/acre) | N = 2.0 P = 0.22 K = 1.66 | 100 N 25 P ₂ O ₅ 100 K ₂ O |

Appendices

Appendix A. Alabama Beef Cattle Website Resources

Alabama Beef Cattle Improvement Association

- www.albcia.org
- Contact: Michelle Elmore, Coordinator
- Phone: (205) 646-0115

Alabama Cooperative Extension System

- www.aces.edu
- Animal Science and Forage Extension Team—Regional Agent Directory
- www.aces.edu/directory

Alabama Beef Systems Extension Program

- www.alabamabeefsystems.com
- Contact: Kim Mullenix, Ph.D.
- Phone: (334) 844-1546

Alabama Beef Quality Assurance Program

- Contact: Soren Rodning, DVM, Extension Veterinarian
- Phone: (334) 844-1521

Alabama Forage Focus Extension Program

- www.alabamaforages.com
- Contact: Leanne Dillard, Ph.D.
- Phone: (334) 844-7514

Alabama Department of Agriculture and Industries

- www.agi.alabama.gov/
- Resources:
 - Livestock Market News
 - Livestock Theft Division
 - State Veterinarian
 - Alabama Hay Directory

- www.agi.alabama.gov/s/haylist
- Alabama State Veterinary Diagnostic Laboratories
- Thompson-Bishop-Sparks State Diagnostic Laboratory—Auburn.
Phone: (334) 884-4987
- J. B. Taylor Veterinary Diagnostic Laboratory—Elba.
Phone: (334) 897-6340
- Hinton Michem Poultry Diagnostic Laboratory—Hanceville.
Phone: (256) 352-8036
- Michem-Sparks State Diagnostic Laboratory—Boaz.
Phone: (256) 593-2995

Alabama Cattlemen's Association

- www.bamabeef.org
- Phone: (334) 265-1867

Alabama Farmer's Federation

- www.alfafarmers.org
- Phone: (334) 288-3900

USDA Natural Resources Conservation Service—Alabama

- www.nrcs.usda.gov/wps/portal/nrcs/site/al/home/
- Phone: (334) 887-4500

USDA Farm Service Agency—Alabama

- www.fsa.usda.gov/state-offices/Alabama/index
- Phone: (334) 279-3500

Alabama Department of Agriculture Veterinary Diagnostic Laboratories

- Auburn (334) 844-4987
- Boaz (256) 593-2995
- Elba (334) 897-6340
- Hanceville (256) 352-8036

Appendix B. Comparison of Common Fences

| Types | Strands | Wire Gauge | Height (inches) | Stay Spacing (inches) | Fence Life (years) ¹ | Upkeep |
|---------------------------------|---------|------------|-----------------|-----------------------|---------------------------------|--------|
| Permanent Materials | | | | | | |
| Barbed wire, 2-point | 3 | 12½ | | 4 | 33 | high |
| | 4 | 12½ | | 4 | 33 | high |
| | 5 | 12½ | | 4 | 33 | high |
| | 3 | 14 | | 4 | 18 | high |
| Barbed wire, 4-point | 3 | 12½ | | 5 | 33 | high |
| | 4 | 12½ | | 5 | 33 | high |
| | 5 | 12½ | | 5 | 33 | high |
| Woven wire, light weight | Top | 11 | 26 | 6 | 19 | high |
| | Bottom | | | | | |
| | Filler | 14½ | 32 | 6 | 19 | high |
| Woven wire, medium weight | Top | 10 | 26 | 6 | 30 | medium |
| | Bottom | | | | | |
| | Filler | 12½ | 32 | 6 | 30 | medium |
| | Filler | 12½ | 39 | 6 | 30 | medium |
| | Filler | 12½ | 47 | 6 | 30 | medium |
| Woven wire, heavy weight | Top | 9 | 26 | 6 | 40 | low |
| | Bottom | | | | | |
| | Filler | 11 | 32 | 6 | 40 | low |
| | Filler | 11 | 39 | 6 | 40 | low |
| | Filler | 11 | 47 | 6 | 40 | low |
| High tensile wire | 3 | 12½ | | | 30 | medium |
| | 4 | 12½ | | | 30 | medium |
| | 5 | 12½ | | | 30 | medium |
| | 8 | 12½ | | | 30 | medium |
| Temporary Materials | | | | | | |
| High tensile wire | 2 | 12½ | | | 30 | medium |
| | 1 | 12½ | | | 30 | medium |
| Polywire/tape | | | | | 7 to 10 | medium |
| Aluminum wire | 9 | | | | 30 | medium |
| | 13 | | | | 30 | medium |

Source: Adapted from Buschermohle et al., EP-10-95 (University of Tennessee, Extension).

¹Fence life based on combination of post and wire life expectancy in humid climates.

Appendix C. Fence Post Characteristics

| Post Type | Bending Strength | Expected Life (years) | Initial Cost | Fire Resistance | Maintenance |
|-------------------------------|------------------|-----------------------|--------------|-----------------|-------------|
| Steel-T, concrete | Fair | 25 to 30 | Medium | Good | Low |
| Steel rod, 3/8" diameter | Poor | 15 to 20 | Low | Good | Medium |
| Fiberglass rod, 1" or greater | Fair (flexible) | 25 to 30 | High | Poor | Low |
| Fiberglass rod, 7/8" or less | Fair (flexible) | 25 to 30 | Medium | Poor | Low |
| Plastic, step in | Fair (flexible) | 7 to 10 | Low | Poor | Medium |
| Pressure-treated wood | Good | 30 to 35 | High | Poor | Very low |
| Untreated wood | Good | 7 to 15 | Medium | Poor | High |

Source: Adapted from Buschermohle et al., EP-10-95 (University of Tennessee, Extension).

Appendix D. Life Expectancy of Wood Posts

| Kind | Untreated | Treated (Pressure) | Treated (Soak) |
|---------------|-----------|--------------------|----------------|
| White oak | 5 to 10 | 20 to 30 | 15 to 30 |
| Hickory | 2 to 6 | 15 to 20 | 10 to 15 |
| Red oak | 2 to 6 | 20 to 30 | 20 to 30 |
| Yellow poplar | 2 to 6 | 20 to 25 | 15 to 25 |
| Sweet gum | 3 to 6 | 20 to 30 | 20 to 30 |
| Southern pine | 3 to 7 | 25 to 30 | 15 to 20 |

Source: Adapted from Buschermohle et al., EP-10-95 (University of Tennessee, Extension).

Appendix E. Recommended Post Spacings

| Fence | Spacing (Feet) |
|--------------------------------|----------------|
| Woven wire | 12 to 14 |
| Barbed wire | 12 to 14 |
| Electric | 20 to 75 |
| High tensile wire ¹ | 16 to 60 |
| Board | 8 |

Source: Adapted from Buschermohle et al., EP-10-95 (University of Tennessee, Extension).

¹Depending on terrain, use battens (stays). Can be single-strand, woven wire, and/or electric.

Appendix F. Suggested Wire Spacing for Permanent or Temporary Fences

| Cattle Type | Distance from Ground (for Wire Number) | | | | |
|---------------------|--|-----------|-----------|-----------|-----------|
| | No. 1 | No. 2 | No. 3 | No. 4 | No. 5 |
| Cows | 30 inches | | | | |
| Cows and Calves | 17 inches | 38 inches | | | |
| Hard-to-Hold Cattle | 17 inches | 27 inches | 38 inches | | |
| Boundary Fence | 5 inches | 10 inches | 17 inches | 27 inches | 38 inches |

Source: Adapted from Buschermohle et al., EP-10-95 (University of Tennessee, Extension).

Appendix G. Minimum Trailer Space Requirement for Hauling Cattle

| Average Weight (Pounds) | Number of Cattle Per Running Foot of Truck Floor (92 Inches Truck Width) |
|-------------------------|--|
| 300 | 1.5 |
| 350 | 1.3 |
| 400 | 1.1 |
| 450 | 1.0 |
| 500 | 0.9 |
| 600 | 0.8 |
| 700 | 0.7 |
| 800 | 0.6 |
| 1,000 to 1,2000 | 0.5/0.4 |

Source: Adapted from Temple Grandin, Livestock Trucking Guide, 2001.

Appendix H. Expected Shrink Loss During Handling and Transport

| Conditions | Percent Shrink |
|--------------------------|----------------|
| 8-hour dry lot stand | 3.3 |
| 16-hour dry lot stand | 6.2 |
| 24-hour dry lot stand | 6.6 |
| 8 hours in moving truck | 5.5 |
| 16 hours in moving truck | 7.9 |
| 24 hours in moving truck | 8.9 |

Appendix I. Stand Measurements

Length

- Inch = 0.083 foot
- Foot = 12 inches
- Yard = 36 inches = 3 feet
- Mile = 1,760 yards = 5,280 feet

Area

- Square inch = 0.007 square foot
- Square foot = 144 square inches
- Square yard = 9 square feet
- Acre = 4,940 square yards = 43,560 square feet
- Square mile = 640 acres = 1 section

Liquid

- Teaspoon = 0.1667 fluid ounces
- Tablespoon = 3 teaspoons = 0.5 fluid ounces
- Fluid ounce = 2 tablespoons
- Pint = 2 cups = 16 fluid ounces
- Quart = 4 cups = 2 pints = 32 fluid ounces
- Liter = 2.113 pints = 1.057 quarts
- Gallon = 4 quarts = 8 pints = 128 fluid ounces
- Acre inch of water = 27,154 gallons = 3,630 cubic feet

Volumes

- Cubic inch = 0.00058 cubic foot
- Cubic foot = 1,728 cubic inches = 0.037 cubic yard
- Cubic yard = 27 cubic feet

Weights

- Gram = 1,000 milligrams
- Ounce = 28.35 grams
- Pound = 16 ounces = 454 grams
- Kilogram = 1,000 grams = 2.205 pounds
- Ton (long) = 2,240 pounds

Appendix J. 283-Day Gestation Table

| Date of Service | Calf Due |
|-----------------|----------|-----------------|----------|-----------------|----------|-----------------|----------|-----------------|----------|-----------------|----------|
| 1-Jan | 10-Oct | 1-Feb | 10-Nov | 1-Mar | 8-Dec | 1-Apr | 8-Jan | 1-May | 7-Feb | 1-Jun | 10-Mar |
| 2-Jan | 11-Oct | 2-Feb | 11-Nov | 2-Mar | 9-Dec | 2-Apr | 9-Jan | 2-May | 8-Feb | 2-Jun | 11-Mar |
| 3-Jan | 12-Oct | 3-Feb | 12-Nov | 3-Mar | 10-Dec | 3-Apr | 10-Jan | 3-May | 9-Feb | 3-Jun | 12-Mar |
| 4-Jan | 13-Oct | 4-Feb | 13-Nov | 4-Mar | 11-Dec | 4-Apr | 11-Jan | 4-May | 10-Feb | 4-Jun | 13-Mar |
| 5-Jan | 14-Oct | 5-Feb | 14-Nov | 5-Mar | 12-Dec | 5-Apr | 12-Jan | 5-May | 11-Feb | 5-Jun | 14-Mar |
| 6-Jan | 15-Oct | 6-Feb | 15-Nov | 6-Mar | 13-Dec | 6-Apr | 13-Jan | 6-May | 12-Feb | 6-Jun | 15-Mar |
| 7-Jan | 16-Oct | 7-Feb | 16-Nov | 7-Mar | 14-Dec | 7-Apr | 14-Jan | 7-May | 13-Feb | 7-Jun | 16-Mar |
| 8-Jan | 17-Oct | 8-Feb | 17-Nov | 8-Mar | 15-Dec | 8-Apr | 15-Jan | 8-May | 14-Feb | 8-Jun | 17-Mar |
| 9-Jan | 18-Oct | 9-Feb | 18-Nov | 9-Mar | 16-Dec | 9-Apr | 16-Jan | 9-May | 15-Feb | 9-Jun | 18-Mar |
| 10-Jan | 19-Oct | 10-Feb | 19-Nov | 10-Mar | 17-Dec | 10-Apr | 17-Jan | 10-May | 16-Feb | 10-Jun | 19-Mar |
| 11-Jan | 20-Oct | 11-Feb | 20-Nov | 11-Mar | 18-Dec | 11-Apr | 18-Jan | 11-May | 17-Feb | 11-Jun | 20-Mar |
| 12-Jan | 21-Oct | 12-Feb | 21-Nov | 12-Mar | 19-Dec | 12-Apr | 19-Jan | 12-May | 18-Feb | 12-Jun | 21-Mar |
| 13-Jan | 22-Oct | 13-Feb | 22-Nov | 13-Mar | 20-Dec | 13-Apr | 20-Jan | 13-May | 19-Feb | 13-Jun | 22-Mar |
| 14-Jan | 23-Oct | 14-Feb | 23-Nov | 14-Mar | 21-Dec | 14-Apr | 21-Jan | 14-May | 20-Feb | 14-Jun | 23-Mar |
| 15-Jan | 24-Oct | 15-Feb | 24-Nov | 15-Mar | 22-Dec | 15-Apr | 22-Jan | 15-May | 21-Feb | 15-Jun | 24-Mar |
| 16-Jan | 25-Oct | 16-Feb | 25-Nov | 16-Mar | 23-Dec | 16-Apr | 23-Jan | 16-May | 22-Feb | 16-Jun | 25-Mar |
| 17-Jan | 26-Oct | 17-Feb | 26-Nov | 17-Mar | 24-Dec | 17-Apr | 24-Jan | 17-May | 23-Feb | 17-Jun | 26-Mar |
| 18-Jan | 27-Oct | 18-Feb | 27-Nov | 18-Mar | 25-Dec | 18-Apr | 25-Jan | 18-May | 24-Feb | 18-Jun | 27-Mar |
| 19-Jan | 28-Oct | 19-Feb | 28-Nov | 19-Mar | 26-Dec | 19-Apr | 26-Jan | 19-May | 25-Feb | 19-Jun | 28-Mar |
| 20-Jan | 29-Oct | 20-Feb | 29-Nov | 20-Mar | 27-Dec | 20-Apr | 27-Jan | 20-May | 26-Feb | 20-Jun | 29-Mar |
| 21-Jan | 30-Oct | 21-Feb | 30-Nov | 21-Mar | 28-Dec | 21-Apr | 28-Jan | 21-May | 27-Feb | 21-Jun | 30-Mar |
| 22-Jan | 31-Oct | 22-Feb | 31-Nov | 1-Dec | 22-Mar | 22-Apr | 29-Jan | 22-May | 28-Feb | 22-Jun | 31-Mar |
| 23-Jan | 1-Nov | 23-Feb | 2-Dec | 23-Mar | 30-Dec | 23-Apr | 30-Jan | 23-May | 29-Mar | 23-Jun | 1-Apr |
| 24-Jan | 2-Nov | 24-Feb | 3-Dec | 24-Mar | 31-Dec | 24-Apr | 31-Jan | 24-May | 2-Mar | 24-Jun | 2-Apr |
| 25-Jan | 3-Nov | 25-Feb | 4-Dec | 25-Mar | 1-Jan | 25-Apr | 1-Feb | 25-May | 3-Mar | 25-Jun | 3-Apr |
| 26-Jan | 4-Nov | 26-Feb | 5-Dec | 26-Mar | 2-Jan | 26-Apr | 2-Feb | 26-May | 4-Mar | 26-Jun | 4-Apr |
| 27-Jan | 5-Nov | 27-Feb | 6-Dec | 27-Mar | 3-Jan | 27-Apr | 3-Feb | 27-May | 5-Mar | 27-Jun | 5-Apr |
| 28-Jan | 6-Nov | 28-Feb | 7-Dec | 28-Mar | 4-Jan | 28-Apr | 4-Feb | 28-May | 6-Mar | 28-Jun | 6-Apr |
| 29-Jan | 7-Nov | 29-Feb | 8-Dec | 29-Mar | 5-Jan | 29-Apr | 5-Feb | 29-May | 7-Mar | 29-Jun | 7-Apr |
| 30-Jan | 8-Nov | 30-Feb | 9-Dec | 30-Mar | 6-Jan | 30-Apr | 6-Feb | 30-May | 8-Mar | 30-Jun | 8-Apr |
| 31-Jan | 9-Nov | 31-Feb | 10-Dec | 31-Mar | 7-Jan | | | | | 31-May | 9-Mar |

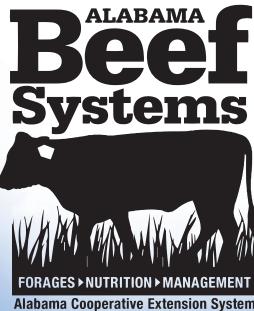
Notes

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