ALABAMA A&M AND AUBURN UNIVERSITIES

ANR-1323

ALABAMA

BEEF CATTLE POCKET GUIDE

ALABAMA CATTLEMEN'S ASSOCIATION

ALABAMA COOPERATIVE Extension SYSTEM

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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 pocket guide 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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Contents

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, and they 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

Over 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, and 3) a warm-season or cool-season plant. Use of these criteria creates eight basic categories that include all commonly used Alabama forages.

Planting and Seed Information for Forage Grasses in Alabama

Table 1. Warm-Season Perennials (Forage Grasses)

	Adaptation		**Seeding Rate (pounds per acre)**	**Planting Depth (inches)**	**Optimum Planting Dates**
	Area	**Soils**			
Bahiagrass	C,S	Moist, sandy bottoms to droughty uplands	B[1]: 15 to 20	¼ to ½	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 to 10 Unhulled B: 10 to 15	¼ to ½	March 15 to early summer
Bermudagrass (vegetatively propagated)	N,C,S	Well drained, light sand to clay loam	Rows: 10 bushels sprigs B: 30 to 40 bushels sprigs		Late February to early summer when soil moisture is adequate
Dallisgrass	N,C,S	Moist, fertile, well drained	B: 20 (10 pounds pure, live seed)	¼ to ½ (Germination is often low; adjust rate accordingly.)	February 15 to May 15
Johnsongrass	N,C	Medium to heavy	B: 20 to 30 D[2]: 10 to 15	½ to 1	April to July

[1] B = broadcast; [2] D = drilled

Table 2. Cool-Season Perennials (Forage Grasses)

	Adaptation		Seeding Rate (pounds per acre)	Planting Depth (inches)	Optimum Planting Dates
	Area	**Soils**	B[1]:15 to 20 D[2]: 10 to 15	¼ to ½	September to October
Fescue, tall	N,C	Moist, fertile bottoms; productive uplands S only: heavy moist soils			
Orchardgrass	N	Well drained, medium to heavy, fertile	Alone: 15 In mixtures: 10	¼ to ½	September to October

[1] B = broadcast; [2] D = drilled

Table 3. Warm-Season Annuals (Forage Grasses)

	Adaptation		Seeding Rate (pounds per acre)	Planting Depth (inches)	Optimum Planting Dates
	Area	**Soils**			
Millet-browntop and proso	N,C,S	Well drained, productive	D[1]: 15 to 20 B[2]: 25 to 30	½ to ¾	N: May 1 to Aug 1 C: Apr 1 to Aug 15 S: Apr 1 to Aug 15
Millet pearl	N,C,S	Well drained, fertile (Avoid lime Black Belt soils.)	D: 12 to 15 B: 25 to 30	½ to 1	N: April 20 to July 1 C: April 15 to July 1 S: April 1 to July 15
Sorghum-sudan hybrids	N,C,S	Well drained, productive	D: 20 to 25 B: 30 to 35 Wide rows: 8 to 12	½ to 1	N: May 1 to August 1 C: April 15 to August 1 S: April 1 to August 15
Sorghum, sweet and forage	N,C,S	Well drained	B: 15 to 20 Syrup: D: 3 to 5 Silage: D: 4 to 6	1	Late April to May 15 S only: late as July 1 for forage sorghums
Sudangrass	N,C	Light sandy to heavy clay	D: 20 to 25 B: 30 to 40	½ to 1	May 1 to Aug 1

[1]D = drilled; [2]B = broadcast

Table 4. Cool-Season Annuals (Forage Grasses)

	Adaptation		Seeding Rate (pounds per acre)	Planting Depth (inches)	Optimum Planting Dates
	Area	**Soils**			
Barley	N,C	Well drained, productive	Grain: B[1]: 75 to 100 D[2]: 75 Grazing alone B: 100 to 120 In mixtures: 60 to 75	1 to 2	September to October
Oats, rye, wheat	N,C,S	Well drained, sandy to clay loams	Grain: 60 to 90 Grazing alone: 90 to 120 In mixtures: 60 to 90	1 to 2	N: September 1 to October 1 C: September 1 to October 15 S: September 15 to November 1 Overseeded: 5 weeks later
Ryegrass, annual	N,C,S	Clay loam to sandy	Alone B: 20 to 30 In mixtures: 15 to 20	0 to ½	Same as for oats, rye, wheat

[1] B = broadcast; [2] D = drilled

Planting and Seed Information for Forage Legumes in Alabama

Table 5. Warm-Season Perennials (Forage Legumes)

	Adaptation		Seeding Rate (pounds per acre)	Planting Depth (inches)	Optimum Planting Dates
	Area	**Soils**			
Lespedeza, sericea	N,C,S	Well drained (Avoid lime soils.)	B[1]: 20 to 30 D[2]: 15 to 20	¼	March through May

[1] B = broadcast; [2] D = drilled

Table 6. Cool-Season Perennials (Forage Legumes)

	Adaptation		Seeding Rate (pounds per acre)	Planting Depth (inches)	Optimum Planting Dates
	Area	**Soils**			
Alfalfa	N,C,S	Deep, fertile, well drained	B[1]: 20 to 25	0 to ¼	N: August 15 to October 1 C: September 1 to October 1 S: October 1 to November 1
Clover, white and ladino	N,C,S	Moist bottoms and productive uplands	B: 2 to 4	0 to ¼	September to October (also February to March in N,C)
Clover, red (acts as an annual in south Alabama)	N,C,S	Moist bottoms and productive uplands	D[2]: 8 to 10 B: 12 to 15	¼ to ½	September to October

[1] B = broadcast; [2] D = drilled

Table 7. Warm-Season Annuals (Forage Legumes)

	Adaptation		Seeding Rate (pounds per acre)	Planting Depth (inches)	Optimum Planting Dates
	Area	**Soils**			
Clover, alyce	S	Fertile, well drained	B[1]: 15 to 20	¼ to ½	May 15 to July 15
Cowpeas	N,C,S	Well drained	Rows: 30 to 40 B: 120	2 to 3	May 1 to June 15
Lespedeza, annual	N,C	Well drained (Avoid lime soils of Black Belt.)	B: 25 to 35	¼ to ½	February 15 to March 15

[1] B = broadcast

Table 8. Cool-Season Annuals (Forage Legumes)

	Adaptation		Seeding Rate (pounds per acre)	Planting Depth (inches)	Optimum Planting Dates
	Area	**Soils**			
Black medic	Black Belt	Lime soils	B[1]:10	0 to ¼	September to October
Caley peas	Black Belt	All Black Belt soils; pH 6.5 or higher	B: 50	½ to 1	September to October 15
Clover, arrowleaf	N,C,S	Well drained, medium to highly fertile	B: 5 to 8 (scarified seed)	0 to ½	N: September 1 to October 1 C: September 15 to October 15 S: September 15 to November 1 Overseeded: 5 weeks later
Clover, ball	N,C,S	Sandy loam to clay; tolerates moist soils	B: 2 to 3	0 to ¼	September to October
Clover, crimson	N,C,S	Well drained (Avoid lime soils.)	B: 20 to 30 D[2]: 15 to 20	0 to ½	Same as for clover, arrowleaf
Clover, subterranean	N,C,S	Well drained, productive	B: 8 to 10	¼ to ½	September to October
Vetch, common	N,C,S	Well drained	B: 30 to 40	1 to 1 ½	N: September 1 to October 15 C: September 1 to October 15 S: September 15 to November 1
Vetch, hairy	N,C,S	Well drained	B: 20 to 25	1 to 1 ½	Same as for common vetch

[1] B = broadcast; [2] D = drilled

Table 9. Characteristics of Forage Grasses

	Tolerance[1] to				
Name	**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					
Corn	E	F	P	P	P
Crabgrass	G	G	P	F	E
Pearl millet	E	E	P	E	F
Sorghum	G	P	P	E	F
Sorghum-sudan	E	P	F	G	F
Cool-Season Perennial Grasses					
Orchardgrass	F	F	F	F	G
Tall fescue E + [2]	G	G	G	G	E
Tall fescue E - [2]	F	G	G	F	F
Cool-Season Annual Grasses					
Annual ryegrass	G	G	E	F	E
Oats	E	F	F	F	G
Rye	E	G	F	F	G
Wheat	E	P	P	F	G

Source: Adapted from D.M. Ball, C.S. Hoveland, and G.D. Lacefield, *Forage Crop Pocket Guide* (Norcross, GA: International Plant Nutrition Institute, 1999).

[1]E = Excellent, G = Good, F = Fair, P = Poor

[2]E+ = Endophyte-infected (toxic or novel endophyte);
E - = Endophyte-free

Table 10. Characteristics of Forage Legumes

Name	Tolerance[1] 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[3]
Warm-Season Annual Legumes					
Annual lespedeza	F	E	F	G	G
Cool-Season Perennial Legumes					
Alfalfa	G	P	P	E	P[3]
Red clover	E	F	F	F	G
White clover	F	F	G	F	E
Cool-Season Annual Legumes					
Arrowleaf clover	F	F	P	G	G
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
Rose clover	P	G	P	G	G
Subterranean clover	G	G	G	F	E

Source: Adapted from D.M. Ball, C.S. Hoveland, and G.D. Lacefield, *Forage Crop Pocket Guide* (Norcross, GA: International Plant Nutrition Institute, 1999).

[1]E = Excellent, G = Good, F = Fair, P = Poor

[2]V = Vegetatively propagated

[3]P = Nongrazing tolerant varieties (Grazing tolerant varieties are rated G.)

The Nitrogen Fixation Process

With time, legume nodules slough off, decompose, and nitrogen becomes available to host legumes or other plants growing in association with them. Many *Rhizobium* bacteria continue to live in the soil, assuming soil conditions are suitable. Amounts of nitrogen (lb/A/yr) fixed by various legumes vary greatly depending on conditions. However, with good legume stands, amounts generally range from about 50 to 150 for annual clovers and vetches; 75 to 200 for birdsfoot trefoil, white clover, and red clover; and 150 to over 200 for alfalfa.

Where very little or no nitrogen fixation is occurring, plants will indicate nitrogen deficiency by stunted growth and yellowing, especially of the lower leaves. When inoculation has failed, it is sometimes possible to improve nodulation by broadcasting or drill-planting inoculated sand, or by spraying an inoculum/water mix in the field—either of which should be done just prior to a rain or irrigation. Such an approach may or may not be effective, but is more likely to work if done soon after planting when seedlings are small.

Although legume seed inoculation is a simple process, it is highly important and deserves careful attention. The hot, dry conditions often encountered at planting time in the South can quickly reduce numbers of *Rhizobium* bacteria. Poor inoculation and the resulting poor nodulation and nitrogen fixation are major reasons why legume production is often difficult in the South.

Table 11. Approximate Hay Stage Crude Protein and Total Digestible Nutrient (TDN) Content of Selected Forage Crops

Cool-Season Forage Crops	Approximate Usual Nutrient Level[1]	
	Crude Protein %	TDN%
Alfalfa (early bloom)	17 to 22	57 to 62
Arrowleaf clover	14 to 17	56 to 61
Oats	8 to 10	55 to 60
Orchardgrass	12 to 15	55 to 60
Red clover	14 to 16	57 to 62
Rye	8 to 10	50 to 55
Ryegrass	10 to 16	56 to 62
Soybean	15 to 18	54 to 58
Tall fescue	10 to 15	55 to 60
Wheat	8 to 12	54 to 60

Warm-Season Forage Crops	Approximate Usual Nutrient Level[1]	
	Crude Protein %	TDN%
Annual lespedeza	14 to 17	52 to 58
Bahiagrass	9 to 11	50 to 56
Coastal bermudagrass (4 weeks)	10 to 14	55 to 60
Common bermudagrass	9 to 11	50 to 56
Dallisgrass	9 to 12	55 to 60
Johnsongrass	10 to 14	55 to 60
Pearl millet	8 to 12	50 to 58
Sericea lespedeza	14 to 17	50 to 55
Sudangrass	9 to 12	55 to 60

Source: Adapted from D.M. Ball, C.S. Hoveland, and G.D. Lacefield, *Southern Forages,* 4th ed. (Norcross, GA: International Plant Nutrition Institute, 2007).

[1]Dry matter basis, assuming recommended production and harvesting practices and no excessive weather damage. Forage quality is affected by many factors.

Table 12. Recommended Stage to Harvest Various Forage Crops for Hay

Plant Species	Time of Harvest
Alfalfa	Bud stage for first cutting; 1/10 bloom for second later cuttings. For spring seedlings, allow the first cutting to reach full bloom.
Orchardgrass, timothy, or fescue	Boot to early head stage for first cut; aftermath cuts at 4- to 6-week intervals.
Red clover, arrowleaf clover, crimson clover	From early bloom to half bloom.
Rye, oats, wheat, annual ryegrass	Boot to early head stage (boot preferable for rye).
Soybeans	Full bloom to mid pod fill and before leaves begin to fall.
Sericea lespedeza	Height at 15 to 18 inches; leave a 4-inch stubble. Do not cut between mid-August and a killing frost.
Annual lespedeza	Early blossom and before bottom leaves begin to fall.
White (including ladino) clover	Cut at correct stage for companion plant.
Johnsongrass, sudangrass, sorghum-sudangrass hybrids, pearl millet	Height of 40 inches or early boot stage, whichever comes first. Leave a 4- to 6-inch stubble on johnsongrass. Leave a 6- to 8-inch stubble on annual sorghums.
Bermudagrass	Height of 15 to 18 inches for first cutting; for later cuttings, cut every 4 to 5 weeks, or when 15 inches high.

Source: Adapted from Joe Burns, J. Kenneth Evans, and Gary Lacefield, *Quality Hay Production; Southern Regional Beef Cow-Calf Handbook* (Alabama Cooperative Extension System, 1977).

Table 13. Usual Recommended Stage of Maturity for Silage Harvest[1]

Crop	Stage of Maturity
Corn	Kernels dented and black layer visible.
Grain sorghum	Late milk to late dough.
Forage sorghum	Forty inches or late boot stage.
Sorghum, sudangrass, johnsongrass, millet	Forty inches or boot stage, whichever comes first.
Small grains, ryegrass	Boot to early head.
Soybeans	Late bloom, seed forming in pods and before lower leaves fall.
Alfalfa	Bud to early bloom.
Cool-season grasses	Boot to early head, first cutting; thereafter at 4- to 6-week intervals.
Hybrid bermudagrass	Fifteen inches at first harvest; thereafter at 4- to 5-week intervals.

Source: Adapted from D.M. Ball, C.S. Hoveland, and G.D. Lacefield, *Southern Forages,* 4th ed. (Norcross, GA: International Plant Nutrition Institute, 2007).

[1]These are guidelines. The quality of feed needed for the type or class of livestock should also be taken into consideration.

Table 14. Hay Heating Concepts

Temperature F	Potential for
120	Protein breakdown
140	Sugar caramelization
150 to 180	Fire (likely)

Source: Adapted from D.M. Ball, C.S. Hoveland, and G.D. Lacefield, *Southern Forages,* 4th ed. (Norcross, GA: International Plant Nutrition Institute, 2007).

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.

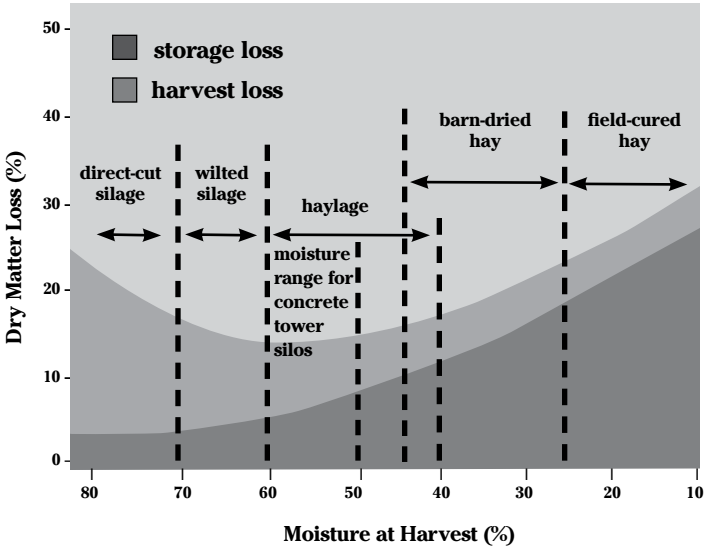


Figure 1. Estimated dry matter loss during harvest and storage of hay-crop forages at various moisture levels

Source: Michigan State University

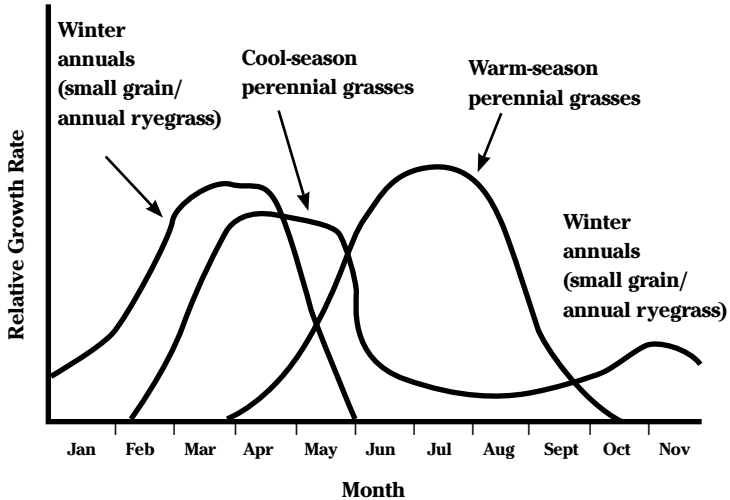


Figure 2. Usual seasonal distribution of growth of various categories of forage crops

Source: Adapted from D.M. Ball, C.S. Hoveland, and G.D. Lacefield, *Southern Forages,* 4th ed. (Norcross, GA: International Plant Nutrition Institute, 2007).

Definitions of Selected Grazing Terms

Grazing method: A defined procedure or technique of grazing management designed to achieve a specific objective or objectives. One or more grazing methods can be utilized within a grazing system.

Grazing system: A defined, integrated combination of animal, plant, soil, and other environmental components and the grazing methods(s) by which the system is managed to achieve specific results or goals.

Stockpiling forage: To allow forage to accumulate for grazing at a later period.

Continuous stocking: A method of grazing livestock on a specific unit of land where animals have unrestricted and uninterrupted access throughout the time period when grazing is allowed.

Creep grazing: The practice of allowing juvenile animals to graze areas that their dams cannot access at the same time.

Forward grazing: A method of utilizing two or more groups of animals, usually with different nutritional requirements, to graze sequentially on the same land area. (Synonyms: *leader-follower, preference-follower, top and bottom grazer, first-last grazing*).

Rotational stocking: A grazing method that utilizes recurring periods of grazing and rest among two or more paddocks in a grazing management unit throughout the period when grazing is allowed.

Set stocking: The practice of allowing a fixed number of animals on a fixed area of land during the time when grazing is allowed.

Strip grazing: Confining animals to an area of grazing land to be grazed in a relatively short period of time, where the paddock size is varied to allow access to a specific land area.

Source: Adapted from Forage and Grazing Terminology Committee, *Terminology for Grazing Lands and Grazing Animals* (Blacksburg, Virginia: Pocahontas Press, Inc., 1991).

Major Benefits of Improved Grazing Management[1]

- 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 are more vigorous and regrow more quickly after being grazed, thus making them more competitive.
- Forage plants can be managed for reseeding in connection with other pasture management objectives.
- 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*.
- 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 rain water lost as runoff from pastures 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.
- 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.

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

Table 15. Guidelines for Rotational Stocking of Selected Forage Crops[1]

	Target Height (inches)		
	Begin Grazing	**End Grazing[2]**	**Usual Days Rest**
Crop			
Alfalfa (hay types)	10 to 16	3 to 4	35 to 40
Alfalfa (grazing types)	10 to 16	2 to 3	15 to 30
Bahiagrass	6 to 10	1 to 2	10 to 20
Bermudagrass	4 to 8	1 to 2	7 to 15
Big bluestem	15 to 20	10 to 12	30 to 45
Clover, white and subterranean[3]	6 to 8	1 to 3	7 to 15
Clovers, all others[3]	8 to 10	3 to 5	10 to 20
Dallisgrass	6 to 8	3 to 4	7 to 15
Eastern gamagrass	18 to 22	10 to 12	30 to 45
Fescue, tall	4 to 8	2 to 3	15 to 30
Indiangrass	12 to 16	6 to 10	30 to 40
Johnsongrass	16 to 20	8 to 12	30 to 40
Orchardgrass	8 to 12	3 to 6	15 to 30
Pearl millet	20 to 24	8 to 12	10 to 20
Ryegrass, annual	6 to 12	3 to 4	7 to 15
Sericea lespedeza	8 to 15	4 to 6	20 to 30
Small grains	8 to 12	3 to 4	7 to 15
Sorghum, forage	20 to 24	8 to 12	10 to 20
Sorghum/sudan hybrids	20 to 24	8 to 12	10 to 20
Switchgrass	18 to 22	8 to 12	30 to 45

Source: Adapted from D.M. Ball, C.S. Hoveland, and G.D. Lacefield, *Forage Crop Pocket Guide* (Norcross, GA: International Plant Nutrition Institute, 1999).

[1]These 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 species that are sensitive to defoliation.

[2]When 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.

[3]Clovers 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.

Key Concepts Regarding 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 below.

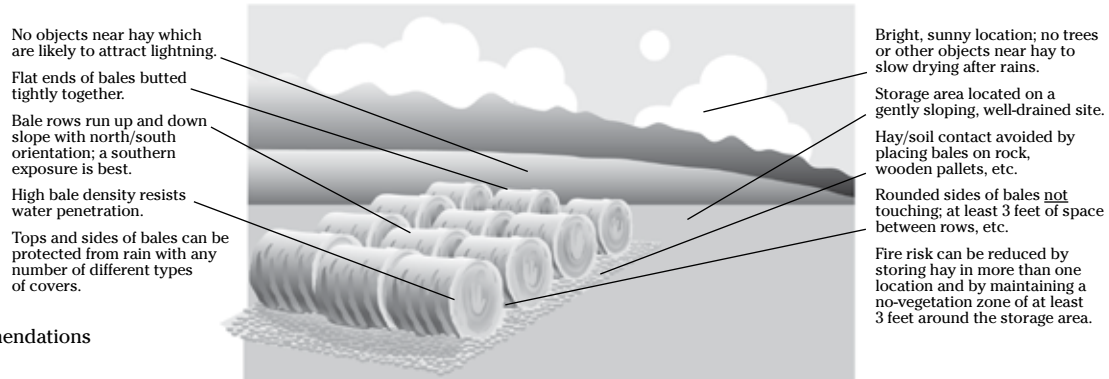
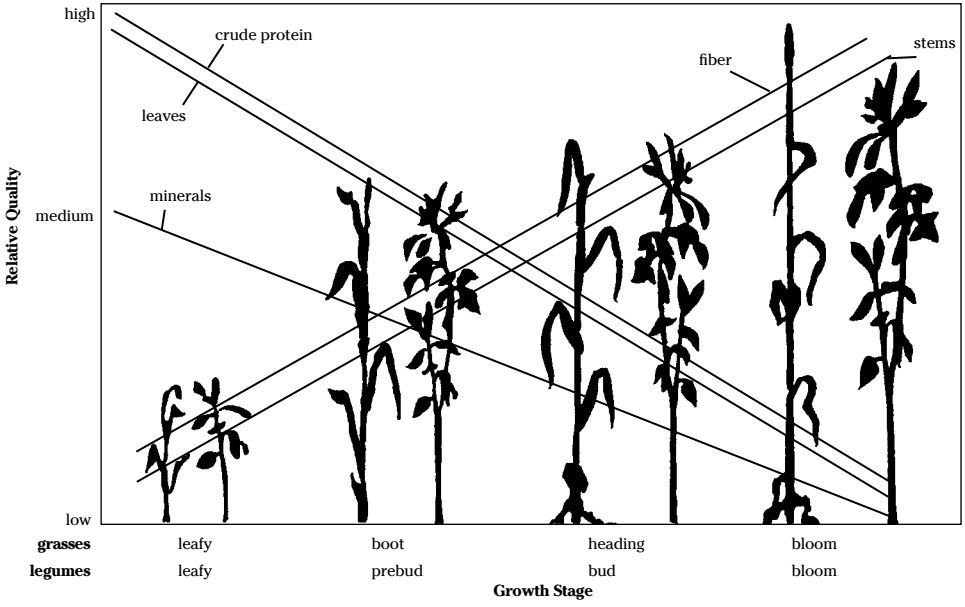


Figure 3. Outside hay forage recommendations



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.

Figure 4. Effect of plant maturity on forage intake and digestibility

Sampling Forage for Laboratory Nutritive Analysis

Identification of a Forage Lot

A *forage lot* is defined as forage taken from the same farm and field and cut under uniform conditions within a 48-hour time 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 ⅜ to ⅝ 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 ½ to ¾ pound. Note that many labs will not grind entire larger samples, and samples that are too small will not adequately represent the hay lot.

How to Take a Silage Sample

Sampling during harvesting. During unloading, collect three to five handfuls of chopped forage from the middle of a load. Place forage in a plastic bag, and refrigerate immediately. Follow the same procedure for several loads throughout the day. Combine samples from a single harvested field and mix well. Place the entire sample in a clean plastic bag or other container, and seal tightly. Label each container with your name and address, as well as the date, sample number, and forage type. Store the sample in a cool place (do not freeze) until you send it to a laboratory for analysis. Repeat for each field, variety, or hybrid. If filling tower silos or silo tubes, keep a record of where each lot is in the silo or tube. Feeding colored plastic strips through the blower at the end of each lot may help identify the lots later.

At feeding, resample silos with seepage. Loss of soluble compounds due to seepage will increase dry matter, acid detergent fiber, and neutral detergent fiber, and will decrease crude protein. Similarly, at feeding, resample silos that were filled with forage at less than 50 percent moisture or that may have heated excessively, causing increased acid detergent fiber and acid detergent fiber insoluble nitrogen. Recheck dry matter of silages at feed-out. Fiber and protein are not likely to change much during storage, except as mentioned above; however, moisture can change significantly.

Ensiled material from a tower silo. Do not sample spoiled material on the top or bottom of a silo; wait until 2 to 3 feet of silage has been removed. Collect a 1- to 2-pound sample from the silo unloader while it is operating. Collect samples from opposite sides of the silo. Combine the samples and mix well. Place the entire sample in a plastic bag, and handle as described earlier.

Ensiled material from a bunker silo. If feeding with a total mixed ration (TMR) mixer, load silage from bunker into TMR mixer and mix well. Take several grab samples to collect a 1- to 2-pound total sample. Place in a plastic bag, and handle as described earlier.

If not feeding with a TMR mixer, collect a 1- to 2-pound total sample from different vertical layers of the silo face. Grab several handfuls from freshly exposed forage after the day's feeding has been removed. Do not sample the spoiled material on top of the silo. Combine handfuls and mix well. Place the entire sample in a clean plastic bag or other container, and seal tightly. Store immediately in a cold place until shipping. Label each container as indicated earlier. Place in a plastic bag, and handle as described earlier.

Table 16. Analytical Fractions/Chemical Constituents in Forage

Percentage of Feed or Forage

Analytical Fractions				Chemical Constituents
moisture				water
dry matter	ash			various minerals plus sand
	organic matter	NDF	ADF	cellulose
				lignin
				fiber-bound N[1] heat-damaged N[1]
			hemicellulose	
		NDS	NDSC	fructans glucans pectic substances
				sugars starches organic acids
			crude protein	NPN (amino acids, amines, urea)
				true protein: degradable
				true protein: undegradable
			ether extract	esterified fatty acids pigments and waxes

[1]Fiber-bound nitrogen and heat-damaged nitrogen are also found in crude protein and RUP.

Source: John Moore. Professor Emeritus of Animal Sciences, University of Florida.

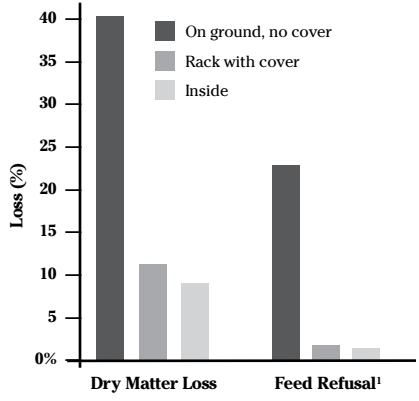


Figure 5. Changes during storage of ryegrass round bales in Louisiana

[1]Refusal measurements were made after 7 months of storage

Source: Verma, L., and B.D. Nelson. 1983. Changes in round bales during storage. Trans. ASAE. 26:328-332.

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 represents the area from which it is taken. Generally, a sample should be a composite of subsamples taken with a soil probe from ten to twenty 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, fertilizer and lime recommendations vary for different crops. When submitting the sample for analysis, be sure to 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 farther 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 anytime 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, it is desirable to apply lime and till it into the top few inches of soil 3 or 4 months before planting.

Table 17. Composition of Principal Fertilizer Materials

Material supplying	Nitrogen (N) %	Phosphate (P_2O_3) %	Potash (K_2O) %	Sulfur (S) %
Nitrogen				
Ammonium nitrate	33.5	0	0	0
Ammonium nitrate and limestone	20.5	0	0	0
Anhydrous ammonia	82	0	0	0
Urea-ammonium nitrate solution	28 to 32	0	0	0
Ammonium sulfate	21	0	0	24
Urea	46	0	0	0
Ammonium thiosulfate	12	0	0	26
Sewage sludge (activated)	4 to 6	2.5 to 4	0	<1
Phosphorus				
Ammonium polyphosphate (APP)	10	34	0	0
Diammonium phosphate (DAP)	18	46	0	0
Monoammonium phosphate (MAP)	10 to 12	50 to 55	0	0
Triple superphosphate (TSP)	0	44 to 46	0	1
Ground rock phosphate	0	26 to 35 (Approximately 3% available)	0	0
Basic slag	0	10 to 25	0	0
Potassium				
Potassium chloride	0	0	60 to 62	0
Potassium nitrate	13	0	44	0
Potassium sulfate	0	0	48 to 52	18
Sulfate of potash-magnesia	0	0	22	22

Source: Adapted from D.M. Ball, C.S. Hoveland, and G.D. Lacefield, *Forage Crop Pocket Guide* (Norcross, GA: International Plant Nutrition Institute, 1999).

Table 18. Average Precipitation by Month in Selected Locations Within Alabama (inches)

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Anniston	5.34	4.80	6.28	4.87	4.16	4.14	4.49	3.35	3.32	2.87	4.20	4.11
Dothan	6.32	5.19	6.18	3.80	4.22	4.83	6.06	4.19	4.17	3.18	4.25	4.22
Florence	4.97	4.46	6.21	4.43	5.30	4.90	4.52	2.96	4.30	3.22	5.09	5.44
Fort Payne	6.06	5.62	6.57	4.73	4.70	4.33	5.18	3.49	4.27	3.29	5.00	5.12
Huntsville	7.07	5.67	6.82	5.03	5.08	4.13	4.85	3.47	4.08	3.25	5.06	6.87
Mobile	5.75	5.10	7.20	5.06	6.10	5.01	6.54	6.20	6.01	3.25	5.41	4.66
Montgomery	5.04	5.45	6.39	4.38	4.14	4.13	5.31	6.63	4.22	2.58	4.53	4.97
Tuscaloosa	5.80	4.87	6.49	4.96	4.54	4.03	4.75	3.37	3.32	3.67	4.44	4.75

Table 19. Average Date of First and Last Frost

	Last Frost	First Frost
Birmingham	April 14	Oct 24
Clanton	April 11	Oct 18
Evergreen	April 7	Oct 26
Haleyville	April 18	Oct 13
Mobile	March 19	Nov 5
Montgomery	March 28	Oct 29
Ozark	April 1	Oct 31
Scottsboro	April 22	Oct 9

Nutrition Management and Feeding

Table 1. Daily Water Requirements for Various Classes of Cattle From 40 to 90 Degrees Fahrenheit

	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		
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

Use of Intake Limiters

Cows nursing young calves and replacement heifers occasionally need additional energy and protein. This often occurs during the winter months when cattle are fed hay. These nutrients are needed in fairly small amounts, which can make it difficult to feed economically and be assured that all cattle are getting their fair share.

Daily hand-feeding requires a large amount of labor and trough feeding space. In addition, boss cows usually keep timid cows from getting adequate amounts of the supplement. If the supplements can be self-fed, nutritional needs could be more likely met, and labor cost could be greatly reduced.

Intake limiters can make self-feeding practical. Many cattle producers think of intake limiters as products that are added to a diet in relatively small amounts to reduce consumption. However, a limiter can make up a large portion of the diet. For example, nutrient intake can be limited by diluting the diet with bulky ingredients such as peanut hulls, cottonseed hulls, gin trash, or hay. With this example, the amount of intake is determined by the amount of bulk that the cattle can consume.

Salt, on the other hand, limits intake by physiological changes produced in the cow. Thus, it is very important to accustom cattle to the feed via hand-feeding for a week or so before allowing them free access to the feed. For many years, salt has been used as a successful intake limiter. The amount consumed depends on the availability of other feeds. In general, cattle consume about $^{1}/_{10}$ pound of salt per 100 pounds of body weight when salt is used to limit intake of a palatable feed. Table 2 shows estimated salt intake for various weights of cattle.

Table 2. Expected Daily Salt Consumption for Varying Weights of Cattle

	Salt Consumption (pounds/day)		
Body Weight (pounds)	**Low**	**Average**	**High**
300	0.3	0.5	0.6
500	0.5	0.6	0.7
700	0.6	0.7	0.9
900	0.7	0.9	1.1
1100	0.8	1.1	1.3
1300	0.9	1.3	1.5
1500	1.0	1.5	1.6

As an example, if we have a group of cows with an average weight of 1,100 pounds and we want to supplement them with 2 pounds of cottonseed meal per day, we would make a bulk mix of 1.1 parts salt per 2 parts cottonseed meal. In other words, we would mix 1,100 pounds of salt with 2,000 pounds (1 ton) of cottonseed meal, ensuring a mix that these cows would consume at our desired rate. When using high-moisture feeds such as silage, the amount of salt that cattle consume will increase. Cattle consuming salt-regulated supplements should always have available adequate water. Cattle that are fed high levels of salt will consume at least 50 percent more water than usual. This will amount to approximately 5 gallons of additional water for each pound of salt consumed. Thus, high-salt feeds should not be located close to water or overconsumption might be a problem.

Negative Aspects of Using Salt as an Intake Limiter

- Salt is corrosive to equipment used to handle the mixes.
- When continually fed in the same pasture area, salt can build up in the soil and cause productivity problems.
- Cattle that consume a high-salt supplement consume less mineral mix.

Take-Home Message

- Self-fed supplements decrease labor and allow timid cows better access to the feed.
- Salt can be used as an effective intake limiter.
- Generally, cows will consume 0.1 pounds of salt per 100 pounds of body weight.
- Hand-feed the supplement for a week to allow cattle to adjust.
- Continually monitor intake and make adjustments as needed.

What to Look for in a Mineral Supplement

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 percent salt
- 6 to 12 percent calcium
- 6 to 12 percent phosphorus
- 1 to 4 percent magnesium (8 to 14 percent for Hi-Mag)
- .09 to .18 percent copper
- .18 to .36 percent zinc
- .0026 to .0052 percent selenium

If concentrations of these minerals are considerably outside of these ranges, look for another bag of minerals. Consumption levels should be between 2 and 4 ounces per day. There will be extreme differences in prices; make sure that you consider composition and daily intake when evaluating these price differences. (The least expensive bag is not necessarily the best buy.)

Other Considerations

- If cows routinely run out of mineral supplements, their consumption levels will not be in the 2 to 4 ounce range. It is important to have mineral supplements available at all times.
- If you feed abundant quantities of poultry litter, mineral consumption will nearly cease.
- If you feed a “hot mix” such as cottonseed meal and salt during the winter, take special care to ensure adequate trace mineral, calcium, and phosphorus consumption.
- A good homemade recipe is: mix a 50-pound sack of trace mineral salt with a 50-pound sack of dicalcium phosphate. Feed this free-choice.
- High-Mag mineral does not need to be fed all year long; the most critical time is during the spring.

Predicting Intake

When you plan for winter feed needs and assess the nutrient needs of beef cattle, it is important that you are able to predict daily intake. For most of the hays fed in Alabama, you can estimate daily intake by looking at the amount of fiber present in the hay. A hay sample can be analyzed for neutral detergent fiber content (NDF) by any hay testing laboratory. Once the NDF value has been determined, you can use the prediction of dry matter intake = 120/NDF. For example, if the hay report indicates that your hay contains 60 percent NDF, you would predict an intake of 120/60 = 2 percent of body weight per day. For this particular hay, you would predict that a 1,200-pound cow would consume 24 pounds per day (2 percent of 1,200).

Typical Weaning and Preconditioning Diets

When you wean calves, it is extremely important to provide a palatable feed. This will get calves consuming quickly. For the first 24 hours after weaning, it is good practice to feed good quality hay at 2 percent of a calf's body weight, and concentrate at 1 percent of the calf's body weight. Then, over the next 48 hours, convert the calf to a complete diet.

The following are some example weaning diets that work well for calves:

Diet 1

300 pounds chopped hay
300 pounds corn gluten feed
390 pounds soyhulls
5 pounds trace mineral salt
5 pounds dicalcium phosphate

Diet 2

250 pounds peanut hulls (loose, not ground or pelleted)
250 pounds cracked corn
370 pounds soyhulls
120 pounds soybean meal
5 pounds trace mineral salt
5 pounds dicalcium phosphate

Diet 3

300 pounds peanut hay

690 pounds soyhulls

5 pounds trace mineral salt

5 pounds dicalcium phosphate

Feeder Space

When you supplement brood cows, provide about 30 inches of linear bunk or trough space for each cow, and about 24 inches per head for weaned calves.

When you provide free-choice feed, approximately 6 inches per calf is enough feeder space. This may need to be increased to 12 inches for bigger cattle in a backgrounding situation.

Creep feeders should have openings of 16 to 20 inches wide and 36 to 42 inches high.

Commodity Sheds

In order to take advantage of a bargain-priced feed at low-demand times of the year, you need to have a storage system such as a commodity shed. As you begin to plan a commodity, it is important to consider various factors.

Delivery vehicle. The typical commodity feed delivered in Alabama is transported by tractor-trailers that use 53-foot trailers and need about 14 feet of vertical clearance. It is important to note that the trailer may be a dump trailer or a walking-floor type. Those with walking floors are most often used to eliminate the need for excessively high roof clearance. These are also used to avoid having to dump feed outside and then move inside with a front-end loader.

Size of commodity shed. Size considerations for your commodity shed must begin with the fact that most feeds come in increments of 24 tons. Tractor-trailers need an eave height of at least 14 feet, and each bay should be at least 12 to 14 feet wide. Clearance is needed along each side of the truck in order to open end doors. Most feeds that are unloaded off of a live-bottom truck will be piled to a height of 6 to 8 feet.

To size your shed, you need to consider the bulk density of various commodity feeds. For example, determine the size of bay needed to store one load of cottonseed weighing 24 tons. At 25 pounds per cubic foot, 24 tons (48,000 pounds) of cottonseed would require 1,920 cubic feet of space. It is always best to have about 25 percent extra size. By adding 25 percent, you end up with a total of 2,400 cubic feet. If you can stack it to a height of 6 feet and the bay is 14 feet wide, you need a length of 28 feet.

Table 3 gives an average weight of various commodity feeds from around the state of Alabama.

Table 3. Bulk Densities of Various Commodity Feeds

Commodity	Pounds/Cubic Foot
Broiler litter	30
Corn, shelled	45
Corn gluten feed	33
Cottonseed	25
Cottonseed meal	38
Oats	26
Peanut hulls, loose	7
Peanut skins	11
Soybean hulls, loose	28
Soybean hulls, pelleted	40
Wheat flour	40

Body Condition Scores

Body condition scores are numbers used to assess the relative fatness of a cow. The system uses scores from 1 to 9, with a 1 being extremely thin and a 9 being extremely fat. The target for most cows should be a score of 5 to 6. If cows are too thin, they will not return to estrus and will not rebreed. It is very important to assess body condition scores across the entire herd at 75 days prior to the calving season. This assessment will allow you time to make necessary adjustments in nutrition. For most cows, an increase of one body condition score equates to gaining about 70 to 80 pounds of body weight. The accompanying photos and descriptions describe the nine body condition scores.

Indications to Look for on the Body Condition Score 1-9 Scale

Figure 1. Bone structure of shoulder, ribs, back, hooks, and pins sharp to touch and easily visible. Little evidence of fat deposits or muscling. Cow is severely emaciated and physically weak. There is muscle breakdown and the cow is likely to go down when stressed by hauling, cold weather, and so forth.

Figure 2. Little evidence of fat deposits, yet some muscling in the hindquarters but severely depleted. The spinous processes feel sharp to the touch and are easily seen with space between them. Still, the cow is not weak.

Figure 3. 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.

Figure 4. Foreribs not noticeable; twelfth and thirteenth ribs 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 (with slight pressure) to feel rounded rather than sharp. Full but straightness of muscling in the hindquarters.

Figure 5. Twelfth and thirteenth ribs not visible to the eye unless the animal has been shrunk. The transverse spinous processes can be felt only with firm pressure and feel rounded—not noticeable to the eye. Spaces between the processes not visible and only distinguishable with firm pressure. Areas on each side of the tailhead are fairly well-filled but not mounded. The cow can be described as thin to moderate.

Figure 6. Ribs fully covered, not noticeable to the eye. Hindquarters plump and full. Noticeable sponginess to the covering of foreribs and on each side of the tailhead. Firm pressure is now required to feel the transverse processes. The cow appears smooth throughout.

Figure 7. Ends of the spinous processes can only be felt with very firm pressure. Spaces between processes can barely be distinguished at all. There is abundant fat cover on either side of tailhead with some patchiness evident. The cow appears in very good flesh.

Figure 8. Animal taking on a smooth, blocky appearance; bone structure disappearing from sight. The fat cover is thick and spongy with patchiness likely. The cow is obese.

Figure 9. Bone structure not seen or easily felt. Tailhead buried in fat. Animal's mobility may actually be impaired by excess fat.

Nutrient Requirements of Beef Cattle

Table 4. 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 male 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, %	.24	.25	.23	.22	.20	.19	.15	.15	.15	.24	.24	.24
P, %	.17	.17	.16	.15	.14	.14	.11	.11	.11	.15	.15	.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, %	.30	.32	.30	.27	.24	.22	.15	.15	.15	.24	.24	.24
P, %	.20	.21	.19	.18	.17	.15	.11	.11	.11	.15	.15	.15

	Months Since Calving											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
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	21.0	21.4
TDN, %	62.8	64.5	62.1	60.1	57.9	55.9	44.9	45.7	47.0	49.1	52.0	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, %	.35	.38	.35	.32	.28	.25	.15	.15	.15	.24	.24	.24
P, %	.22	.24	.22	.21	.19	.17	.11	.11	.11	.15	.15	.15

Table 5. 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 male 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, %	.24	.25	.23	.21	.20	.19	.15	.15	.15	.26	.25	.25
P, %	.17	.17	.16	.15	.14	.14	.12	.12	.12	.16	.16	.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, %	.29	.31	.29	.26	.24	.22	.15	.15	.15	.26	.25	.25
P, %	.19	.21	.19	.18	.17	.15	.12	.12	.12	.16	.16	.16

	Months Since Calving											
	1	2	3	4	5	6	7	8	9	10	11	12
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, %	.34	.36	.34	.31	.27	.25	.15	.15	.15	.26	.25	.25

Table 6. Daily Dry Matter Intake and Diet Nutrient Densities for Beef Cows—Mature Weight = 1,400 Pounds

	Months Since Calving											
1,400-pound cow weaning 7-month-old male weighing 535 pounds	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
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, %	.23	.25	.23	.21	.20	.19	.16	.16	.16	.27	.26	.26
P, %	.17	.17	.16	.15	.15	.14	.12	.12	.12	.17	.17	.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, %	.28	.30	.28	.26	.24	.22	.16	.16	.16	.27	.26	.26
P, %	.19	.20	.19	.18	.17	.16	.12	.12	.12	.17	.17	.17

Months Since Calving

	1	2	3	4	5	6	7	8	9	10	11	12
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	10.2	9.3	8.5	6.0	6.2	6.5	7.0	7.8	8.9
Ca, %	.33	.35	.32	.30	.27	.24	.16	.16	.16	.27	.26	.26
P, %	.22	.23	.21	.20	.18	.17	.12	.12	.12	.17	.17	.17

Table 7. Daily Dry Matter Intake and Diet Nutrient Densities for Pregnant Replacement Heifers

	Months Since Conception								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
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, %	.22	.22	.22	.21	.21	.20	.32	.31	.31
P, %	.17	.17	.17	.17	.17	.16	.23	.23	.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, %	.23	.23	.22	.22	.22	.21	.31	.31	.30
P, %	.18	.18	.18	.17	.17	.17	.23	.22	.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, %	.24	.24	.23	.23	.22	.22	.31	.31	.30
P, %	.18	.18	.18	.18	.18	.18	.23	.22	.22

Table 8. Mineral Requirements and Maximum Tolerable Amounts

Mineral	Growing/ Finishing	Gestating Cow	Lactating Cow	Maximum
	Calves			Tolerable
Chromium, mg/kg	——	——	——	1,000
Cobalt, mg/kg	.10	.10	.10	10
Copper, mg/kg	10	10	10	100
Iodine, mg/kg	.50	.50	.50	50
Iron, mg/kg	50	50	50	1,000
Magnesium, %	.10	.12	.20	.40
Manganese, mg/kg	20	40	40	1,000
Molybdenum, mg/kg	——	——	——	5
Nickel, mg/kg	——	——	——	50
Potassium, %	.60	.60	.70	3
Selenium, mg/kg	.10	.10	.10	2
Sodium, %	.06 to .08	.06 to .08	.10	——
Sulfur, %	.15	.15	.15	.40
Zinc, mg/kg	30	30	30	500

Herd Health

Health Management

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:

- herd immunization (vaccination)
- parasite control (internal and external)
- proper culling guidelines
- biological risk management (biosecurity)
- nutrition
- reproductive management
- Beef Quality Assurance (BQA)

Contact your local veterinarian, extension agent, state extension specialists (e.g., 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. However, selecting the proper vaccines for your herd can be a difficult task, considering the large number of vaccines that are available. Some things to consider when developing a vaccination program for your herd are:

- 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.
- 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:**
• Available for many diseases. • No risk of the vaccine organism spreading between animals. • Minimal risk of causing abortion. • No on-farm mixing required.	• More likely to cause allergic reactions and post-vaccination lumps. • Two initial doses required. • Slower onset of immunity. • Immunity is usually not as strong or long-lasting when compared to MLV products. • Usually more expensive than MLV products.

Table 2. Modified Live Vaccines (MLV)

Advantages:	**Disadvantages:**
• One initial dose may be sufficient, but boosters are sometimes required. • Stimulate more rapid, stronger, and longer-lasting immunity than KV products. • Less likely to cause allergic reactions and postvaccination lumps. • Usually less expensive than KV products.	• Risk of causing abortion or transient infertility, therefore they should generally be administered 6 to 8 weeks prior to the breeding season. • Must be mixed on-farm and used within about 30 minutes.

Table 3. Chemically Altered Vaccines

Advantages:	**Disadvantages:**
• Share many of the advantages of MLV products. • Safety is similar to KV products. • Minimal risk of causing abortion.	• Two initial doses required. • Slower onset of immunity than MLV product. • Immunity is usually not as strong or long-lasting when compared to MLV products. • Usually more expensive than MLV products. • Must be mixed on-farm and used within about 30 minutes.

Vaccines are available for many diseases. However, not all diseases 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 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
- 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/PI_3/BRSV
- 7-way clostridial (blackleg)
- *Mannheimia haemolytica*
- *Pasteurella multocida*

Breeding Animals

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

- IBR/BVD/PI_3/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 Remember, 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.

Common Internal Parasites

- The brown stomach worm (*Ostertagia ostertagi*) is the most common internal cattle parasite.
- A variety of other gastrointestinal worms and lungworms also affect cattle.

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 Worms

- Many dewormers (anthelmintics) are available for controlling stomach, lung, and intestinal worms in cattle. Consult your herd health veterinarian or extension agent 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 label directions ensures product efficacy, safety, and promotes the production of safe, wholesome food.
- When applicable, always make sure the product used is safe for pregnant animals.
- The long-acting dewormers listed in table 4 protect against reinfection for a prolonged period of time after administration. The duration of this persistent activity depends on the product and the parasite, so consult individual product labels for specific information.
- The trade names listed in table 4 are used to give specific examples. This list is not all inclusive. The Alabama Cooperative Extension System does not endorse or guarantee any product.

Table 4. Common Dewormers Used to Control Stomach, Lung, and Intestinal Worms in Cattle

Drug Ingredient	Trade Name Examples	Long-acting	Short-acting	Pour-on	Injectable	Oral
Albendazole[1]	Valbazen®[1]		X			X
Doramectin	Dectomax®	X		X	X	
Eprinomectin	Eprinex®	X		X		
Fenbendazole	Panacur® Safe-Guard®		X			X
Ivermectin	Ivomec®	X		X	X	X
Levamisole	Levasole®		X		X	X
Moxidectin	Cydectin®	X		X	X	
Oxfendazole	Synanthic®		X			X

[1] Do not use in early pregnancy.

Common External Parasites

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

Consequences of External Parasitism

- Anemia (in some cases)
- Decreased weight gain
- Decreased milk production
- Decreased reproductive performance
- Less beef per acre produced
- Damaged hides
- Many external parasites also transmit diseases

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 is 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 5 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. However, it is appropriate 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:
  - 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 5. 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 lambdacy-halothrin permethrin zetacypermethrin
Pyrethrins	pyrethrins

Growth-Stimulating Implants

When used correctly, growth-stimulating implants offer the commercial cattle producer a fast, easy-to-use method of increasing the weaning weights of calves. If producers adhere to 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 sub-fertility.

Correctly Administering Implants

(See 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 gun needle and implant site with a disinfectant to reduce contamination of the needle wound. (Disinfect the implant gun needle between animals.)
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.
10. Feel the ear for the implant under the skin to ensure proper placement.

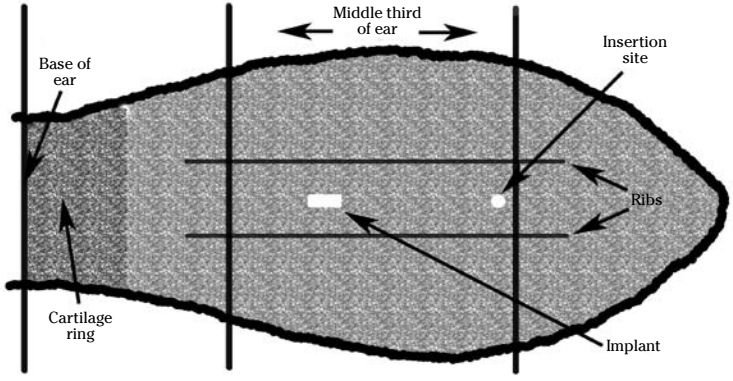


Figure 1. Proper implant site

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, it is quite probable that the cartilage has been gouged. Pellets may be covered with scar tissue and walled off, resulting in poor drug absorption and decreased gain.
- 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 listed 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.

- **Pregnancy—**Perform a pregnancy check every year, and cull open cows before spending extra money on feed.
- **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.
- **Mouth—**Cows must have adequate teeth to harvest forage for body condition maintenance and milk production to support calf growth.
- **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.
- **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).
- **Body condition—**Thin cows lack energy reserves and usually do not rebreed.
- **Disposition—**Cows with bad dispositions often produce excitable calves that do not gain as well in the feedyard 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. Some things to consider 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 6).

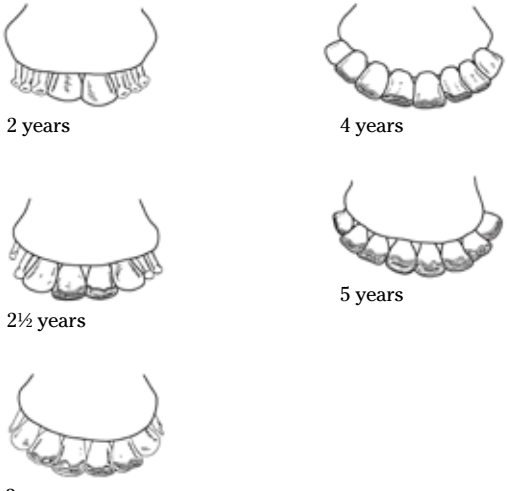


Figure 2. Aging cattle by teeth

- Temporary teeth (milk teeth) are easily distinguished from permanent teeth by their whiter color and smaller size.
- The degree of wear is affected by the type of feed the animal consumes. Under rough feed conditions, teeth are worn at a much faster rate.
- Several years after a tooth erupts, the neck of the tooth begins showing above the gum line (Table 6). The neck is a narrow area seen at the base of the tooth.

Table 6. Guidelines for Aging Cattle[1]

Teeth (Permanent)	Eruption	In Wear (Typically 6 Months After Eruption)	Neck of Tooth Visible Above Gum Line
First incisors (I_1) (two central incisors)	1 ½ to 2 years	2 to 2 ½ years	6 years
Second incisors (I_2)	2 to 2 ½ years	2 ½ to 3 years	7 years
Third incisors (I_3)	3 years	3 ½ years	8 years
Fourth incisors (I_4) (two outer incisors)	3 ½ to 4 years	4 ½ years	9 years

[1] Based on when permanent incisors erupt, are "in wear," and when the neck of the tooth is visible above the gum line.

Biosecurity (Biological Risk Management)

A biosecurity plan is an innovative approach to managing the risk of disease introduction and spread on your livestock operation. A biosecurity plan is designed to help livestock producers identify disease risks and manage them through practical measures for common, everyday infectious diseases, as well as 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. There are five primary routes of disease transmission: aerosol, direct contact, fomite or traffic, oral, and vector transmission.

- *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 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. 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. 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 label directions to achieve maximum product efficacy. 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) or prescription (Rx), 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."

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

- Dosage—example: "4 ml or cc"
- 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—"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 adhering 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.
- Use of any estrogenic compound in a food animal is prohibited.

Off-label use of vaccines is not illegal, but such use 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. They will not be effective for later use and may be contaminated.
- Some drugs, and most vaccines, need to be refrigerated at 40 to 50 degrees Fahrenheit 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 ten to fifteen animals to minimize disease spread and drug contamination. Do not store medication in syringes. They 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:

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

Most injections are administered either subcutaneously (under the skin) or intramuscularly (into a muscle) as illustrated in figures 3 and 4. The product label provides an acceptable route of administration. In some cases, the label may specify more than one route of administration. If the label allows for either subcutaneous or intramuscular administration, give the drug subcutaneously to reduce the chances of violative residues and lesions in the muscle.

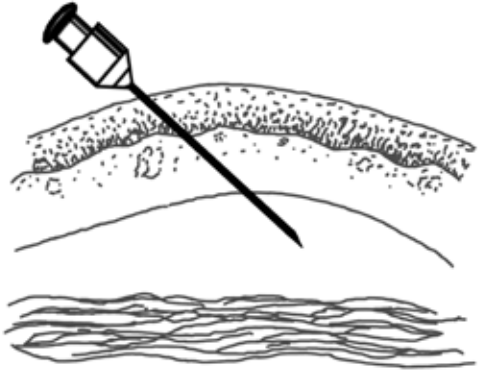


Figure 3. SubQ site

Choose the best location for the injection (Figure 5). The best 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 into the buttock or top of the rump.**
- For both vaccines and antibiotics, the triangular mass of neck muscle is the only acceptable site for IM and SubQ injections (Figure 5).
- 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.

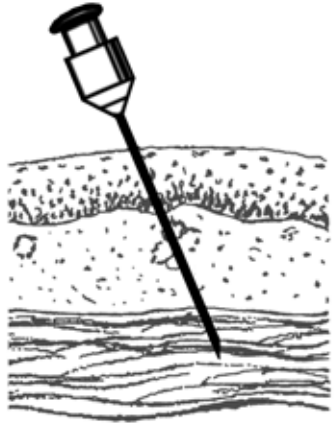


Figure 4. IM site

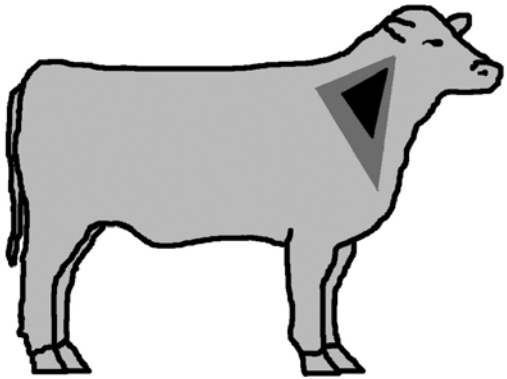


Figure 5. Acceptable injection sites for cattle

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 7 for proper needle size selection.

Table 7. Needle Selection Guide

	Intramuscular (IM)		Subcutaneous (SubQ)	
Weight	**Gauge**	**Length (inches)**	**Gauge**	**Length (inches)**
Less than 300 pounds	18	¾ to 1	18 to 20	½ to ⅝
300 to 700 pounds	16 to 18	¾ to 1	16 to 18	½ to ⅝
Over 700 pounds	16	¾ to 1	16 to 18	½ to ⅝

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, and along the side of the road.

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 B for locations and contact information. Alabama Veterinary Diagnostic Laboratories should only be used when the cause of death needs to be determined.

Failure to properly dispose of a carcass is against the law, not responsible, and potentially detrimental to herd health and the environment. Care must be taken not to contaminate the water table, creeks, ponds, rivers, and watersheds when disposing of a carcass. If you need assistance, contact ADEM at (334) 394-4309, your local NRCS district office, or the Alabama Cooperative Extension System.

Animal Identification, Performance Records, and Genetics

Beef Cattle Breeds

Beef cattle are classified into two species: *Bos Taurus* and *Bos Indicus*. Since the domestication of cattle, producers have bred certain types and kinds of cattle together to form breeds. Today, there are over eighty recognized breeds of beef cattle in the United States.

The most popular beef breeds in the United States can be classified as English, Continental, American, or *Bos Indicus*. Refer to Appendix C for trait similarities and differences between the breed classifications.

Beef Cattle Identification

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

Temporary identification is any type of identification that can be removed or lost. This includes ear tags, electronic ear tags, neck chains, and the like. Permanent identification is with the animal forever. Permanent identification includes tattoos, hot brands, and freeze brands. The methods of permanent identification must be done properly, or identification will not be legible.

All identification starts with a system. There should never be two individuals in the herd with the same permanent identification. There are many unique livestock numbering systems available. One of the more common systems uses the last digit of the birth year as the first digit of the identification number (e.g., 7101). Use of this system allows 10 years before the same identification number could be used again. Another very common system is the International Lettering System. In this system, letters are identified for specific birth years (Table 1), and a letter is used as the first digit of the identification number (e.g., T101). Using this system ensures 22 years before another animal has the potential for the same identification number. Another very simple system is to consecutively number the cattle (e.g., 1 to 999). The drawback of this system is that you cannot quickly identify birth year.

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. If you have less than 100 cows, you can use two additional digits (e.g., T25 or 725). If you have more than 100 cows, you have to use three additional digits (e.g., T025 or 7025). Other systems use the dam identification number as the additional digits. This is useful if you want to quickly identify cow families in the pasture.

Table 1. International Lettering System and Corresponding Birth Year

Year	Letter[1]	Year	Letter
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

[1] Letters *I*, *O*, *Q* and *V* are not used.

Temporary Identification

Ear tags. The most common form of identification is the ear tag. There are several types of ear tags, most of which are generally inexpensive, ranging in price from $0.80 to $3.00 per tag. To apply the tag, you must have the appropriate tagger matching the brand of tag.

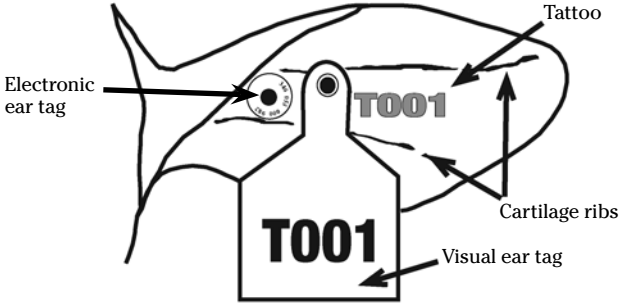


Figure 1. Correct placement of tattoos and ear tags to maximize readability

To tag an animal:

- Place the ear tag and ear tag back (if applicable) into the appropriate tagger.
- Restrain the animal.
- Apply the tag in the middle rib of the ear, at least half way 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 a 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 no permanent form of identification and the tag is lost, the animal can no longer be positively identified.

Permanent Identification

Tattooing. A good method for permanent identification is tattooing the ear, commonly paired with a visual ear tag. Tattooing is simple and cost effective; however, it is important to ensure a readable tattoo. Materials needed to tattoo an animal include a tattoo gun,

the numerals 0 through 9, the letters *A* through *Z* (if using the International Lettering System), and tattoo ink. Animals should be tattooed at birth or weaning. Note that if the calf looses its ear tag between birth and weaning, you will have to spend time determining exact identity.

To tattoo an animal:

- Load a tattoo gun with the appropriate letters or numbers. Clamp the tattoo gun onto a piece of paper or cardboard to ensure the letters are loaded correctly.
- Properly restrain the animal.
- Rub tattoo ink into the animal's ear in the middle rib. Note the location of the tattoo in figure 1. Ensure the tattoo will not be placed into the hair of the outer ear. Use green ink for black hided cattle; use black or green ink for all other cattle.
- 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. Note that animals must be restrained in order for you to read a tattoo.

Two other forms of permanent identification are hot and freeze branding. Both branding methods can cause permanent damage to the hide. Therefore, hot or freeze branding should only be used when there is no other suitable form of permanent identification. The ideal location for either type of brand is high on the hip.

Hot branding. Today, most hot brands are electric. Electric branders take 90 seconds to heat up, and they keep a constant temperature. The optimal hot-brand width is 3/8 inch. If using an electric brander, you must use extreme care to eliminate accidental burning of workers or pets.

To hot brand an animal with an electric brander:

- Properly restrain and squeeze the animal into a chute. You do not want to reapply the brand in the same spot, as this can cause blotching or be difficult to read.
- Do not hot brand wet cattle; this will cause an uneven brand.
- Do not brand cattle that you just poured an alcohol base on, as it creates a fire hazard. Wait until after branding is complete to worm.
- Place the brander firmly on the animal for 15 to 20 seconds. Rock the brander 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, remove the brander. 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.

  Note that you should be able to see the brand immediately.

Freeze branding. As compared to hot branding, freeze branding generally does not cause as much hide damage to cattle and is less painful. However, if done improperly, freeze brands are illegible. Materials needed to freeze brand cattle include freeze-branding irons, liquid nitrogen or dry ice, denatured alcohol (95 percent or higher pure alcohol), coolers, clippers, a 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, 3/8 to ½ inch thick, and 1 inch deep. Coolers used to hold brands and coolant (liquid nitrogen or dry ice) need to be resistant to extreme cold and alcohol. Make sure you use gloves when freeze branding to prevent frostbite.

To freeze brand an animal:

- Cool the iron for 20 minutes in liquid nitrogen or a combination of dry ice and alcohol. The coolant should cover the head of the iron by at least 1 inch. Look for frost lines on the handle of the iron to determine when it is ready for use. Recool for 2 minutes between each use, and add more coolant as needed to keep the iron head 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, but make sure to clip closely. Use a rice-root brush to remove clipped hair, dirt, and debris.
- Using a squeeze bottle, saturate the clipped area with 95 to 99 percent 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 a more even brand. Note that you should apply only one iron at a time 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 the 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. After 5 or 10 minutes, the brand site will begin to swell and will remain swollen for up to 5 days. After 1 month, the top layer of skin will shed. Watch to see if any cattle do not shed. In that case, you may have to rebrand. After 2 months, you should notice white hair growing where the brand was applied. Reclipping the brand area will sometimes allow the brand to pop. 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.

Note: If you would like to brand animals with a farm brand, the brand must be registered with the Alabama Board of Agriculture and Industries. For more information go to http://www.legislature.state.al.us/CodeofAlabama/1975/142395.htm, or call (334) 240-7263. This does not apply if you are just branding the animal with its individual identification.

Conformation of Beef Cattle

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

Each year, the cowherd needs to be evaluated for:

- Feet and legs
- Udder structure and abnormalities
- Teeth
- Eyes
- Overall structure and muscling

Feet and Legs

Evaluate feet and leg structure initially at selection. Correct conformation of feet and legs (Figures 2A and 2B) and how they blend into the shoulder and hip structure directly impacts how well cattle can forage and walk to water. When watching cattle walk, their back feet should step into the footprints from the front feet. From behind, the same distance between the hocks should be observed at the pasterns. Any decrease in the ability to forage will have a direct impact on body condition score and production.

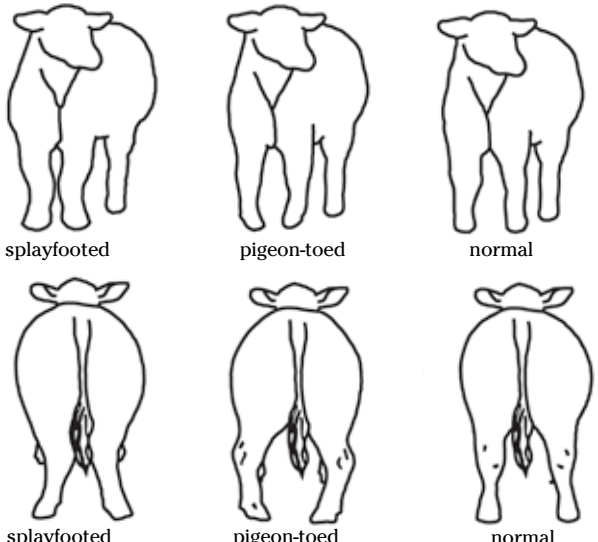


Figure 2A. Conformation of beef cattle

Note: Select cattle with normal conformation. Avoid splayfooted or pigeon-toed individuals.

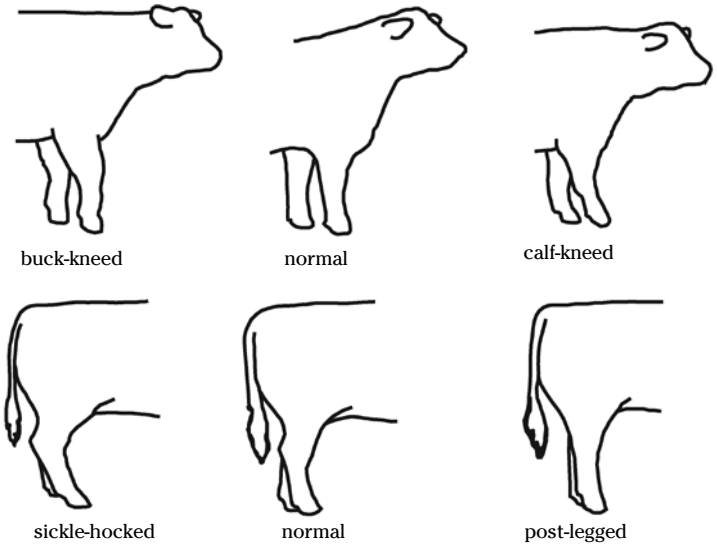


Figure 2B. Conformation of beef cattle from a side view

Note: Select individuals with proper conformation, avoiding cattle with too much or too little angle in the front or rear leg structure.

Both the front and rear feet should be facing forward with no evidence of toes pointing in (pigeon-toed) or toes pointing out (splayfooted). Also, cattle should have a correct set or angle of the front and rear legs into the shoulders or hips. Evaluate cattle for being sickle-hocked (too much angle from pastern to hock to hip) or post-legged (too little angle from pastern to hock to hip), and watch for cattle that are straight in the front shoulders.

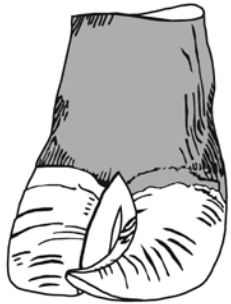


Figure 3. Screwclaw

Note: Screwclaw will impact mobility and longevity of cattle. It is also highly heritable.

You should also 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 legs and hips during breeding. Look for signs of screwclaw (Figure 3). 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 cowherd.

Udder Structure and Abnormalities

Udder and teat conformation is very important in beef cattle. Improper udder or teat structure will reduce longevity in the cowherd. Udders should be composed of four small, equally spaced teats centered under each quarter. Oversized teats provide difficulty for newborn calves to nurse and receive adequate colostrum, which could lead to a higher incidence of scours or decreased immunity levels in the newborn calf. Teat circumference causes more problems than teat length in newborn calves. As teat size and spacing is a heritable trait, you should evaluate this when selecting replacement heifers.

Udders also need correct support. When viewing the udder from the side, it needs to exhibit a level udder floor without any quartering. The median suspensory ligament supports the udder to the cow's body wall. A weak suspensory ligament allows the udder to hang down too far from the body and subjects the udder to serious problems, including increased risk of injury and mastitis.

Just like dairy cattle, increased milk production will adversely affect udder longevity in beef cattle. Research indicates that female beef cattle with higher maternal weaning weight or milk Expected Progeny Difference (EPD) values have a moderate genetic antagonism with udder quality. This enforces the concept of matching genetics with environmental conditions and limiting use of extremes.

Teeth

Teeth also impact production. To graze and physically break down roughages into small particles, a cow's teeth must be in good condition. The age of the animal has a direct effect on its teeth. Wearing of teeth becomes noticeable when beef cattle reach age five. Considerable wear can be found between the ages of five and seven. By age twelve, many or most of the teeth may be triangular or worn smooth to the gum line. Sandy soil environments can wear teeth down more quickly than average. It is important to cull cattle as teeth deteriorate and impact body condition score, production, and pregnancy status.

Eyes

Closely monitor eyes in beef cattle. Look for incidence of pinkeye, cancer eye, and other eye injuries. Pinkeye, left untreated, can cause blindness as well as other eye injuries. Also, look for cancer eye plaques on the eyeball, eyelid, or below the eye. It is important to get the cancer eye plaques removed or to cull the animal before the cancer enters the lymph system.

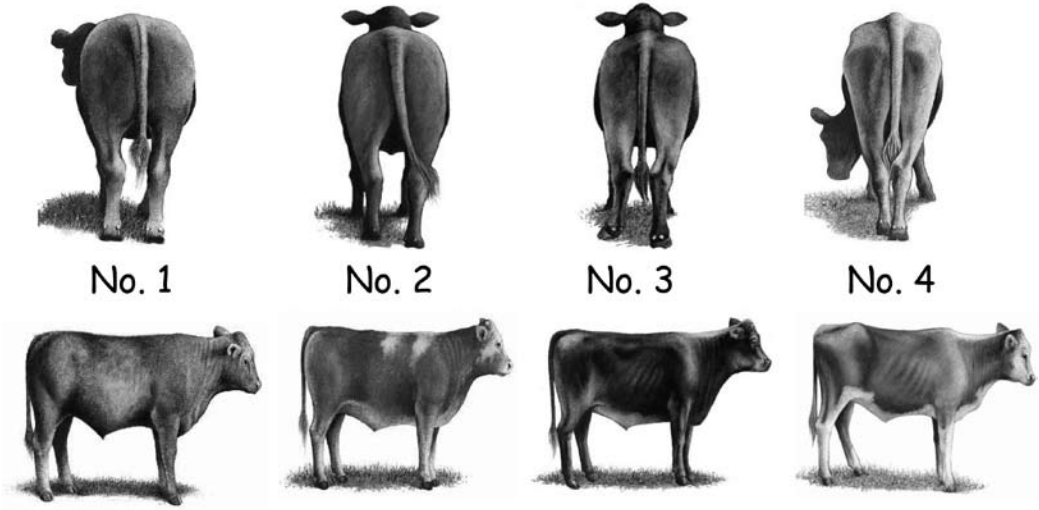


Figure 4. USDA feeder cattle grades; muscle thickness scores

Source: USDA/MRP/AMS

Overall Structure and Muscling

Evaluate cattle for adequate muscling. Beef cattle are raised for beef production. Make sure beef bulls, cows, and calves exhibit average muscling or above. Generally, bulls and steers exhibit more muscling than females. Use the USDA muscling score chart (Figure 4) as a guide to evaluate muscling. The target should be USDA 1 or 2 muscling scores. Muscling scores will not necessarily impact longevity in the herd but will most certainly have economic impacts as calves are sold. For example, calves with USDA muscle scores 1 and 2 will generally sell for higher prices than calves with USDA muscle scores 3 and 4.

Measures of Performance

Written records on beef cattle are essential for informed selection and culling decisions, both of which have an economic impact on your herd. Written records may also allow you to participate in beef alliances and source and age verification programs. Written records can be kept in Redbooks, notebooks, tablets, or on a computer. Regardless of your record-keeping style, it is crucial to keep your records in a safe place.

The minimum information to record on each animal is individual identification, birth date, dam age, and weaning weight. Note that it is never a good idea to take records on traits that you will not utilize in decision making or marketing.

Birth Dates

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 the age of an animal and will be useful in selecting replacements in a commercial operation.

Performance Records

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 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. Some commercial producers utilize just paper records in decision making. Others record information in a computer spreadsheet or programs specifically designed to analyze commercial cow-calf data. Others send their data to programs such as Alabama BCIA (http://www.albcia.org) for processing. Alabama BCIA is set up to input and run commercial cow-calf records.

Calving Ease

Calving ease is recorded at birth. This is an indication of how easily a calf was born. This data is analyzed to help predict which bulls will produce daughters that calve easily. A 5-point scale is used to record calving ease (Table 2).

Table 2. 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 (e.g., breech, upside down)

Birth Weight

Birth weight is an indication of calving difficulty. Birth weights should be adjusted for the sex of the calf and the age of the dam. In general, bull calves are 7 percent heavier than heifer calves. Also, calves born to cows younger than five are generally 3 to 8 pounds lighter than calves born to mature cows (5 to 10 years of age). Birth weights need to be measured and recorded within 24 hours of birth.

If your commercial herd needs calving-ease bulls, you should select bulls based on birth weight EPDs. Birth weight EPDs are the best indicator of birth weight since EPDs account for the sex of the calf, the age of the dam, and whether the dam was a recipient dam. Using actual birth weights to select herd bulls is the least accurate method of ensuring minimal calving difficulty.

Weaning Weight

Weaning weight of a 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 the 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.

In a normal production environment, calves should be weighed between 160 and 240 days of age. This allows you to adjust the weaning weight to a 205-day weight. You can also measure height to determine frame score. Calves do not need to be physically weaned at this time. They can remain with the cows until feed resources become limited, or until 60 days before calving will begin again.

For comparison of calves, it is best if all calves are weighed on the same day, and the range of ages is between 160 and 240 days. If the age range is wider than this, it is best to break the weigh dates into two or more groups. In this case, make sure the age range of each group is between 160 and 240 days. If calves come from multiple pastures, also record the pasture each calf was raised in.

In times of extreme drought or limited resources, calves can be early weaned. Typically, an early weaned calf is physically weaned and weighed between 90 and 120 days. Early weaning means less feed resources are needed for the cowherd. In general, feed resources needed for early weaned calves are less than the cowherd with calves at side.

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

Yearling Measurements

Yearling measurements are an indication of postweaning growth of the individual calf. Typical yearling measurements include weight, height, scrotal circumference (in breeding bulls), and carcass ultrasound traits. All yearling measurements should be taken between 330 and 400 days of age. Again, calves should be measured and recorded on the same day in the proper age range.

Yearling weights are adjusted for the age of the calf as well as the weaning factors discussed above. Besides ranking animals based on growth from weaning to yearling, yearling weights also ensure replacement heifers are on track to reach target breeding weight (65 percent of mature weight) at 15 months of age. Body condition scores should also be taken at yearling. Animals with good yearling weights but poor body condition scores are probably "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 Alabama Cooperative Extension publication, ANR-1100, or visit http://www.beefimprovement.org/library/.

Yearling scrotal circumference is part of a breeding soundness exam. The actual scrotal circumference measurement is an indication of the bull's ability to produce and store sperm, his age at puberty, and his subsequent daughters' ages at puberty. The Society of Theriogenology has established a minimum scrotal circumference measurement of 30 cm for yearling bulls to classify him as a satisfactory potential breeder. He must also pass minimum sperm morphology and motility standards.

The equation to adjust scrotal circumference measurements taken at yearling is:

Adjusted 365-day Scrotal Circumference = Scrotal Circumference + [(365 – Age in days) X Breed Age Adjustment Factor]

Table 3. Age Adjustment Factors for Yearling Scrotal Circumference by Breed

Breed	Adjustment[1]
Angus	0.0374
Red Angus	0.0324
Brangus	0.0708
Charolais	0.0505
Gelbvieh	0.0505
Hereford	0.0425
Polled Hereford	0.0305
Limousin	0.0590
Salers	0.0574
Simmental	0.0543

Source: Adapted from Geske, J.M., R.R. Schalles, and K.O. Zoellner. 1995. *Yearling scrotal circumference prediction equation and age adjustment factors for various breeds of beef bulls*. Agricultural Experiment Station, Kansas State University, Report of Progress 727:99.

[1]Most breed associations have refined the adjustment factors. Refer to your breed association's adjustment factors as appropriate.

Yearling ultrasound measurements for carcass merit should be taken by a certified ultrasound technician (http://www.aptcbeef.org). Measures include rump fat, 12th rib fat, rib eye area, and percent intramuscular fat. Independent laboratories interpret the ultrasound images. Purebred cattle data is reported to the appropriate breed association for EPD analysis. For commercial cattle, adjusted data and ratios are returned to the owner for selection and culling decisions.

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

Cattle should not be selected based on a single piece of information or trait. For commercial females, available information will be in the form of adjusted weights and ratios. When making selecting decisions about purebred or composite bulls, you should assess EPD values as well as the environmental conditions. For most producers, maximization of production traits (e.g., using weights, ratios, or EPDs) is not the solution. Performance information should be coupled with data regarding structural soundness and the farm environment to arrive at final selection or culling decisions.

Frame Scores of Cattle

Frame scores are a way to evaluate skeletal size of cattle. Frame scores can also be used to predict final mature weights of cattle which affect stocking rates and nutrient requirements for the herd. Cattle are typically measured for frame score at weaning or yearling; however, mature cattle can also be measured. With appropriate nutrition, most animals should maintain the same frame score throughout their lifetime. If an animal matures earlier or later than average, its frame score can change.

To determine frame score, you need to measure the height of the animal over the hip (Figure 5). To begin, make sure the animal is standing level and naturally. A frame score stick can be purchased 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 1-inch and ½-inch increment until reaching 70 inches (or as tall as your tallest animal). Fasten the plywood or lumber to the scale box or working chute, ensuring that the 30-inch mark is correctly positioned from the bottom of the scale box or chute.

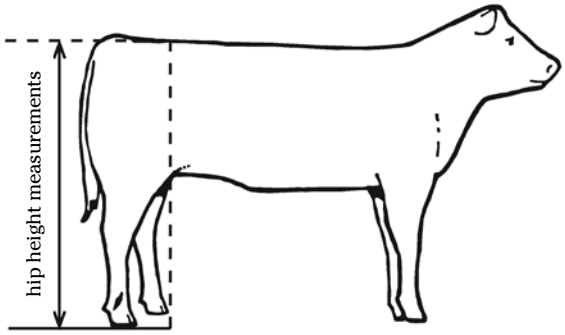


Figure 5. Correct measurement location over the hips to determine frame score in cattle

To determine frame score, you also need the age and sex of the animal (Tables 4 through 8). Using the age, find the height measurement in the table, and read the corresponding frame score. For example, if a heifer at 7 months has a hip-height measurement of 45 inches, the heifer would have a frame score of 6.

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

Age (months)	Frame Score								
	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	46.5	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 BIF Guidelines, 8th Edition. http://www.beefimprovement.org/library.

Table 5. 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	47.3	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

Source: Adapted from BIF Guidelines, 8th Edition. http://www.beefimprovement.org/library.

Table 6. Hip Heights (inches) and Associated Frame Scores for Growing Heifers

Age (months)	Frame Score								
	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	47.4	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	45.5	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 BIF Guidelines, 8th Edition. http://www.beefimprovement.org/library.

Table 7. 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

Source: Adapted from BIF Guidelines, 8th Edition. http://www.beefimprovement.org/library.

Table 8. Approximate Harvest and Mature Weights of Cattle Based on Frame Score

	Frame Score					
Type of Animal	3	4	5	6	7	8
Steer harvest weight (pounds)	1010	1105	1200	1295	1390	1485
Heifer harvest weight (pounds)	860	940	1020	1100	1180	1260
Mature bull weight (pounds)	1590	1740	1890	2040	2190	2340
Mature cow weight (pounds)	1010	1105	1200	1295	1390	1485

Reproductive Management

Control of Reproduction

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

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

According to a recent survey, pregnancy and calving in the Southeastern part of the country is at 88 percent. In Alabama, however, pregnancy and calving are estimated to be 7 to 8 percent lower, or only 80 to 81 percent. We can improve these figures if we know and understand the factors affecting reproductive performance in a cowherd.

Table 1. General Reproductive Information

	Average	Range	Comments
Age at puberty	10 to 12 months	6 to 24 months	• Varies with breed. • Brahmans and continental breeds usually reach puberty later than British breeds.
Gestation	283 days	273 to 290 days	• Bull calves are often carried slightly longer. • Brahman type cattle often have longer gestations.
Length of estrous cycle	21 days	18 to 24 days	• Heifers often have slightly shorter cycles than cows.
Length of estrus (heat)	18 hours	6 to 30 hours	• Signs include restlessness, clear mucous vaginal discharge, and mounting other animals. The primary sign is "standing to be mounted."
Interval to first heat after calving	45 days	16 to 90+ days	• Retained afterbirth and uterine infection delay onset. • Adequate body condition is critical.
Reproductive life	10 years	Up to 15 years (rarely longer)	• Management, death loss, and culling 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

Drugs used for estrus synchronization programs often mimic what occurs during a cow or heifer's normal estrous cycle. Therefore, understanding the physiology of the normal estrous cycle is critical to understanding estrus synchronization programs.

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 (PGF2α) 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 encounter the egg. Capacitation 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 the cow becomes pregnant, the embryo in the uterus prevents the release of PGF2α. 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.

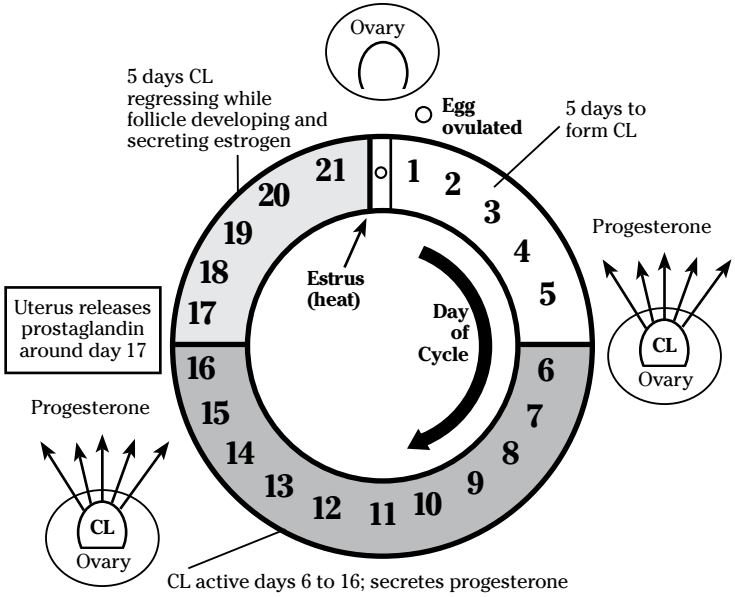


Figure 1. Cyclicity—the normal 21-day cycle

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.

The 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	1100 pounds	
Target weight at breeding (65 percent 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	165 pounds	
ADG needed	1.37 pounds/day	

[1]Calculate 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 (Different Frame Sizes)

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.

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

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

Estrus Synchronization Programs

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

- Prostaglandin (PGF2α) 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 PGF2α.
- 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 PGF2α injection.

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

- The animals were not cycling.
  - Cows must be in sufficient body condition at calving and have adequate nutrition available to return to cyclicity 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 persons 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 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.

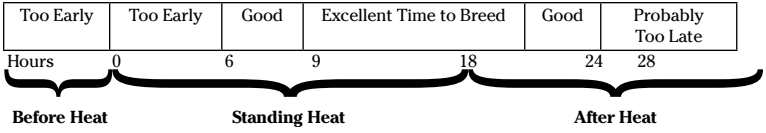


Figure 2. Timing of artificial insemination for maximum conception

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 a.m.-p.m. rule. An animal first observed in heat in the a.m. should be inseminated that p.m.. An animal first observed in heat in the p.m. should be inseminated the next a.m..
- An alternative to the traditional a.m.-p.m. rule is to inseminate animals on a once-a-day schedule in the morning. Animals in heat in the a.m. are bred that morning. Animals in heat in the p.m. are bred the next morning. Breeding animals once per day may be a more efficient use of labor and can be a reliable method for artificially inseminating cattle. However, if you use this method, you must continue to monitor heat activity a minimum of twice each day (a.m. and p.m.).

- Some producers may consider the use of timed artificial insemination in which insemination occurs at a predetermined time following an appropriate synchronization program. Timed artificial insemination allows for a more regimented schedule, but often results in poorer conception rates.

Parturition (Calving)

Observation of cows and heifers before and during the calving season is necessary to ensure a good calf crop percentage. Observe cows at least daily during the calving season, and observe heifers more frequently (perhaps several times a day). It is important that you are familiar with the signs of impending parturition, as well as the sequence of events associated with normal labor and delivery to determine when assistance is necessary.

Signs of Impending Parturition

- The udder and vulva will often enlarge 1 to 3 weeks prior to parturition.
- Cows and heifers often become nervous (restless) and will isolate themselves from the rest of the herd just prior to parturition.
- Cows and heifers may show signs of abdominal discomfort by kicking at their belly. They may also glance to the rear nervously.

Normal parturition is divided into three stages:

Table 3. Three Stages of Parturition

Stage	Duration	Comments
Stage I Preparatory	cows (4 to 8 hours) heifers (6 to 12 hours)	• Cow or heifer may become nervous and isolate herself from the rest of the herd. • Uterine contractions begin. • "Dropping" of colostrum into the teats. • Water bag appears toward the end of this stage. Stage II begins when the water bag breaks.
Stage II Delivery of the calf	cows (< 1 hour) heifers (1 to 4 hours)	• Cow or heifer is now actively straining. • In normal parturition, the calf's forelegs and head protrude first about 70 percent of the time, and the hind legs and tail come first about 30 percent of the time. • The calf is delivered.
Stage III Expulsion of the placenta (afterbirth)	cows (1 to 12 hours) heifers (1 to 12 hours) This usually occurs within the first few hours.	• 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.)

It might be necessary for you to assist 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 as needed.

Supplies Needed to Assist With Calf Delivery

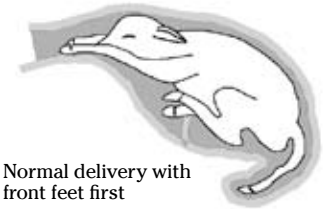
- Obstetrical (OB) chains or ropes. (Chains are preferred because they can be easily disinfected after use.) OB chains and ropes are used for pulling on the legs. Never attach OB chains or ropes to the jaw and then pull on a calf; the jaw will almost always fracture.
- OB handles for pulling on the chains or ropes.
- Mechanical calf puller, also known as a "calf jack." USE WITH CAUTION, AND DO NOT APPLY EXCESSIVE FORCE. Calf pullers 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
- Tincture of iodine for disinfecting calf's navel

Providing Assistance During Parturition

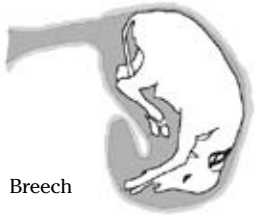
The first step in providing assistance during parturition is assessing the problem. Several common situations encountered when delivering a calf are described below and illustrated in figure 3.

- Normal delivery
  - o The calf's forelegs and head protrude first about 70 percent of the time.
  - o The hind legs and tail come first about 30 percent of the time. Always make sure the tail is protruding with the hind legs in this situation.
- Calf too big (not illustrated)
  - o Most frequently encountered in heifers, but it can also occur in cows.
  - o 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.
  - o Call a veterinarian as soon as you determine that 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.

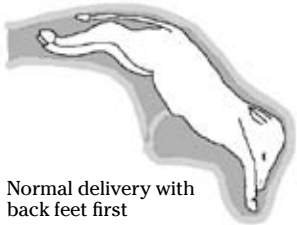
- Breech (hindquarters first with both hind legs retained)
  - Both hind legs and the tail must be straightened out and placed correctly within the birth canal for delivery to proceed.



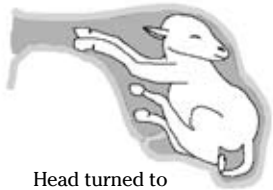
Normal delivery with front feet first



Breech

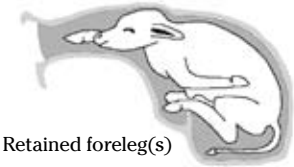


Normal delivery with back feet first

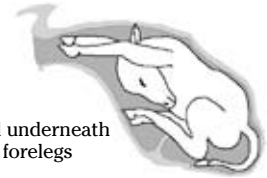


Head turned to the side

- Head turned to the side
  - The neck must be straightened out and the head placed on top of the forelegs for delivery to proceed.
- 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.
- Head underneath both forelegs
  - The head must be placed on top of the forelegs, and then delivery can proceed.



Retained foreleg(s)



Head underneath both forelegs

Figure 3. Common situations encountered when delivering a calf

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 carnucles are present on the prolapsed tissue, the cow has a uterine prolapse. The carnucles 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 3 to 12 percent of all calvings. Closely evaluate your herd's nutrition if you are experiencing a more 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 listed 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 = (Number palpated pregnant ÷ Number of cows exposed) x 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 = (Number of lives calves ÷ Number of cows exposed to breeding) x 100

- Weaning percent (WP), also called "percent calf crop weaned," is the single most descriptive measure of reproductive performance of a cowherd.

  WP = (Number of live calves weaned ÷ Number of cows exposed to bulls) x 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 = [Age (in days) at first calving – Age at last calving + 365] ÷ 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*)
- and others

Noninfectious Causes of Infertility or Abortion

- Nutrition
  - o Poor body condition score
  - o 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 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 strung-out calves. Establish a controlled breeding and calving season.
- 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 before breeding season.
- Select early born replacement heifers.
- Select replacement females based on performance.
- Develop replacement heifers to reach target weight to breed as yearlings.
- Breed replacement heifers 2 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.
- Check bulls to determine if and why they are not settling cows.
- Use only bulls that pass an annual breeding soundness evaluation (BSE) 60 days prior to 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.

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.

A bull BSE includes the following components:

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 4 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 percent 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 percent normal sperm to pass a BSE.

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

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 percent sperm motility
- produces at least 70 percent normal sperm

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.

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 they are doing their job. A BSE also does not guarantee that bulls are free of infectious diseases, so consult with 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 4. 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 "Breeding Soundness Evaluation Form" (Hastings, NE: 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

Note: Any irregular shape or swelling may indicate abnormal structure, illness, or injury.

Table 5. Ratio of Heifers or Cows per Bull

Age of Bull	Ratio of Heifers or Cows per Bull
12 to 18 months	1:10 to 15
2 years	1:15 to 20
3 to 7 years	1:25 to 30
Aged (7 plus)	1:20 to 40

Table 6. How Reproductive Performance Affects Breakeven Prices per Pound of Calf at Fifteen Production Levels and Four Annual Calf Production Costs

Percent Calf Crop Weaned/Average Market Weight	Pounds of Calf per Cow	Annual Calf Production Cost[1]				
		$250	$300	$400	$500	Yours[2]
90/600	540	$0.46	$0.56	$0.74	$0.93	
90/550	495	$0.51	$0.61	$0.81	$1.01	
90/500	450	$0.56	$0.67	$0.89	$1.11	
90/450	405	$0.62	$0.74	$0.99	$1.23	
90/400	360	$0.69	$0.83	$1.11	$1.39	
80/600	480	$0.52	$0.62	$0.83	$1.04	
80/550	440	$0.57	$0.68	$0.91	$1.14	
80/500	400	$0.63	$0.75	$1.00	$1.25	
80/450	360	$0.69	$0.83	$1.11	$1.39	
80/400	320	$0.78	$0.94	$1.25	$1.56	
70/600	420	$0.60	$0.71	$0.95	$1.19	
70/550	385	$0.65	$0.78	$1.03	$1.30	
70/500	350	$0.71	$0.86	$1.14	$1.43	
70/450	315	$0.79	$0.95	$1.27	$1.59	
70/400	280	$0.89	$1.07	$1.43	$1.79	

Source: Adapted from L.R. Sprott, "Break-even Costs for Cow/Calf Producers," Pub L-5220 (*College Station, Texas*: Texas Cooperative Extension, 1998).

[1] Annual calf production cost per cow is the total cow-calf production cost, less cull cow and bull revenue, divided by the total number of brood cows.

[2] Your breakeven cost per pound of calf produced =

$$\frac{\text{Your annual calf production cost}}{\text{Pounds of calf per cow}}$$

Management and Marketing Economics

Beef Cattle Economics

Each of us makes economic decisions every day. Earning and spending money involves economic decision making. These decisions influence the way our economy functions. Similarly, decisions made by beef consumers and beef cattle farmers result in changes in the cattle industry each day.

The economics of beef cattle management and marketing is really a study of human behavior. Cattle prices are determined by how much beef consumers choose to buy and how much beef farmers choose to sell in the marketplace. If consumers want to buy more beef than is available, the price is bid up, thereby rationing the beef among buyers. If beef farmers need to sell more beef than consumers are willing to buy, the price of beef is forced down to move the excess supply.

The United States beef industry has evolved into an intricate, highly sophisticated beef production system. Beef farmers add value to their products at each stage in the management and marketing process. Cow-calf farmers produce a product called a *calf*. What they are really selling is not just the calf, but output from the cow and bull and the grass, grain, labor, management, and capital used to produce the calf. Stocker operators buy 300- to 500-pound feeder calves from cow-calf farmers. Then, the stock operators put an additional 300 to 400 pounds of weight gain on the calves and sell them as feeder cattle, thereby increasing their value in the marketplace. Feedlots buy the feeder cattle, feed grain to finish them, and sell them at about 1,100 to 1,300 pounds to a meat packer. Packers slaughter the finished cattle and break the carcass into wholesale cuts for purveyors and retailers who, in turn, sell the beef cuts to consumers.

Beef cattle management and marketing economics are simply the beef farmers' way of obtaining dollars for the value added to the products they produce. The following beef cattle management and marketing economic tables and figures are provided to help you make wise economic decisions.

Table 1. Beef Enterprise Investment Cost (Owned Real Estate)

Item	Number	Units	Dollars per Unit	Percent Charged	Total Dollars	Dollars per Cow	Dollars per Acre
Land	200	acres	2,200	100	440,000	4,400	2,200
Well and pump	1	each	4,500	100	4,500	45	23
Cows	100	head	1,000	100	100,000	1,000	500
Bulls	3	head	2,000	100	6,000	60	30
Commodity barn	1	each	6,500	100	6,500	65	33
Equipment barn	1	each	4,500	100	4,500	45	23
Tractor and implements	1	each	55,000	50	27,500	275	138
Pickup	1	each	20,000	50	10,000	100	50
Fences	4	miles	3,960	100	15,840	158	79
Corral	1	each	6,500	100	6,500	65	33
Water troughs	4	each	500	100	2,000	20	10
Mineral troughs	4	each	250	100	1,000	10	5
Total Beef Enterprise Investment Cost					**$624,340**	**$6,243**	**$3,124**

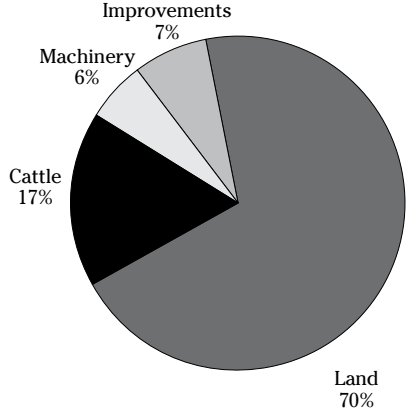


Figure 1. Beef enterprise investment cost

Table 2. Cow-Calf Budget, Raised Replacements, One Bull Unit, 60 Acres, Preconditioned Feeders, 10-Year Average Cattle Market Prices, Alabama, 2007[1]

30	Cow herd size	90	Percent weaning rate	8	Labor hours/cow/year
30	Cows per bull ratio	15	Percent culling of cows	100	Days cow-herd fed supplement
30	Grass pasture acres	25	Percent culling of bulls	3	Pounds/head/day—cow herd
30	Grass and clover pasture acres	17	Percent culling of replacements	45	Days on preconditioning/backgrounding feed
0	Small grain and ryegrass acres	1.5	Percent death loss, cow-herd	18	Pounds/head/day, preconditioning/
		0	Percent death loss, backgrounders		backgrounding

Item	Head	Unit	Quantity	Price or Cost/Unit	Total Value/Cost	Dollars/ Brood Cow	Percent of Total
Gross Receipts(1)							
Steer calves	13.00	cwt.	7.00	91.19	8,298.29	277	53
Heifer calves	8.00	cwt.	6.50	87.72	4,561.44	152	29
Cull cows	5.00	cwt.	11.00	37.76	2,076.80	69	13
Cull replacement heifers	1.00	cwt.	9.00	63.63	572.67	19	4
Cull bulls	0.25	cwt.	17.00	52.05	221.21	7	1
Total					**15,730.41**	**524**	**100**
Variable Costs(2)							
Grass pasture		acre	30.00	80.88	2,426.40	81	11
Grass and clover pasture		acre	30.00	66.93	2,007.90	67	9
Small grains and ryegrass		acre	0.00	163.55	0.00	0	0
Hay purchased		ton	38.75	70.00	2,712.50	90	12
Supplements—cow-herd		ton	4.65	70.00	325.50	11	1
Backgrounding feed		ton	10.94	70.00	765.45	26	3
Veterinarian and medical—cow-herd(3)		head	31.00	18.00	558.00	19	2
Veterinarian and medical—calves(3)		head	27.00	14.00	378.00	13	2
Veterinarian and medical—backgrounders(3)		head	27.00	6.00	162.00	5	1

Salt and minerals	cwt	24.00	16.00	384.00	13	2
Custom hauling	head	27.00	3.25	87.75	3	0
Labor	hour	295.71	7.25	2,143.90	71	9
Land rental	acre	60.00	18.50	1,110.00	37	5
Sales commission	dollars	15,730.41	0.03	471.91	16	2
National/state promotion fee	head	27.00	1.50	40.50	1	0
Miscellaneous supplies	head	31.00	5.00	155.00	5	1
Bull replacement	head	0.25	2,000.00	500.00	17	2
Equipment (repair)	dollars			444.96	15	2
Interest on operating capital	dollars	7,080.68	0.0900	637.26	21	3
Total Variable Cost				**15,311.03**	**510**	**68**
Income Above Variable Cost				**419.38**	**14**	
Fixed Costs						
General overhead	unit	1.00	210.00	210.00	7	1
Grass pasture	acre	30.00	21.03	630.81	21	3
Grass and clover pasture	acre	30.00	21.03	630.81	21	3
Small grains and ryegrass	acre	0.00	7.84	0.00	0	0
Interest on livestock capital	dollars	23,000.00	0.0800	1,840.00	61	8
Interest on building and equipment	dollars	17,584.13	0.0800	1,406.73	47	6
Depreciation on building and equipment	dollars			1,886.36	63	8
Other fixed costs on building and equipment	dollars			666.01	22	3
Total Fixed Costs				**7,270.72**	**242**	**32**
Total Costs of All Specified Expenses				**22,581.75**	**753**	**100**
Net Returns Above Total Costs				**-6,851.34**	**-228**	

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

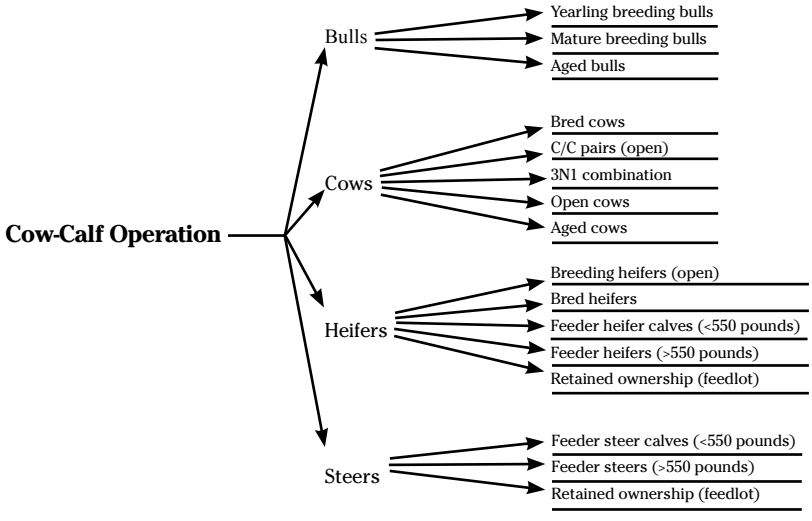


Figure 2. Potential beef cattle market products for a commercial cow-calf operation

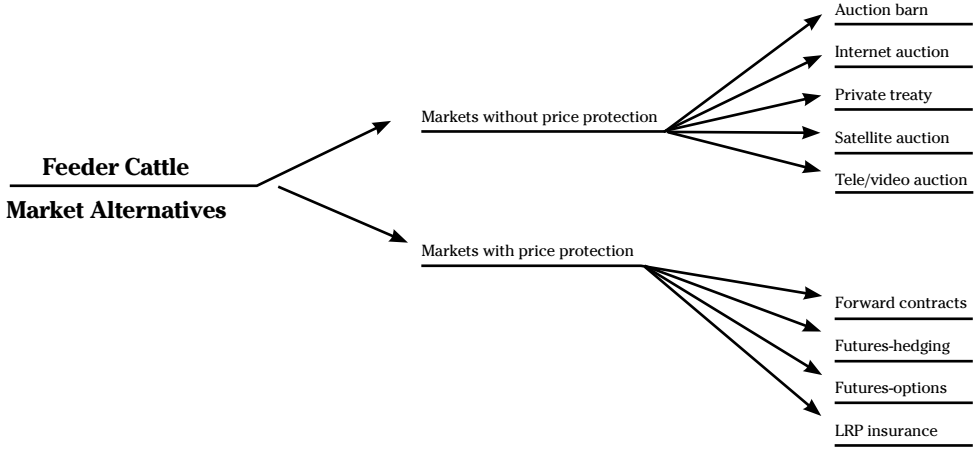


Figure 3. Feeder cattle market alternatives

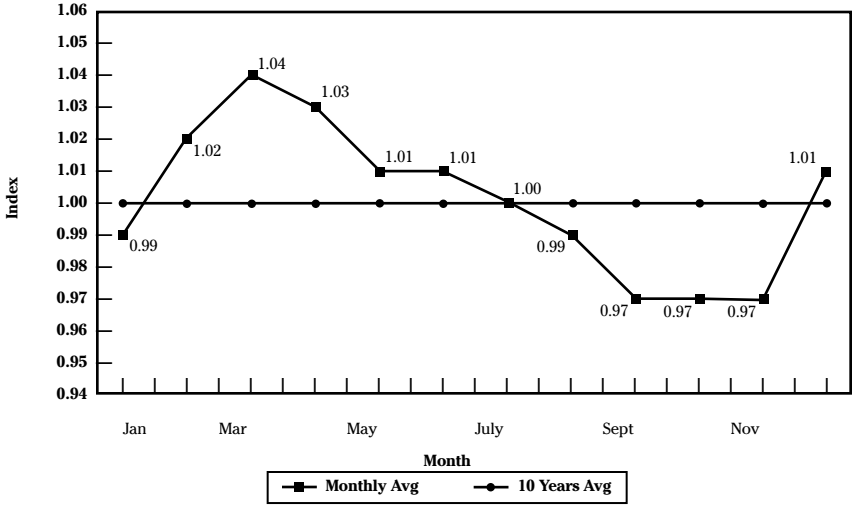


Figure 4. Seasonal feeder steer price indices, 500 to 600 pounds, medium and large frame, #1 muscling score, 1997-2006, Alabama

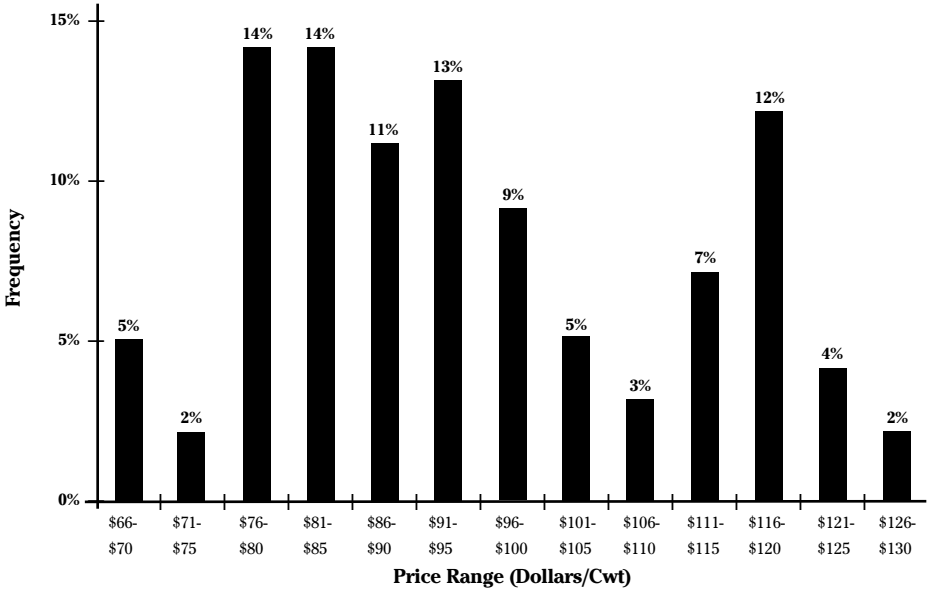


Figure 5. Price distribution of feeder steers, 500 to 600 pounds, medium and large frame, #1 muscling score, 1997-2006, Alabama

Table 3. Annual Payments (Principal and Interest) Required to Amortize a $1,000 Loan

Interest Rate	Length of Loan (in years)										
	1	2	3	4	5	7	10	15	20	25	30
1%	$1,010.00	$507.51	$340.02	$256.28	$206.04	$148.63	$105.58	$72.12	$55.42	$45.41	$38.75
2%	$1,020.00	$515.05	$346.75	$262.62	$212.16	$154.51	$111.33	$77.83	$61.16	$51.22	$44.65
3%	$1,030.00	$522.61	$353.53	$269.03	$218.35	$160.51	$117.23	$83.77	$67.22	$57.43	$51.02
4%	$1,040.00	$530.20	$360.35	$275.49	$224.63	$166.61	$123.29	$89.94	$73.58	$64.01	$57.83
5%	$1,050.00	$537.80	$367.21	$282.01	$230.97	$172.82	$129.50	$96.34	$80.24	$70.95	$65.05
6%	$1,060.00	$545.44	$374.11	$288.59	$237.40	$179.14	$135.87	$102.96	$87.18	$78.23	$72.65
7%	$1,070.00	$553.09	$381.05	$295.23	$243.89	$185.55	$142.38	$109.79	$94.39	$85.81	$80.59
8%	$1,080.00	$560.77	$388.03	$301.92	$250.46	$192.07	$149.03	$116.83	$101.85	$93.68	$88.83
9%	$1,090.00	$568.47	$395.05	$308.67	$257.09	$198.69	$155.82	$124.06	$109.55	$101.81	$97.34
10%	$1,100.00	$576.19	$402.11	$315.47	$263.80	$205.41	$162.75	$131.47	$117.46	$110.17	$106.08
11%	$1,110.00	$583.93	$409.21	$322.33	$270.57	$212.22	$169.80	$139.07	$125.58	$118.74	$115.02
12%	$1,120.00	$591.70	$416.35	$329.23	$277.41	$219.12	$176.98	$146.82	$133.88	$127.50	$124.14
13%	$1,130.00	$599.48	$423.52	$336.19	$284.31	$226.11	$184.29	$154.74	$142.35	$136.43	$133.41
14%	$1,140.00	$607.29	$430.73	$343.20	$291.28	$233.19	$191.71	$162.81	$150.99	$145.50	$142.80
15%	$1,150.00	$615.12	$437.98	$350.27	$298.32	$240.36	$199.25	$171.02	$159.76	$154.70	$152.30

Example: You want to buy a herd bull for $3,000. Your lender will finance the bull over 5 years at 9 percent interest rate. To find the annual payments to finance the bull, identify 9 percent in the left column and 5 years in the row at the top of the table. The intersection of the interest-rate row and 5-year column is $257.09. This is the annual payment (principal and interest) necessary to repay a $1,000 loan amortized over 5 years at 9 percent interest. Thus, an annual payment of $771.27 (3 x 257.09) would be needed to pay for the $3,000 herd bull over 5 years.

Table 4. Beef Enterprise Financial Strength/Weakness Measures, 2007

		Desirable	Caution	Undesirable
Asset turnover ratio =	Gross farm revenue / Average farm assets	40% or larger	20% to 40%	Less than 20%
Current ratio =	Current farm assets / Current farm debt	2 or larger	1 to 2	Less than 1
Debt to asset ratio =	Total farm debt / Total farm assets	Less than 40%	40% to 70%	Greater than 70%
Interest expense ratio =	Interest expense / Gross farm revenue	Less than 10%	10% to 20%	Greater than 20%
Net farm income =	Gross cash farm income - total cash farm expense - depreciation +/- inventory change	+$xxx,xxx	$0	-$xxx,xxx

Operating expense ratio =	Gross farm expense - farm interest expense - depreciation expense ——————— Gross farm revenue	Less than 60%	60% to 80%	Greater than 80%
Operating profit margin =	Net farm income + farm interest expense - value of operator's labor and management ——————— Gross revenue	Greater than 5%	0% to 5%	Less than 0%
Rate of return on farm assets =	Net farm income + farm interest expense - value of operator's labor and mgt. ——————— Average farm assets	Greater than 5%	0% to 5%	Less than 0%
Rate of return on farm equity =	Net farm income - value of operator's labor and mgt. ——————— Average farm equity	Greater than 10%	5% to 10%	Less than 5%

Meat Yield, Quality, and Value

Requirements Prior to Slaughter

Documentation of age. Because of the danger of Bovine Spongiform Encephalopathy (BSE), also known as mad-cow disease, it is now required that packing plants document the age of all of animals that are harvested. Research has shown that animals older than 30 months are at risk of carrying BSE. As a result, packing plants must remove all Specified Risk Material (SRM) such as spinal column, brain, and nerve ganglia of undocumented cattle and cattle older than 30 months. Many small packers require only a signed affidavit stating that the producer knows the animals are younger than 30 months. The producer should be able to provide documentation if requested. Other packers have a qualified person (usually a DVM) age the animal by oral dentition.

Withdrawal times for medications. One of the most important and often overlooked food safety aspects in beef is the presence of residual medications or other items that should not enter the human food chain. These are a result of producers not following the labeled withdrawal times for any injectable or orally administered medications or vaccines. 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 insure meat quality. Numerous management and nutritional factors may influence meat quality. Besides following labeled withdrawal times, there are several things you can do to maximize 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. Excess stress during the time prior to harvest may have negative impacts on meat quality. Longer-term stress from excessive transport, weather changes, or mixing unfamiliar cattle can cause the cattle to use energy stores in the muscle. This results in a condition called *Dark Cutter*, which causes a large price discount to the carcass.
- Document feed and feed additives. Many of today's contamination risks can be traced to feed sources and additives such as minerals, proteins, and fat supplements. Thorough documentation of everything included in an animal's diet is essential for proper tracing to contamination sources. Keeping feed tags from feedbags and diet formulations from the feedmill is a good way to document these sources.

Dressing and Dressing Percentage

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:

$$\text{Dressing percentage} = \frac{\text{Hot carcass weight}}{\text{Live weight}} \times 100$$

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. This is usually affected by muscling, fat cover, or both. Fatter carcasses and more heavily muscled carcasses have higher dressing percentages. The amount of fat is usually the most variable and therefore has the greatest impact on dressing percentage. Differences in the weight of the hide, internal organs, head, and so forth can also impact dressing percentage. The biggest variable in those items removed from the carcass during dressing is the gut—more specifically, the amount of gut fill. If an animal is fed right up until the time of harvest, it will have a full gut when the live weight is taken, resulting in a lower dressing percentage. The following table 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%)/double muscled	High amount of muscle/fat	63 to 67
Bulls	High muscle	65 to 69

USDA Quality and Yield Grading

Calculations

Quality grading. Quality grading is a determination of the eating quality of meat from beef carcasses. This grading is a combination of two specific factors: maturity and marbling.

- **Maturity.** The maturity of an animal refers to its chronological age and is determined by evaluation of the exposed bony cartilage and the lean texture of the carcass. The maturity is important to eating quality because as an animal gets older, the connective tissue, also known as *gristle*, becomes cross-linked and tougher to chew. The maturity scores are as follows:

  A = younger than 30 months
  B = 30 to 41 months
  C = 42 to 59 months
  D = 60 to 72 months
  E = older than 72 months

While the above ages in months are generally correct, the ultimate determination is made by evaluating the carcass and not by birth records or actual animal age.

- **Marbling.** The little flecks of fat that are found within muscle are called *intramuscular fat* or *marbling*. Having more marbling in the muscle tends to improve the eating quality of meat within a maturity score. Marbling has been shown to significantly improve flavor, juiciness, and to a certain extent, tenderness. It is appropriate to think of marbling as an "insurance policy" for good-eating beef steaks and not a guarantee of tenderness or any other eating quality. The amount of marbling in loin muscle is determined by trained meat graders and therefore may be somewhat subjective. Nevertheless, it has been shown to be the most valuable and accurate method for determining eating quality.

There are eight possible USDA quality grades: Prime, Choice, Select, Standard, Commercial, Utility, Cutter, and at one time, Canner. Only "young" beef receive the top four grades, and the bottom four are generally reserved for "old" beef. Nearly all commercially produced beef in the United States marketed through quality grocery stores and restaurants is from young beef. Commercial, Utility, and Cutter beef is usually further processed or sold in deeply discounted retail outlets and restaurants. Figure 1 shows the designation of USDA quality grades.

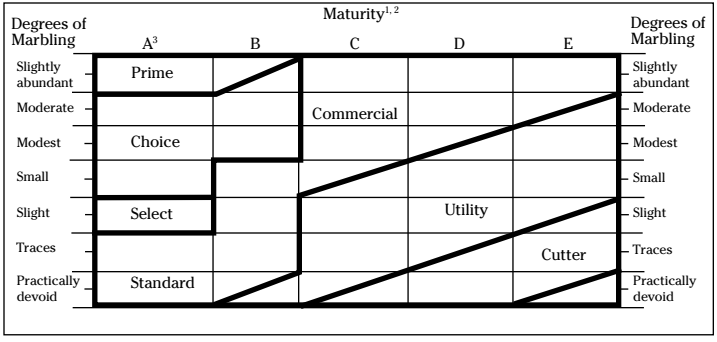


Figure 1. USDA quality grades

[1]Assumes that firmness of lean is comparably developed with the degree of marbling and that the carcass is not a "dark cutter."
[1, 2] Maturity increases from left to right (A through E).
[3] The A maturity portion of the figure is the only portion 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:

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

HCW = hot carcass weight
fat = subcutaneous fat measured opposite the rib eye at the 12th rib
KPH = kidney, pelvic, and heart fat as a percentage of the HCW
rib eye 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.

Interpretation

Quality grading. The higher the quality grade, the higher the expected eating quality. So, a Prime steak should be of higher eating quality than a Select steak. Also, the eating quality is only applied to steaks from the carcass, such as NY strip, rib eye, and T-bone, and not to roasts or ground products. Roasts tend to have higher amounts of gristle and are generally tough, even if they are taken from a Prime carcass. Additionally, ground beef is just that: ground pieces of lean and fat. Ground beef quality is almost solely dependent on the fat content percentage of the ground product.

Eating quality should be viewed as an insurance policy as it relates to the USDA quality grade. In other words, it is possible to get a Standard steak that eats wonderfully, but the odds of getting that steak are small compared to getting one that is graded Prime or Choice. Figure 2 illustrates relative eating quality from 0 to 10, with 0 representing poor eating quality and 10 representing great eating quality. The shaded area represents all steaks that we would find in each quality grade. As it shows, Prime is very high in eating quality and has very little variation (~8 to 10 in eating quality). While Standard may be very high in eating quality, on average these steaks are not as good and have much more variability (~0 to 9 in eating quality). This illustrates the insurance policy theory when selecting steaks from a higher quality grade.

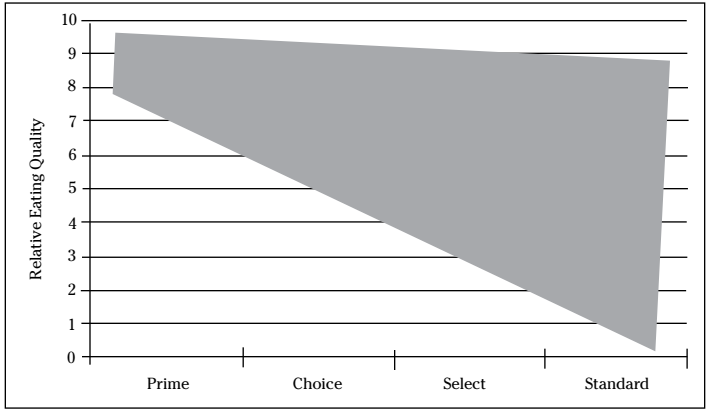


Figure 2. Relative eating quality

Yield grading. While quality grading is the subject of much speculation and interpretation, yield grading is more straightforward. Table 2 shows the relative yield of BCTRC that we would expect out of the four major wholesale cuts from a beef carcass.

Table 2. Relative Yield of BCTRC

USDA Yield Grade	Percentage of BCTRC
1.0 – 1.9	54.6 – 52.6
2.0 – 2.9	52.3 – 50.3
3.0 – 3.9	50.0 – 48.0
4.0 – 4.9	47.7 – 45.7
5.0 – 5.9	45.4 – 43.4

A good way to remember these yields is the following: a base YG 3.0 will yield 50 percent BCTRC, and a change of one full YG in either direction will change the percentage of BCTRC by ~2 percent. The difference in YG1 and YG5 may be more than 10 percent difference in yield.

Basic Fabrication of a Beef Carcass

Basic primal or wholesale cuts of a beef carcass are illustrated in figure 3. These primal cuts are packaged either whole or in parts (subprimals) in vacuum-packages. The cuts are then boxed at the packing plant, four to eight (or more) of the same cuts per box. These primals and subprimals are then shipped to retail outlets and restaurants where they are cut into individual portions and offered for sale. For complete information regarding primal and subprimal cuts, refer to the USDA Agricultural Marketing Service Web site: http://www.ams.usda.gov/lsg/imps/imps100pc.pdf.

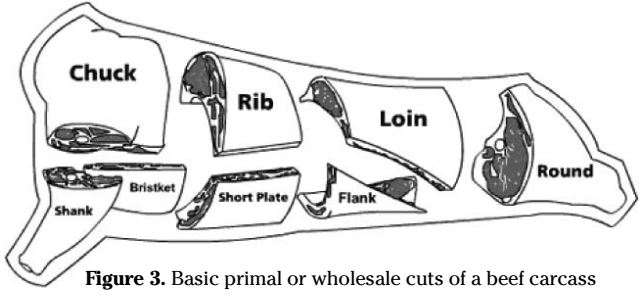


Figure 3. Basic primal or wholesale cuts of a beef carcass

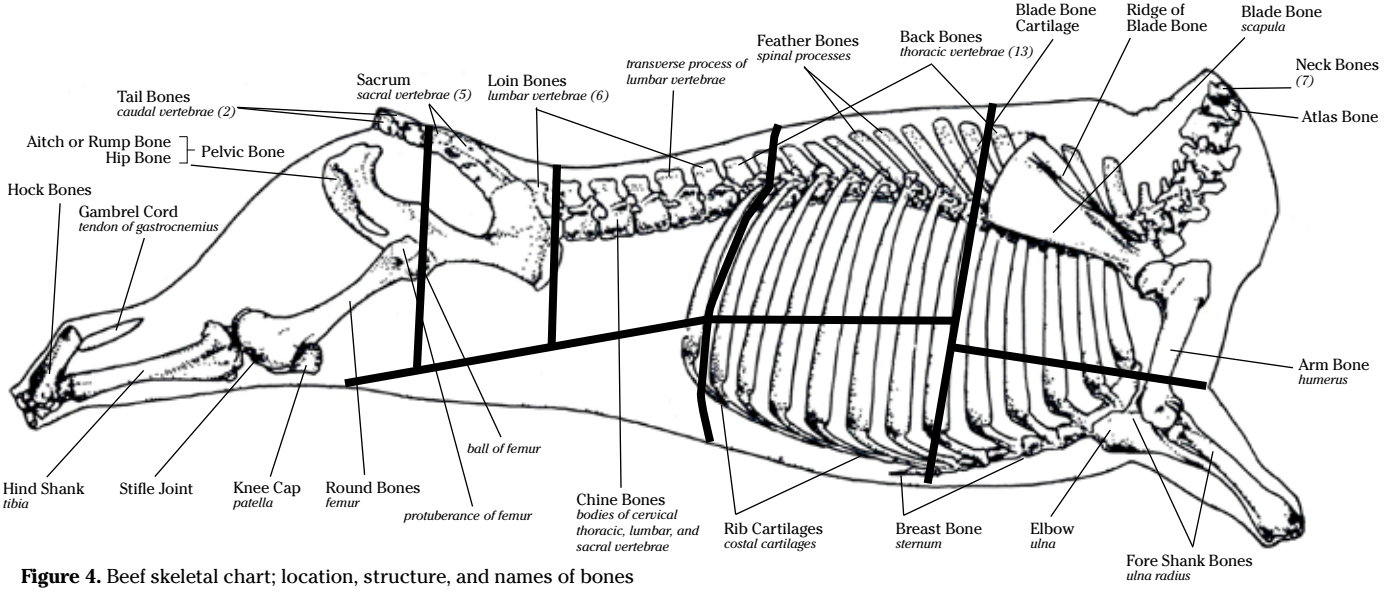
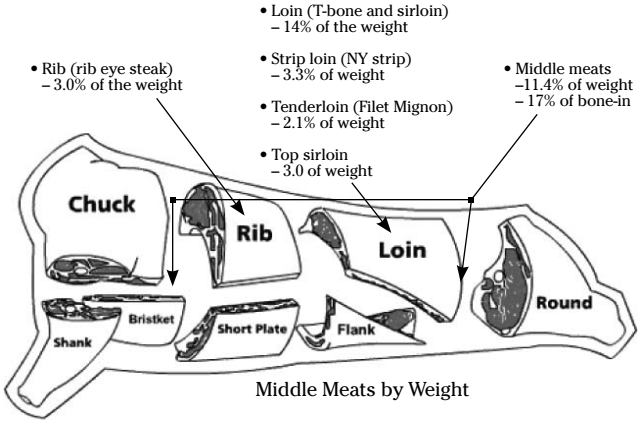
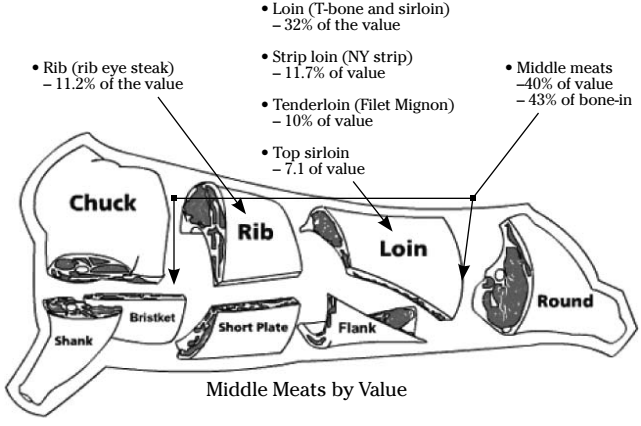


Figure 4. Beef skeletal chart; location, structure, and names of bones

Source: Adapted from a publication of the American Meat Science Association.

Note: Dark lines on the skeleton above represent the approximate location for each separation.





Figusre 5. Relative yield of various cuts

Value-Based Pricing of Meat

To get a handle on the true value of the animal at market, we must have a good understanding of the potential profit losses or opportunities. Since we sell meat as dollars per pound, a good understanding of where weight is lost in the process is paramount.

We start with the following:

- We have a 1,200-pound live steer on our premises. We haul the steer to the packer.
- During transport we lose 1 to 5 percent (12 to 60 pounds), commonly called *drift*.
- At harvest we lose 35 to 40 percent of live weight during dressing (415 to 475 pounds).
- When we hang the carcass in the cooler, even for 48 hours, we lose 1 to 10 percent of carcass weight in cooler shrink (1 to 8 pounds).
- During fabrication, the amount of meat is determined by the USDA YG. We lose 46 to 54 percent of carcass weight from bones and fat trimming (at least 355 pounds).

Therefore, our 1,200 pound animal yields 283 to 412 pounds of meat. When we cook the steaks, roasts, or ground beef, we lose another 25 percent, so we end up with about 212 to 309 pounds of edible product.

In our example of the 1,200 pound steer, let's assume the following:

- We paid $0.80 per pound, or $960.
- If it cost $50 per head to harvest and $0.50 per carcass pound to cut and wrap, that would add another $50 + $378 (1,200 pounds x 63 percent dress = 756 pounds x $0.50 per pound), or a $1,388 total investment in that steer.
- To break even selling just the meat, we would have to charge an average of $3.37 to $4.90 per pound ($1,388/412 pounds or $1,388/283 pounds) for steaks, roasts, and ground beef. That means more than $1.50 difference per pound in the price of our retail cuts, depending on the yields or weight losses at each stage.
- Steaks (middle meats from the figures above) are ~11 percent of the weight (283 to 412 pounds BCTRC x 11 percent = 31 to 45 pounds middle meats) and 40 percent of the value ($1,388 x 40 percent = $555). To break even, we would need to charge between $12 and $17 per pound.

Environmental Stewardship

Environmental Stewardship in Beef Cattle Production

As urban sprawl increases, much of rural Alabama has or will come under closer scrutiny from neighbors concerned about the environment. Many aspects of animal agriculture are dealing with stringent environmental regulations due in part to the public's perception of confined animal production. According to some estimates, grazing livestock accounts for about 25 percent of agricultural nonpoint source pollution in the United States, usually in the form of runoff. The potential for pollution from most farms and ranches comes from heavy use areas and poor pasture management practices.

Heavy use areas. Heavy use areas include gates, holding pens, trails, and feeding areas. Because of high cattle traffic, there is little or no vegetative cover on these areas. During rainstorms, water will runoff of these areas, carrying silt, manure, and nutrients with it. Reducing or eliminating runoff from heavy use areas will correct most environmental issues from grazing cattle. Dry lots pose a unique problem. If you keep animals in a dry lot for extended periods (45 days in a 12-month period) your farm is considered an Animal Feeding Operation, and you are responsible for following the Alabama AFO/CAFO regulations.

Another heavy use area is surface water such as creeks, rivers, and streams. Surface water is often the only source of water and shade for cattle. When this is the case, cattle stay in the water much of the time in an effort to remain cool. The effects on water quality from the increased silt alone can be significant. During periods of sustained drought, dependence on surface water as the sole source of water can reduce or eliminate the cattle holding capacity of your farm or ranch. If you provide alternative sources of water and shade, you can help your farm withstand the effects of drought and maintain a quality surface water supply.

Maintain environmental quality in heavy use areas by:

- Using silt control for heavy use areas such as feed bunks, waterers, gates, and crossings. ("Heavy Use Area Protection," NRCS Alabama Guide Sheet No. AL 561)
- Using vegetative filter strips between heavy use areas and surface water.

- Providing shade and shelter in pastures.
- Using portable or permanent waterers.
- Controlling runoff from dry lots, using vegetative filters or a waste storage pond. ("Waste Storage Pond," NRCS Alabama Guide Sheet No. AL 313A)

Grazing management. Grazing management will also have an impact on the quality of a creek, river, or stream. Poor management results in poor soil and vegetation quality and an increase in the potential for contamination from nutrients, pathogens, and sediment. Managing pastures to minimize environmental impacts will also enhance the forage production from the pasture. A good stand of forage prevents erosion and nutrient or bacterial runoff. Pasture rotation prevents the build-up of manure in one place and reduces damage from heavy use areas. A uniform stand of forage will reduce selective grazing. Applying fertilizer as recommended by a soil-test report will help to maintain a quality pasture and will eliminate over application of fertilizer. In short, good pasture management is good environmental management.

A quality pasture will:

- Reduce or prevent soil erosion.
- Hold nutrients.
- Prevent nutrient runoff.
- Hold moisture.

Protect pasture quality by:

- Matching forage production with grazing needs.
- Using controlled/rotational grazing.
- Using approved weed control methods.
- Using soil testing to monitor soil fertility.
- Fertilizing according to soil test recommendations.

Maintain environmental quality by:

- Using organic fertilizer (poultry litter) wisely.
  - o Cover litter, keeping rain out but allowing moisture to escape.
  - o Store litter on a surface that will prevent leaching of nutrients into ground water. ("Waste Field Storage," NRCS Alabama Guide Sheet No. AL 749)
  - o Apply litter based on soil test recommendations and litter analysis.
  - o Follow established setbacks for dry litter application: 25 feet from roads, 100 feet from public use areas, 50 to 200 feet from surface water, 100 to 300 feet from wells, and 50 feet from roads.
- Controlling runoff from dry lots, using vegetative filters or a waste storage pond. ("Waste Storage Pond," NRCS Alabama Guide Sheet No. AL 313A)

For additional information, contact your local Alabama Cooperative Extension System Office (http://www.aces.edu) or your district Natural Resources Conservation Service (NRCS) office (http://www.nrcs.usda.gov). To access the publications listed above, visit http://efotg.nrcs.usda.gov/toc.aspx?CatID=321.

Appendixes

Appendix A. Livestock Markets

Alabama Livestock Auction (Uniontown)
(334) 628-2371
Sale Day: Tuesday
Contact: Jimmy Sealey

Arab Stockyard
(256) 586-4212
Sale Day: Tuesday
Contact: Robbie Gibbs

Ashville Stockyard
(205) 594-5151
Sale Day: Monday
Contact: Brad Plunkett

Clay County Livestock (Lineville)
(256) 354-2276
Sale Day: Tuesday
Contact: Justin McCollum

Coffee County Stockyard (Elba)
(334) 897-2540
Sale Day: Thursday
Contact: Rusty Lushington

Cullman Stockyard
(256) 734-4531
Sale Day: Thursday
Contacts: Keith and Hoagie Parrish

Dothan Stockyard
(334) 677-3361
Sale Day: Monday
Contact: Ed Neel

Escambia County Coop. (Brewton)
(251) 867-5111
Sale Day: Saturday
Contact: Stanley Johnson

Farmer's Coop. Market (Opp)
(334) 493-4568
Sale Day: Wednesday
Contact: Bobby Jackson

Farmers Coop. Market (Frisco City)
(251) 267-3175
Sale Day: Monday
Contact: Kenneth Waters

Farmers Stockyard Coop. (Hamilton)
(205) 952-9265
Sale Day: Saturday
Contact: Rodney Sanderson

Fort Payne Stockyard
(256) 845-1028
Sale Day: Tuesday
Contact: Glean Plunkett

Linden Stockyards
(334) 295-8707
Sale Day: Wednesday
Contacts: Jerry Etheridge and Hub Wyatt

Livingston Stockyard
(205) 652-7411
Sale Day: Wednesday
Contacts: Billy and Ken Tinsley

Mid-State Stockyard (Letohatchee)
(334) 227-8000
Sale Day: Tuesday
Contacts: Scott Garrett, Billy Younkin, and W.D. Farrior, IV

Montgomery Stockyards
(334) 288-8060
Sale Day: Monday
Contacts: Charles and John Edwards

Moulton Stockyards
(256) 974-3133
Sale Day: Wednesday
Contacts: Rob Whitsell, Nathan Thompson, and Roland Gargis

Natural Bridge Stockyard
(205) 486-8878
Sale Day: Saturday
Contact: Bo Wells

Northwest Alabama Livestock Auction (Russellville)
(256) 332-3323
Sale Day: Monday
Contact: Jim Martin

Roanoke Stockyards
(334) 863-2411
Sale Day: Wednesday
Contacts: Don, Cal, and Chad Green

Robertsdale Livestock Auction
(251) 947-2162
Sale Day: Monday
Contact: Harry Bryant

Sand Mountain Stockyard (Boaz)
(256) 561-3434
Sale Day: Monday
Contacts: David Evans and Jon Williams

South Alabama Livestock (Brundidge)
(334) 735-2364
Sale Day: Monday
Contact: Ed Jones

Tennessee Valley Livestock Association (Florence)
(256) 766-0281
Sale Day: Monday
Contact: Harry Floyd

Valley Stockyard (Decatur)
(256) 353-7664
Sale Day: Thursday
Contacts: Billy Wallace and Jeff Byars

Appendix B. State of Alabama Resources

Alabama Beef Cattle Improvement Association

http://www.albcia.org/
(205) 646-0115

Alabama Cooperative Extension System

http://www.aces.edu/

Extension Veterinarian
(334) 844-1521

Alabama Department of Agriculture and Industries

http://www.agi.state.al.us/

Commissioner
(334) 240-7100

Livestock Market News
(334) 240-7180

Livestock Theft Division
(334) 240-7208

Premises Identification Coordinator
(334) 240-7253

State Veterinarian
(334) 240-7253

Stockyards and Brands Division
(334) 240-7263

Diagnostic Laboratories
Auburn
(334) 844-4987

Boaz
(256) 593-2995

Elba
(334) 897-6340

Hanceville
(256) 352-8036

Animal Science and Forages Regional Extension Agents

http://www.aces.edu/animalforage/

Bibb County Extension Office
(205) 926-3117
Cell phone: (205) 316-8382

Etowah County Extension Office
(256) 547-7936
Cell phone: (256) 478-0847

Hale County Extension Office
(334) 624-8710
Cell phone: (334) 341-1674
Cell phone: (334) 321-8828

Mobile County Extension Office
(251) 574-8445
Cell phone: (251) 238-0373

Monroe County Extension Office
(251) 575-3477
Cell phone: (251) 238-2007

St. Clair County Extension Office
(205) 338-9416
Cell phone: (256) 299-0683

Talladega County Extension Office
(256) 362-6187
Cell phone: (256) 299-0512

Tennessee Valley Regional Research and Extension Center
(256) 353-8702
Cell phone: (256) 508-2020

Wiregrass Regional Research and Extension Center
(334) 693-2010
Cell phone: (334) 726-6814

Auburn University, Department of Animal Sciences

http://www.ag.auburn.edu/ansc/
(334) 844-1521

Appendix C. Beef Cattle Breeds

Individual animals within a breed or breed type can be very different from the general classifications listed in the table below. Therefore, it is important to examine performance and Expected Progeny Difference (EPD) records before making selection decisions.

Table 1. Trait Similarities and Differences Between Breed Classifications

	Breed Classification			
	American	**Bos Indicus**	**Continental**	**English**
Trait				
Calving ease/ birth weight	Moderate/high	Low to high[1]	Moderate/ high	Low/ moderate
Growth	Moderate	Moderate	High	Moderate
Milking ability	Moderate	Moderate	Low to high	Low to high
Age at puberty	High	High	Moderate/ high	Low/ moderate
Carcass traits	Moderate	Low/ moderate	Moderate/ high	Moderate
Beef tenderness	Moderate	Low	Moderate	High
Heat/insect tolerance	High	High	Low	Low

[1]Bos Indicus dams are able to minimize birth weights of calves. However, mating Bos Indicus bulls with Bos Taurus cows can lead to high birth weights.

- The following Web site developed by Oklahoma State University provides a history and short description of most cattle breeds: http://www.ansi.okstate.edu/breeds/cattle. If you are still deciding on which breed(s) to use, this is an excellent beginning resource.
- Most breed associations also have a Web site. These Web sites offer current pedigree and EPD information, as well as information relating to breeds and breed activities (Table 2).

Table 2. Beef Breed Associations and Contacts[1]

Breed Association	Telephone	Web site
American Angus Association	(816) 383-5100	http://www.angus.org
American Belgian Blue Breeders, Inc.	(641) 661-2332	http://www.belgianblue.org
American Brahman Breeders Association	(713) 349-0854	http://www.brahman.org
American-International Charolais Association	(816) 464-5977	http://www.charolaisusa.com
American Chianina Association	(816) 431-2808	http://www.chicattle.org
American Galloway Breeders Association	(406) 728-5719	http://www.galloway-world.org
American Gelbvieh Association	(303) 465-2333	http://www.gelbvieh.org
American Hereford Association	(816) 842-3757	http://www.hereford.org
American Highland Cattle Association	(303) 292-9102	http://www.highlandcattle.org
American Maine-Anjou Association	(816) 431-9950	http://www.maine-anjou.org
American Pinzgauer Association	(800) 914-9883	http://www.pinzgauers.org
American Red Poll Association	(660) 425-7318	http://www.redpollusa.org
American Salers Association	(303) 770-9292	http://www.salersusa.org
American Shorthorn Association	(877) 272-0686	http://www.shorthorn.org
American Simmental Association	(406) 587-4531	http://www.simmental.org
American Wagyu Association	(509) 397-1011	http://www.wagyu.org
Beefmaster Breeders United	(210) 732-3132	http://www.beefmasters.org
Belted Galloway Society, Inc.	(717) 677-9655	http://www.beltie.org
Braunvieh Association of America	(402) 466-3292	http://www.braunvieh.org
North American Limousin Foundation	(303) 220-1693	http://www.nalf.org
North American South Devon Association	(303) 770-3130	http://southdevon.com
Piedmontese Association of the United States	(573) 384-5685	http://www.pauscattle.org
Red Angus Association of America	(940) 387-3502	http://redangus.org
Santa Gertrudis Breeders International	(361) 592-9357	http://www.santagertrudis.com
Senepol Cattle Breeders Association	(800) 736-3765	http://www.senepolcattle.com
United Braford Breeders	(936) 569-8200	http://www.brafords.org

[1]This is a partial list of breed associations. If a particular breed association is not listed, search the Internet to find contact information.

Appendix D. Comparison of Common Fences (One Post per 16 Feet)

Types		Strands	Wire Gauge	Height (inches)	Stay Spacing (inches)	Cost Index[1]	Fence Life (years)[2]	Upkeep
Permanent materials	Barbed wire, 2-point	3	12½		4	132	33	high
		4	12½		4	143	33	high
		5	12½		4	154	33	high
		3	14		4	121	18	high
	Barbed wire, 4-point	3	12½		5	132	33	high
		4	12½		5	143	33	high
		5	12½		5	154	33	high
	Woven wire, light weight	top, bottom	11	26	6	154	19	high
		filler	14½	32	6	165	19	high
	Woven wire, medium weight	top, bottom	10	26	6	176	30	medium
		filler	12½	32	6	187	30	medium
		filler	12½	39	6	198	30	medium
		filler	12½	47	6	220	30	medium

Permanent materials	Woven wire, heavy weight	top, bottom	9	26	6	209	40	low
		filler	11	32	6	231	40	low
		filler	11	39	6	253	40	low
		filler	11	47	6	275	40	low
	High tensile wire	3	12½			44	30	medium
		4	12½			55	30	medium
		5	12½			66	30	medium
		8	12½			110	30	medium
Temporary materials	High tensile wire	2	12½			20 to 35	30	medium
		1	12½			15 to 25	30	medium
	Polywire					10 to 15	7 to 10	medium
	Aluminum wire		9			30 to 40	30	medium
			13			25 to 35	30	medium

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

[1] Labor costs are included, but the costs of electric controllers are not included.
[2] Fence life based on combination of post and wire life expectancy in a humid climate.

Appendix E. 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
Heavy-duty fiberglass-T	fair (flexible)	25 to 30	high	poor	low
Light-duty fiberglass-T	poor (flexible)	15 to 20	low	poor	medium
Pressure-treated wood	good	30 to 35	medium	poor	very low
Untreated wood	good	7 to 15	low	poor	high

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

Appendix F. Life Expectancy of Wood Posts (in years)

Kind	Untreated	Treated (pressure)	Treated (soak)
Osage orange	25 to 35	—	—
Red cedar	15 to 25	20 to 25	20 to 25
Black locust	15 to 25	—	—
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 G. Recommended Post Spacings[1]

Fence	Spacing (feet)
Woven wire	12 to 14
Barbed wire	12 to 14
Electric[2]	20 to 75
High tensile[2]	16 to 60
Board	8
Corrals	6

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

[1] Driven posts are 1.7 times as strong as tamped posts.

[2] Depending on terrain, use battens (stays or droppers).

Appendix H. Suggested Wire Spacing for Permanent or Temporary Electric Fences

Cattle Type	Distance From Ground (for Wire Number)				
	No. 1	No. 2	No. 3	No. 4	No. 5
Cows	30”				
Cows and calves	17”	38”			
Hard-to-hold cattle	17”	27”	38”		
Boundary fence	5”	10”	17”	27”	38”

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

Appendix I. Size and Space Requirements for Cattle Handling and Working Facilities

Facility Component	Recommended Dimensions Up to 600 pounds	600 to 1,200 pounds	Over 1,200 pounds
Holding pen			
Space per head, sq ft/hd	14	17	20
Pen fence			
Height (in)	60	60	60
Post spacing (ft)	8	8	8
Post depth in ground (in)	30	30	30
Crowding pen[1]			
Space per head, sq ft/hd	6	10	12
Post spacing (ft)	4 to 6	4 to 6	4 to 6
Solid wall height (in)	45	50	50 to 60
Working chute, straight sides[2]			
Width (in)	18	22	28
Length (min in ft)	20	20	20
Working chute, sloped sides[2]			
Width at 4 ft in height (in)	20	24	28
Width inside at bottom (in)	15	16	18
Minimum length (ft)	20	20	20
Working chute fence			
Posts			
Spacing (ft)	7	7	7
Depth in ground (in)	36 to 48	36 to 48	36 to 48
Wall			
Solid, height (in)	54 to 60	54 to 60	60
Top rail, gentle cattle (in)	54 to 60	60	60
Top rail, wild and Hard to work cattle (in)	60 to 72	60 to 72	60 to 72
Holding chute/squeeze			
Height (in)	45	50	50
Width			
Straight sides (in)	18	22	28
V-shaped sides, width at bottom (in)	6 to 8	8 to 12	14 to 16
Length, with head gate (ft)	5	5 to 8	5 to 8

Facility Component	Recommended Dimensions Up to 600 pounds	600 to 1,200 pounds	Over 1,200 pounds
Loading chute			
Width (in)	26	26	26 to 30
Minimum length (ft)	12	12	12
Maximum rise (in/ft)	3.5	3.5	3.5
Spacing of 1 X 2 (in) Hardwood cleats (in)	8	8	8
Ramp height (in)			
Trailer		15	
Pickup truck		28	
Large truck		40	
Tractor-trailer		48	
Double-deck trailer	100		

Source: Adapted from J.R. Bicudo, Sam McNeill, Larry Turner, Roy Burris, and John Anderson, *Cattle Handling Facilities: Planning, Components, and Layouts* (University of Kentucky, Cooperative Extension Service, 2002).

[1]Crowding pen: it must be of either circular shape (¼ or ½ circle) or funnel shape.

[2]Working chute: it should be curved or offset (offset angle at 30 degrees maximum).

Appendix J. Minimum Trailer Space Requirement for Hauling Cattle[1]

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 1,200	0.5/0.4

Source: Adapted from Temple Grandin, *Livestock Trucking Guide* (Bowling Green, KY: National Institute for Animal Agriculture, Revised 2001).

[1] Reduce by 5 percent for cattle with horns.

To estimate the number of 450-pound cattle that should be hauled on a 40-foot-long double-deck trailer, simply multiply 40 by 1. This gives 40 per deck, or 80 head. If the cattle have horns, the number should be reduced by 5 percent (80 X .95 = 76 head).

To estimate the number of 600-pound cattle that should be hauled on a 44-foot single-deck trailer, multiply 44 by .8: 44 X 0.8 = 45 head of cattle and 43 head of horned cattle. In a 44-foot possum belly (four compartments: 10-foot front compartment; two middle double decks, 25 feet each; 9-foot rear compartment; total of 69 feet of floor space), multiply 69 by .8: 69 X .8 = 55 head cattle and 53 head of horned polled cattle. Note: Measure the total lineal footage of floor space in your trailer truck.

Appendix K. Reducing Stress During Handling

Following the guidelines below will make working cattle easier for you and your animals and will ensure that best practices are carried out correctly.

- Assess cattle flow.
- Move cattle into chute easily.
- Have solid footing.
- Avoid noise.
- Familiarize cattle with facilities.
- Move cattle carefully.
- Work cattle in groups.
- Call cattle rather than drive them.
- Prevent backing in working chute.
- Use experienced people.
- Treat cattle with respect.
- Remove sharp objects.
- Watch for kicks.
- Keep alert.
- Sort cows from calves.
- Use products carefully.
- Properly restrain cattle when working them.

Appendix L. Tips for Managing Shrink

- Be familiar with weather forecasts and avoid working or transporting during temperature extremes.
- Protect animals from weather while hauling.
- Move slowly and quietly when handling and loading cattle; avoid rough handling.
- Use help that you and the cattle are familiar with.
- Sort at home.
- Avoid exposing animals to strange environments without preconditioning (for example, moving pasture cattle directly to pen or mixing groups).
- Avoid equipment breakdowns by maintaining your scales, truck, chutes, and other equipment.
- Don't overcrowd; group cattle into compartments to take pressure off end animals when truck starts and stops.
- Avoid underloading; this causes stress and bruising.
- Keep trips as short as possible; allow cattle to rest.
- Avoid rough roads; provide for good footing.
- Provide feed and water; pay attention to its quality at rest stops and destination.
- Avoid stressful ration changes right before shipping; however, allow free access to dry cured grass hay (dry forage stays in gut better).
- Withhold water 2 to 3 hours before shipping.
- Withhold grain and alfalfa or clover hay (laxative affect) within 12 hours of shipping.
- If cattle are coming off succulent green feeds, precondition to a dry feed; moisture leads to scours and excessive urination.

Table 1. Shrinkage Loss Due to Different Handling Conditions

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 M. Cause of Shrink During Processing and Transporting

For example: A 600-pound calf is penned, sorted, weighed, and transported for 8 hours over 640 kilometers. The 600-pound calf weighs only 534 pounds at sale time.

Factor	Percent Shrink	Pound Shrink
30 minutes of preliminary sorting	0.5	3
Weighing and loading	3.0	18
First 4-hour trucking	4.0	24
Second 4-hour trucking	1.0	6
Distance traveled = 400 miles	2.5	14.6
Total Shrink	11	66

Source: Reproduced, with permission of the publisher, from "A 272-kg (600-lb) calf is penned, sorted, weighed and transported for 8 hr over 640 km," *Reducing Cattle Shrink* (Ontario Ministry of Agriculture, Food and Rural Affairs, 2005).

Appendix N. Standard Measurements

Length (linear measure)
1 foot = .3048 meter
1 foot = 30.48 centimeters
1 foot = 304.8 millimeters
1 foot = 12 inches
1 inch = .0254 meter
1 inch = 2.54 centimeters
1 inch = 25.4 millimeters
1 yard = 3 feet
1 yard = .9144 meter
1 yard = 91.44 centimeters
1 yard = 914.4 millimeters
1 yard = 36 inches
1 meter = 39.37 inches
1 meter = 3.2808 feet
1 meter = 1.0936 yards
1 centimeter = .3937 inch
1 millimeter = .03937 inch
1 kilometer = 3280.84 feet
1 kilometer = 1093.61 yards
1 kilometer = .62137 mile
1 kilometer = .53996 nautical mile
1 mile = 1.609344 kilometers
1 mile = 1609.34 meters
1 mile = 5,280 feet
1 mile = 1,760 yards
1 mile = .868976 nautical mile
1 nautical mile = 1.852 kilometers
1 nautical mile = 1852 meters
1 nautical mile = 6076.115 feet
1 nautical mile = 2025.372 yards
1 nautical mile = 1.15078 miles
1 mile = 320 rods
1 rod = 16.5 feet
1 knot = 1.152 mile/hour
1 mile/hour = .8684 knots
1 mile = 8 furlongs
1 furlong = 0.125 mile
1 hand (equine) = 4 inches = 10.16 centimeters

Surface (area)
1 square foot = 144 square inches
1 square yard = 9 square feet
1 square rod = 30.25 square yards
1 square rod = 272.25 square feet
1 acre = 160 square rods
1 acre = 1 rod wide & 0.5 mile long
1 acre = 43,560 square feet
1 square acre = 208.71 feet wide and 208.71 feet long
1/2 square acre = 147.58 feet wide and 147.58 feet long
1/4 square acre = 104.355 feet wide and 104.355 feet long
1 circular acre = 235.504 feet in diameter

United States Government Land Measures
1 township = 36 sections
1 section = 640 acres
1 section = 1 square mile
1 quarter section = 160 acres
1 quarter section = 0.5 mile long and 0.5 mile wide
1 eighth section = 80 acres
1 eighth section = 1/2 mile long and 1/4 mile wide
1 sixteenth section = 40 acres
1 sixteenth section = 1/4 mile long and 1/4 mile wide

Surveyors' Measure
1 link = 7.92 inches
1 rod = 25 links
1 chain = 4 rods
1 chain = 66 feet
1 acre = 10 square chains
1 mile = 80 chains
1 rod = 25 links

Cubic Measure (volume)
1 cubic foot = 1,728 cubic inches
1 cubic yard = 27 cubic feet
1 board foot = 1" x 12" x 12" nominal dimensions
1 cord (wood) = 128 cubic feet
1 bushel grain or shelled corn = 1.25 cubic feet
1 cubic foot grain or shelled corn = .8 bushels
1 bushel ear corn = 2.5 cubic feet
1 cubic foot ear corn = .4 bushels
1 cubic yard concrete = 81 square feet—4" floor
1 cubic yard concrete = 54 square feet—6" floor

Calculations
Diameter of a circle = circumference x .31831
Circumference of a circle = diameter x 3.1416
Area of a circle = diameter x diameter x .7854
Surface of a ball = diameter x diameter x 3.1416
Doubling the diameter of a pipe increases its capacity 4 times

Dry Measure
1 quart = 2 pints
1 bushel = 32 quarts

Liquid Measure
1 cup = 8 fluid ounces
1 pint = 2 cups
1 pint = 16 fluid ounces
1 quart = 2 pints
1 quart = 32 fluid ounces
1 gallon= 4 quarts
1 gallon = 128 ounces
1 gallon = .1337 cubic feet
1 cubic foot = 7.48 gallons
1 gallon = 231 cubic inches
1 barrel = 32 1/2 gallons
1 US gallon = .8327 imperial gallons (British)
1 imperial gallon (British) = 1.201 U.S. gallons
1 gallon water (20° C) = 8.33 pounds
1 foot of water (4° C) = .4335 pounds per square inch
1 cubic foot = 62.427 pounds of water (4° C)
1 gallon = 8.33 pounds of water (4° C)
1 teaspoon = .17 fluid ounces (1/6 oz.)
1 tablespoon (1/2 oz.) = 3 teaspoons (level)
1 fluid ounce = 2 tablespoons
1 cup (liquid) = 16 tablespoons (8 oz.)
16 ounces = 1 pound

Apothecaries' Weight
1 scruple = 20 grains
1 dram = 3 scruples
1 ounce = 8 drams
1 pound = 12 ounces
1 dram = 27 11/32 grains

Avoirdupois Weight
1 pound = 16 ounces
1 ton (short) = 2,000 pounds
1 ton (long) = 2,240 pounds

Fertilizer Conversions
Phosphorus (P) x 2.29 = P_2O_5
P_2O_5 x.44 = Phosphorus (P)
Potash (K) x 1.2 = K_2O
K_2O x .83 = Potash (K)

Source: Adapted from Don Hofstrand, File C6-84 "Agricultural Measurements and Conversions" (Ames, IA: Iowa State University Extension, Revised 2007).

Appendix O. Fahrenheit/Celsius Conversions

To convert temperature given in Fahrenheit (F) to Celsius (C):

Start with (F); subtract 32; then divide by 1.8; the answer is (C).

Example: 85° Fahrenheit
85-32 = 53
53 ÷ 1.8 = 29.4° Celsius

To covert temperature given in Celsius (C) to Fahrenheit (F):

Start with (C); multiply by 1.8; then add 32; the answer is (F).

Example: 35° Celsius
35 x 1.8 = 63
63 + 32 = 95° Fahrenheit

Appendix P. 283-Day Gestation Table

Find date of service in upper line. Bottom line numeral indicates date due to calve.

Jan	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Oct	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	Nov
Feb	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28				
Nov	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7				Dec
Mar	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Dec	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	Jan
Apr	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
Jan	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6		Feb
May	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Feb	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	1	2	3	4	5	6	7	8	9	Mar
June	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
Mar	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8		Apr
July	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Apr	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	May
Aug	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
May	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	June
Sep	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
June	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9		July
Oct	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
July	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	Aug
Nov	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
Aug	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8		Sep
Dec	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Sep	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	Oct

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