Mississippi
Beef Cattle Producer
Pocket Guide

MS Beef Cattle Producer Pocket Guide
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Introduction

Beef cattle production in Mississippi

Beef cattle production is a significant component of Mississippi agriculture. The total value of production of cattle and calves in Mississippi contributes millions of dollars annually to the local economy and ranks highly among the state’s agricultural commodities. Cow-calf and stocker cattle operations are very prominent parts of the Mississippi beef cattle industry.

Mississippi State University Extension Service

This pocket guide was authored by beef cattle specialists with the Mississippi State University Extension Service (MSU-ES). Extension's overall purpose is education. The MSU-ES provides research-based information, educational programs, and technology transfer focused on issues and needs of the people of Mississippi. The MSU-ES recognizes that agriculture and its related enterprises are of major economic importance in Mississippi, and directs programs and resources to reflect this importance. The MSU-ES state beef cattle specialists, area livestock/forages agents, and county directors are available to assist beef cattle producers.

msucares.com/livestock/beef

MS Beef Cattle Improvement Association

The printing of this pocket guide was funded by the Mississippi Beef Cattle Improvement Association (MBCIA). The MBCIA encourages the production and identification of genetically superior animals by purebred breeders and promotes the use of these animals by commercial producers through sale offerings.

The purposes of the MBCIA are to:

- promote the use of performance records as a tool for herd improvement
- emphasize economically important traits that can be improved through selection and culling based on performance records
- encourage good management practices

Member benefits include access to and information about:

- monthly MBCIA newsletter
- annual membership meeting
- bull marketing programs
- centralized bull testing programs
    - Hinds Community College Bull Test
    - Gain-on-Forage Bull Test

- ultrasound body composition scanning
- Miss Premium replacement heifers
- feeder calf marketing programs
- Mississippi Farm to Feedlot program
- Cattlemen's Exchange groups
- BIF producer award nominations
- MBCIA educational projects

The MBCIA promotes the use of high-quality Mississippi-raised bulls as herd sires. These bulls are better adapted to the local environment than cattle from other regions. Mississippi-raised herd sires can be readily compared with other bulls on a national basis using expected progeny differences. Breed-leading genetics are found in Mississippi bulls of many breeds. Beyond bulls, Mississippi is home to well-managed feeder calves and heifers. Purchasing high-quality cattle locally reduces freight costs and supports the local economy.

Demand EPDs. Demand health records. Demand Mississippi cattle.

msucares.com/livestock/beef/mbcia

Monthly Mississippi Beef Cattle Management Calendar

January	February	March
General Recommendations		
• Control lice • Supplement as needed (energy, protein, Vit. A) • Prevent grass tetany • Gather income tax records • Set yearly goals	• Control lice • Supplement as needed (energy, protein, Vit. A) • Prevent grass tetany • Fertilize cool-season forages • Control weeds • Collect soil samples • Gather income tax records • Attend MBCIA meeting	• Control lice • Prevent grass tetany • Control weeds • Service forage harvesting equipment • Prepare income taxes

Spring-calving Recommendations		
• Monitor calving • Acquire herd sires, semen, and breeding supplies • Collect yearling data	• Monitor calving • Acquire herd sires, semen, and breeding supplies • Collect yearling data	• Monitor calving • Administer pre-breeding vaccinations and deworming • Acquire herd sires, semen, and breeding supplies • Perform bull BSEs • Collect yearling data
Fall-calving Recommendations		
• End breeding	• Diagnose pregnancy • Cull open females	• Diagnose pregnancy • Cull open females • Plan pre-weaning vaccinations

Monthly Mississippi Beef Cattle Management Calendar

April	May	June
General Recommendations		
• Prevent grass tetany • Start fly control as needed • Deworm cattle • Plant warm-season forages • Fertilize warm-season forages • Meet income tax deadline	• Provide adequate shade • Reduce cattle heat stress • Control flies • Plant warm-season forages • Fertilize warm-season forages	• Provide adequate shade • Reduce cattle heat stress • Control flies • Test stored forage for quality • Monitor feed prices • Be prepared as hurricane season begins

Spring-calving Recommendations		
• Begin breeding	• Continue breeding	• End breeding season
Fall-calving Recommendations		
• Wean calves (deworm and vaccinate) • Precondition calves • Cull herd for performance and health • Select replacements • Deworm adults at weaning	• Wean calves (deworm and vaccinate) • Precondition calves • Cull herd for performance and health • Select replacements • Deworm adults at weaning	• Precondition calves

Monthly Mississippi Beef Cattle Management Calendar

<table>
<tr><th>July</th><th>August</th><th>September</th></tr>
<tr><td colspan="3">General Recommendations</td></tr>
<tr>
<td>• Provide adequate shade
• Reduce cattle heat stress
• Control flies
• Deworm adults and yearlings
• Test stored forage for quality
• Monitor feed prices
• Be prepared as hurricane season continues</td>
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• Control flies
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• Be prepared as hurricane season continues</td>
<td>• Provide adequate shade
• Reduce cattle heat stress
• Control flies
• Plant cool-season forages
• Fertilize cool-season forages
• Test stored forage
• Monitor feed prices
• Be prepared as hurricane season continues</td>
</tr>
</table>

Spring-calving Recommendations		
• Diagnose pregnancy • Cull open females	• Diagnose pregnancy • Cull open females • Plan pre-weaning vaccinations	• Wean calves (deworm and vaccinate) • Precondition calves • Cull herd for performance and health • Select replacements • Deworm adults at weaning
Fall-calving Recommendations		
• Prepare for calving	• Prepare for calving	• Monitor calving • Acquire herd sires, semen, and breeding supplies • Collect yearling data

Monthly Mississippi Beef Cattle Management Calendar

<table>
<tr><th>October</th><th>November</th><th>December</th></tr>
<tr><td colspan="3">General Recommendations</td></tr>
<tr><td>Monitor feed prices
Supplement as needed (energy, protein, Vit. A)
Plant and fertilize cool-season forages
Be prepared as hurricane season continues</td><td>Control lice
Monitor feed prices
Supplement as needed (energy, protein, Vit. A)
Be prepared as hurricane season continues
Plan holiday labor</td><td>Control lice
Supplement as needed (energy, protein, Vit. A)
Prevent grass tetany
Plan holiday labor
Make end of tax year purchases and sales</td></tr>
<tr><td colspan="3">Spring-calving Recommendations</td></tr>
<tr><td>Wean calves (deworm and vaccinate)
Precondition calves</td><td>Prepare for calving
Precondition calves</td><td>Prepare for calving</td></tr>
</table>

• Cull herd for performance and health • Select replacements • Deworm adults at weaning		
Fall-calving Recommendations		
• Monitor calving • Administer pre-breeding vaccinations and deworming • Acquire herd sires, semen, and breeding supplies • Perform bull BSEs • Collect yearling data	• Monitor calving • Begin breeding • Acquire herd sires, semen, and breeding supplies • Collect yearling data	• Continue breeding

Beef Cattle Terminology

Ad libitum: free choice; allowing animals to eat all they want; on full feed
Bloom: haircoat has a luster (shine) that gives the appearance of a healthy animal
Breed character: a combination of masculine or feminine qualities with ideal breed type features. Head and color markings are given considerable attention in estimating breed character
Brindle: coat coloring pattern with narrow, vertical, alternating stripes of black and red pigmentation; base color may range from light red or fawn to dark brown or even nearly white; "tiger striped"
Brockle-faced: white-faced with other colors splotched on face and head; mottle-faced
Broken mouth: some teeth missing or broken
Bull: male bovine animal, usually of breeding age
Bullock: young bull, typically less than 20 months of age
Bunk breaking: process of acclimating calves to consume feed from a bunk or other feeder
Calf-feds: cattle placed on feed as calves and finished at less than 16 months of age, usually on feed for 150 to 200 days, and placed in the feedlot directly following weaning.
Cancer eye: cancerous growth on eyeball or lid

Closed herd: herd in which no outside breeding cattle are introduced

Colostrum: first milk produced by a female after calving; high in antibodies that protect calves from invading microorganisms

Concentrate: feed high in energy, low in fiber, and highly digestible; typically grains

Cow: sexually mature female bovine animal that has usually produced a calf

Creep feeding: providing supplemental nutrients to nursing calves through the use of gates or exclosures which allow calves but not cows to access the creep feed or forage

Cryptorchid: male with one or both testicles retained in abdominal cavity

Cwt: abbreviation for hundredweight (100 lb.)

Dam: female parent

Diet: a controlled selection of feedstuffs provided on a continuous schedule

Dark cutter: color of muscle in carcass has a dark appearance, often results in price discount

Depreciation: decrease in value of an asset due to age, use, and obsolescence; pro-rated expense of owning an asset

Drench: to give fluid by mouth

Dry (cow): non-lactating cow

Dystocia: difficult birth

Efficiency: ratio of output to input

F_1: offspring resulting from mating a purebred bull to purebred females of another breed
Fed cattle: steers and heifers that have been fed concentrates, usually for 90 to 120 days in a feedlot
Feeder cattle: cattle that need further feeding prior to slaughter
Fill: contents of the digestive tract
Finish: degree of fatness of an animal
Flushing: placing females on a high level of nutrition before breeding to decrease postpartum interval and possibly stimulate an increased conception rate
Freemartin: female born twin to a bull; the female is sterile about 90% of the time
FOB: free on board; buyer pays freight after loading
Grid: method of pricing slaughter cattle which offers premiums and discounts for cattle; cattle which are leaner and have a higher quality grade receive premiums; grids generally have other specifications for carcass weight and dark cutters
Hard keeper (doer): animal that does not do well
Heifer: young female bovine animal prior to the time she has produced her first calf
Heiferette: heifer that has calved once, after which she is fed for slaughter; the calf has usually died or been weaned at an early age

NPN (nonprotein nitrogen): nitrogen in feeds from substances such as urea and amino acids, but not from preformed proteins

Off feed: animal refuses to eat or consumes only small amounts of feed

Open: non-pregnant cow or heifer

Pay weight: actual weight for which payment is made; in many cases it is the shrunk weight (actual weight minus pencil shrink)

Pencil shrink: deduction (percent of liveweight) from an animal's weight to account for fill

Phenotype: characteristics of an animal that can be seen and/or measured

Polled: naturally or genetically hornless

Pons: accumulation of fat over pin bones

Postpartum interval: length of time from calving until the dam is pregnant again

Preconditioning: preparation of feeder calves for marketing and shipment; may include vaccinations, castration, and training calves to eat and drink in pens

Prolapse: abnormal protrusion of part of an organ, such as the uterus or rectum

Purebred: animal eligible for registry with a recognized breed association

Ration: feed offered during a 24-hour period

Scurs: small growths of hornlike tissue attached to the skin of polled or dehorned animals

Shipping fever: respiratory disease of cattle
Sire: male parent
Supplement: mixture of nutrients added to the diet to meet nutrient shortages not supplied by the forage or grain of the base diet
Stag: bovine male castrated after puberty
Steer: bovine male castrated prior to puberty
Stocker: weaned calf fed high-roughage diets (including grazing) before going into a feedlot
Terminal sire: sire used in a terminal crossbreeding program where the sire's offspring are intended to be sold as market animals
Thermoneutral zone (TNZ): range in temperature where rate and efficiency of gain is maximized; comfort zone
Total mixed ration (TMR): all feed ingredients mixed together in a nutritionally balanced ration and fed to the animal rather than each ingredient being fed individually
Type: physical conformation; physical traits that contribute to animal value for a specific purpose
Undegradable intake protein (UIP): protein not fermented in the rumen but digested in the small intestine; escape or bypass protein
Yardage: charges incurred each day that cattle are in the feedlot, usually expressed on a cents per head per day basis

Adapted from R. E. Taylor Beef Production and Management Decisions. 2nd ed. 1994; www.eXtension.org 2012. Beef Cattle Glossary.

Mississippi Frost Dates

Mississippi Location	Average Date of First Frost	Average Date of Last Frost
Batesville	October 15	April 14
Biloxi	November 24	March 8
Brookhaven	October 26	April 5
Carthage	October 21	April 8
Corinth	October 14	April 14
Greenville	November 2	March 27
Greenwood	October 31	April 1
Grenada	October 19	April 11
Hattiesburg	November 3	March 29
Hernando	October 27	April 7
Holly Springs	October 11	April 18
Jackson	October 29	April 5
Laurel	November 3	March 30
McComb	November 3	April 1
Meridian	October 25	April 6
Natchez	November 7	March 27
Philadelphia	October 22	April 6
Poplarville	November 9	March 23
Starkville	October 24	April 7
Tupelo	October 20	April 16
Vicksburg	November 6	March 30
Woodville	November 11	March 24
Yazoo City	November 3	March 31

Adapted from National Oceanic and Atmospheric Administration. 2011. Freeze/Frost Occurrence Data.

Forage Classifications

Classification criteria	Classes	
Form and function	Grasses: generally herbaceous (not woody) plants, parallel leaf veins, fibrous root systems, bear seed on elongated stem stalk, produce only 1 seed leaf; ex: bermudagrass, annual ryegrass	Legumes: produce seed in a pod, netted leaf veins, tap root systems, produce 2 seed leaves; most interact with *Rhizobium* bacteria to fix nitrogen in root nodules; ex: clovers, alfalfa
Lifespan	Annuals: plants that germinate, grow, reproduce, and die in 1 year's time or 1 growing season; reproduce only by seed;	Perennials: plants that, under suitable conditions, have the ability to live for more than 1 year; may die back or become

	ex: crabgrass, wheat	dormant and later recover from tubers, rhizomes, or stolons; reproduce vegetatively or by seed; ex: bahiagrass, alfalfa
Growth season	Warm-season forages: begin growth and/or are planted in the spring or early summer and make most of their growth during the warmest months of the year; ex: dallisgrass, pearl millet	Cool-season forages: begin growth and/or are planted in the autumn or sometimes early spring and make most of their growth during the coolest months of the year, except for the coldest periods of the winter; ex: tall fescue, white clover

Characteristics of Forage Grasses

		Tolerance[1] to			
Forage Species	**Seedling 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[2]					
Tall fescue E+	G	G	G	G	E
Tall fescue E-	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

[1]E = excellent; G = good; F = fair; P = poor

[2]E+ = endophyte-infected; E- = endophyte-free

Adapted from Ball et al. 1999. Forage Crop Pocket Guide. Intl. Plant Nutr. Inst., Norcross, GA.

Characteristics of Forage Legumes

		Tolerance[1] to			
Forage Species	**Seedling Vigor**	**Soil Acidity**	**Poor Drainage**	**Drought**	**Grazing**
Warm-season perennial legumes					
Perennial peanut	Vegetatively propagated	G	P	G	F
Sericea lespedeza	P	E	F	E	P[3]
Warm-season annual legume					
Annual lespedeza	F	E	F	G	G
Cool-season perennial legumes					
Alfalfa	G	P	P	E	P[2]
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

[1]E = excellent; G = good; F = fair; P = poor

[2]Grazing-tolerant varieties are rated G

Adapted from Ball et al. 1999. Forage Crop Pocket Guide. Intl. Plant Nutr. Inst., Norcross, GA.

Planting Information for Perennial Grasses in Mississippi

	Adaptation		Seeding Rate[2], lb/acre	Planting Depth, inches	Optimum Planting Dates
	MS Area[1]	Soils			
Bahiagrass	N, C, S	Moist, sandy bottoms to droughty uplands	B: 15 to 20	¼ to ½	Early spring after frost; S only: late summer, 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	Mar 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 Feb to early summer with adequate soil

					moisture
Dallisgrass	N, C, S	Moist, fertile, well drained	B: 20 (10 pounds pure, live seed)	¼ to ½ (Adjust for low germination)	Feb 15 to May 15
Johnsongrass	N, C	Medium to heavy, fertile	B: 20 to 30 D: 10 to 15	½ to 1	Apr to Jul
Tall fescue	N, C	Moist, fertile bottoms; productive uplands; S only: heavy, moist soils	B: 15 to 20 D: 10 to 15	¼ to ½	Sep to Oct

[1]N = North; C = Central; S = South

[2]B = broadcast; D = drilled

Adapted from Ball et. Al. 2007. Southern Forages. 4th ed. Intl. Plant Nutr. Inst., Norcross, GA.

Planting Information for Annual Grasses

	Adaptation		Seeding Rate[2], lb/acre	Planting Depth, inches	Optimum Planting Dates
	MS Area[1]	Soils			
Pearl millet	N, C, S	Well drained, fertile (avoid lime soils)	D: 12 to 15 B: 25 to 30	½ to 1	N: Apr 20 to Jul 1 C: Apr 15 to Jul 1 S: Apr 1 to Jul 15
Sorghum-sudan hybrids	N, C, S	Well drained, productive	D: 20 to 25 B: 30 to 35	½ to 1	N: May 1 to Aug 1 C: Apr 15 to Aug 1 S: Apr 1 to Aug 15
Sweet and forage sorghum	N, C, S	Well drained	B: 15 to 20 Syrup: D: 3 to 5 Silage: D: 4 to 6	1	Late Apr to May 15 S only: late as Jul 1 for forage types
Sudangrass	N, C	Light sandy to heavy clay	D: 20 to 25 B: 30 to 40	½ to 1	May 1 to Aug 1

Barley	N, C	Well drained, productive	Grain: B: 75 to 100 Grazing alone: D: 75 B: 100 to 120 In mixtures: 60 to 75	1 to 2	Sep to Oct
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: Sep 1 to Oct 1 C: Sep 1 to Oct 15 S: Sep 15 to Nov 1 Overseeded: 5 weeks later
Annual ryegrass	N, C, S	Clay loam to sandy	Grazing alone: B: 30 to 35; D: 25-30 In mixtures: 20	0 to ½	Same as for oats, rye, wheat

[1]N = North; C = Central; S = South

[2]B = broadcast; D = drilled

Adapted from Southern Forages. 4th ed. Intl. Plant Nutr. Inst., Norcross, GA.

Planting Information for Perennial and Warm-season Annual Legumes

	Adaptation		Seeding Rate[2], lb/acre	Planting Depth, inches	Optimum Planting Dates
	MS Area[1]	Soils			
Sericea lespedeza	N, C, S	Well drained (avoid lime soils)	B: 20 to 30 D: 15 to 20	¼	Mar to May
Alfalfa	N, C, S	Deep, fertile, well drained	B: 20 to 25	0 to ¼	N: Aug 15 to Oct 1 C: Sep 1 to Oct 1 S: Oct 1 to Nov 1
White and ladino clover	N, C, S	Moist bottoms and productive uplands	B: 3	0 to ¼	Sep to Oct (also Feb to Mar in N, C)
Red clover (acts as annual in south MS)	N, C, S	Moist bottoms and productive uplands	D: 8 to 10 B: 12 to 15	¼ to ½	Sep to Oct

Alyce clover	S	Fertile, well drained	B: 15 to 20	¼ to ½	May 15 to Jul 15
Cowpeas	N, C, S	Well drained	D: 30 to 40 B: 120	2 to 3	May 1 to Jun 15
Annual lespedeza	N, C	Well drained (avoid lime soils)	B: 25 to 35	¼ to ½	Feb 15 to Mar 15

[1]N = North; C = Central; S = South

[2]B = broadcast; D = drilled

Adapted from Ball et. Al. 2007. Southern Forages. 4th ed. Intl. Plant Nutr. Inst., Norcross, GA.

Planting Information for Cool-season Annual Legumes

	Adaptation		Seeding Rate[2], lb/acre	Planting Depth, inches	Optimum Planting Dates
	MS Area[1]	Soils			
Caley peas	Black Belt	Black Belt soils; pH 6.5 or greater	B: 50	½ to 1	Sep to Oct 15
Arrowleaf clover	N, C, S	Well drained, medium to very fertile	B: 5 to 8 (scarified seed)	0 to ½	N: Sep 1 to Oct 1 C: Sep 15 to Oct 15 S: Sep 15 to Nov 1 Overseeded: 5 weeks later
Ball clover	N, C, S	Sandy loam to clay; tolerates moist soils	B: 2 to 3	0 to ¼	Sep to Oct

Berseem clover	N, C, S	Black Belt soils; tolerates moist soils	B: 20 to 25 D: 10 to 15	¼ to ½	Sep
Crimson clover	N, C, S	Well drained (avoid lime soils)	B: 20 to 30 D: 15 to 20	0 to ½	Same as for arrowleaf clover
Subterranean clover	N, C, S	Well drained, productive	B: 8 to 10	¼ to ½	Sep to Oct
Common vetch	N, C, S	Well drained	B: 30 to 40	1 to 1½	N: Sep 1 to Oct 15 C: Sep 1 to Oct 15 S: Sep 15 to Nov 1
Hairy vetch	N, C, S	Well drained	B: 20 to 25	1 to 1½	Same as for common vetch

[1]N = North; C = Central; S = South

[2]B = broadcast; D = drilled

Adapted from Ball et. Al. 2007. Southern Forages. 4th ed. Intl. Plant Nutr. Inst., Norcross, GA.

Environment: Best Management Practices

Goal: to conserve and protect soil, water, and air resources

- Develop and implement a comprehensive nutrient management plan
- Test soil to determine fertilizer needs
- Use most suitable fertilizer based upon crop, application method, and climatic conditions
- Apply with proper rate, technique, and timing
- Maintain and calibrate equipment
- Inject or incorporate fertilizer applications
- Avoid fertilizer application to surface waters
- Minimize chemical spray drift
- Follow chemical label instructions and laws
- Practice safe chemical storage and disposal
- Use cover crops to control soil erosion
- Protect heavy-use areas
- Use riparian forest buffers as appropriate
- Protect stream banks and shorelines using stabilizing vegetation or structures
- Use field borders and vegetative filter strips to reduce water runoff problems
- Control livestock access to surface water
- Use prescribed grazing practices
- Use legumes
- Appropriately manage cattle mortalities

Soil Testing

Set a testing schedule for each field

- Once every 3 years or per crop rotation

Select the proper tools

- Soil probe or auger and bucket

Divide fields into uniform sampling areas

- Sample based on soil maps and judgment
- Sample different soil types separately

Use the correct sampling technique

- Sample away from fence rows, trees, fertilizer or lime spills, or unusual areas
- Sample to a 6-inch depth

Get a composite sample

- Gather at least 15 to 20 cores
- Gather cores at random in zigzag pattern

Process the soil sample

- Break up clods
- Dry at room temperature
- Thoroughly mix the dried sample
- Mildly crush the soil
- Place 1 pint of sample in soil sample box
- Label box with 5-digits or less to ID

MSU-ES Soil Testing Laboratory (662) 325-3313
msucares.com/crops/soils/testing.html
Box 9610, Mississippi State, MS 39762
Standard tests: pH, available phosphate, potash, calcium, magnesium, sodium, and zinc

Fertilizer Composition

Fertilizer Material	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)	Sulfur (S)
	%			
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	4 to 6	2.5 to 4	0	<1
Ammonium polyphosphate (APP)	10	34	0	0
Diammonium phosphate (DAP)	18	46	0	0
Monoammonium phosphate	10 to 12	50 to 55	0	0

(MAP)				
Triple superphosphate (TSP)	0	44 to 46	0	1
Ground rock phosphate	0	26 to 35; 3% available	0	0
Basic slag	0	10 to 25	0	0
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
Poultry litter[1]	2 to 6	1.4 to 9	1 to 6	0 to 0.8

[1]Varies by bird and litter management practice

Adapted from Ball et al. 1999. Forage Crop Pocket Guide. Intl. Plant Nutr. Inst., Norcross, GA.

Forage Herbage Mass

Forage Species	Dry matter, lb/inch/acre	
	Average	Range
Alfalfa or alfalfa-grass mixture	225	75 to 400
Arrowleaf clover	200	100 to 300
Bermudagrass	260	150 to 500
Crimson clover	200	100 to 300
Native warm-season bunchgrasses	100	50 to 250
Red clover	220	100 to 300
Annual ryegrass	250	75 to 400
Oats, rye, wheat	150	75 to 250
Tall fescue	210	100 to 350
Tall fescue with white clover	190	80 to 325

Adapted from Ball et. Al. 2007. Southern Forages. 4th ed. Intl. Plant Nutr. Inst., Norcross, GA.

Rotational Stocking Guidelines[1]

	Target Grazing Height, inches		
Crop	Begin Grazing	End Grazing[2]	Usual Days Rest
Alfalfa (hay)	10 to 16	3 to 4	35 to 40
Alfalfa (grazing)	10 to 16	2 to 3	15 to 30

Annual ryegrass	6 to 12	3 to 4	7 to 15
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 & subterranean[3]	6 to 8	1 to 3	7 to 15
Clover, 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
Indiangrass	12 to 16	6 to 10	30 to 40
Johnsongrass	16 to 20	8 to 12	30 to 40
Pearl millet	20 to 24	8 to 12	10 to 20
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
Tall fescue	4 to 8	2 to 3	15 to 30

[1]The more closely pastures are grazed, the longer the rest period needs to be for defoliation-sensitive species.

[2]The closer a pasture is grazed, the poorer the forage nutritive value will be toward the end of grazing cycle.

[3]Clovers are typically grown in mixtures with grasses.

Adapted from Ball et al. 1999. Forage Crop Pocket Guide. Intl. Plant Nutr. Inst., Norcross, GA.

Rotational Stocking Benefits

- Increased carrying capacity
- Cattle easier to handle
- Closer observation of cattle
- Better pasture persistence and productivity
- Improved utilization of more forage species
- Less trampling
- Better manure and urine distribution
- Environmental benefits

Recommended Harvest Stage for Silage

Forage	Recommended Harvest Stage
Alfalfa	Bud to early bloom
Bermudagrass (hybrid)	Height of 15 inches for 1st cutting, 4 to 5 week intervals thereafter
Cool-season grasses	Boot to early head for 1st cutting, 4 to 6 week intervals thereafter
Forage sorghum	40 inches or late boot stage
Grain sorghum	Late milk to late dough stage
Small grains, annual ryegrass	Boot to early head
Soybeans	Late bloom and before bottom leaves begin to fall
Summer-annual grasses	40 inches or boot stage (whichever comes 1st)

Adapted from Ball et al. 1999. Forage Crop Pocket Guide. Intl. Plant Nutr. Inst., Norcross, GA.

Recommended Harvest Stage for Hay

Forage	Recommended Harvest Stage
Alfalfa	Bud stage for 1st cutting, 1/10th bloom for later cuttings
Annual lespedeza	Early bloom and before bottom leaves begin to fall
Bermudagrass (hybrid)	Height of 15 to 18 inches for 1st cutting, 4 to 5 week intervals thereafter
Big bluestem, indiangrass, switchgrass	Early head stage
Oats, wheat	Boot to early head stage
Pearl millet, sudangrass, sorghum-sudan	Height of 30 to 40 inches
Red, arrowleaf, crimson clovers	Early bloom
Sericea lespedeza	Height of 15 to 18 inches
Soybean	Mid- to full-bloom and before bottom leaves begin to fall
Tall fescue	Boot to early head stage for 1st cutting, 4 to 6 week intervals thereafter
White clover	Stage for companion grass

Adapted from Ball et al. 1999. Forage Crop Pocket Guide. Intl. Plant Nutr. Inst., Norcross, GA.

Forage Dry Matter Percentage

Dry matter, %	Forage description
8 to 15	Young, green, succulent (i.e., small grains, tall fescue, annual ryegrass, especially in seedling stages)
15 to 20	Young, green leafy grasses in spring or when growth is rapid and succulent; white clover in mature stages; alfalfa in prebud stage
20 to 30	Older, slightly brown, or slow-growing plants; headed cool-season grasses; actively growing bermudagrass; alfalfa at 10% bloom
40 to 50	Growth that is more than 40% brown; stockpiled growth in winter and dormant grasses; may be stored in an airtight silo or tightly wrapped bales
40 to 80	Plants cut for storage; feel slightly damp or pliable, but too wet to bale
80 to 85	Hay freshly baled; mold forms if stored below 80% dry matter
85 to 92	Hay stored inside after several months; in samples that are air dried in cloth bags, the leaves will break easily when crumbled or twisted

Adapted from Ball et. Al. 2007. Southern Forages. 4th ed. Intl. Plant Nutr. Inst., Norcross, GA.

Forage Sampling for Laboratory Analysis

- Follow specific directions for the laboratory selected
- Do not use grab samples
- Use a ⅜- to ⅝-inch internal diameter forage probe to core bales
- Keep forage probe cutting edge sharp
- Sample at random from each hay lot (single cutting, field, and maximum quantity of 200 bales)
- Collect ½ to ¾ lb of sample per lot
- Combine at least 20 core samples from each hay lot into one sample for submission
- Sample round bales stored under cover at a 45 degree angle from the top of the bale
- Sample round bales stored outside without cover at a 90 degree angle from the top of the bale
- Sample square bales from the center of their ends
- Uniquely identify each sample
- Protect from heat and direct sunlight
- Include completed sample submission forms and necessary payments
- Package securely and ship promptly
- Ship perishable samples under refrigeration

Forage Quality Terminology

Dry matter (DM)

- % of plant sample remaining after water removed
- 100 - moisture % = dry matter %

In vitro digestible dry matter (IVDMD)

- digestibility determined via laboratory test

Total digestible nutrients (TDN)

- indicator of forage energy content

Crude protein (CP)

- quantity of true protein and non-protein nitrogen present in plant tissue
- nitrogen x 6.25

Neutral detergent fiber (NDF)

- percentage of cell walls or other plant structural material present
- cellulose + hemicellulose + lignin
- only partially digested by animals
- higher NDF associated with lower animal intake

Acid detergent fiber (ADF)

- percentage of highly indigestible plant material
- cellulose + lignin
- higher ADF associated with lower digestibility

Dry matter intake (DMI)

- amount of forage an animal will eat
- estimate based on results from animal feeding trials and measured NDF concentration of a forage

Digestible dry matter (DDM)

- percentage of forage sample which is digestible
- estimate based on results from animal feeding trials and measured ADF concentration of a forage

Relative feed value (RFV)

- expression of a forage's expected intake by animals and its energy value
- index ranking forages on ADF and NDF
- DDM x DMI ÷ 100
- compared to full bloom alfalfa (RFV = 100)
- forage quality increases as RFV increases

Relative forage quality (RFQ)

- similar to RFV but uses TDN in place of DDM
- includes digestible fiber, so more representative of animal performance than RFV
- use with all forages except corn silage

Forage Quality Standards by Forage Type

Forage Type	Standard	Total Digestible Nutrients[1]	Crude Protein[1]	Moisture	pH
Silage[2]	Excellent	65% or above	8% or above	70% or below	4.2 or below
	Good	60 to 64%	7 to 8%	71 to 74%	4.3 to 4.7
	Fair	55 to 59%	6 to 7%	75% and above	4.8 to 5.1
	Poor	Below 55%	Below 6%	75% and above	5.2 or above
Grass Hay[3]	Excellent	58% or above	12% or above		
	Good	55 to 57%	10 to 11%		
	Fair	52 to 54%	8 to 9%		
	Poor	Below 52%	Below 8%		
Legume Hay[3]	Excellent	64% or above	18% or above		
	Good	60 to 63%	16 to 17%		
	Fair	57 to 59%	14 to 15%		
	Poor	Below 57%	Below 14%		

[1]Dry matter basis.

[2]Determine silage quality by total digestible nutrients rating. If silage does not meet either crude protein or moisture requirement for quality, lower one standard.

[3]Determine hay quality by total digestible nutrients rating. If hay does not meet crude protein requirement or is less than 83% dry matter, lower one standard.

General Forage Quality Standards[1]

Quality Standard	Crude Protein (CP)	Acid Detergent Fiber (ADF)	Neutral Detergent Fiber (NDF)	Digestible Dry Matter (DDM)[2]	Dry Matter Intake (DMI)[3]	Relative Feed Value (RFV)[4]
Prime	Above 19%	Below 31%	Below 40%	Above 65%	Above 3.0%	Above 151
1	17 to 19%	31 to 35%	40 to 46%	62 to 65%	2.6 to 3.0%	125 to 151
2	14 to 16%	36 to 40%	47 to 53%	58 to 61%	2.3 to 2.5%	103 to 124
3	11 to 13%	41 to 42%	54 to 60%	56 to 57%	2.0 to 2.2%	87 to 102
4	8 to 10%	43 to 45%	61 to 65%	53 to 55%	1.8 to 1.9%	75 to 86
5	Below 8%	Above 45%	Above 65%	Below 53%	Below 1.8%	Below 75

[1] Dry matter basis; applicable to legume, grass, or grass-legume hay.

[2] Digestible dry matter (DDM%) = 88.9 – 0.779 ADF (% of dry matter).

[3] Dry matter intake (DMI) = 120 ÷ forage NDF (% of dry matter).

[4] Relative feed value (RFV) calculated from DDM x DMI ÷ 1.29. Reference hay of 100 RFV contains 41% ADF and 53% NDF.

Hay Heating Effects

Hay Core Temperature[1], F°	Possible Event
120	Protein breakdown
140	Sugar caramelization
150 to 180	Fire (likely)

[1]Maximum temperature typically occurs 1 week after baling but can happen up to 3 weeks later.

Adapted from Ball et al. 1999. Forage Crop Pocket Guide. Intl. Plant Nutr. Inst., Norcross, GA.

To reduce risk of hay heating, manage moisture content of hay at baling:

- Large round bales: <18% moisture
- Small square bales: <20% moisture

Factors Affecting Forage Intake

- animal weight, condition, stage of production, milk production level
- environmental conditions
- forage nutritive value
- pasture herbage mass (available forage)
- amount and type of forage or feed offered
- palatability
- toxic factors
- management

Predicting Hay Intake

Dry matter intake as % of body weight
= 120/neutral detergent fiber content of hay

Forage Intake Capacity of Beef Cows[1]

Forage Type and Maturity	Stage of Production	Forage Dry Matter Intake Capacity, % of body weight
Low quality forage (< 52% total digestible nutrients)	Non-lactating	1.8
	Lactating	2.2
Average quality forage (52 to 59% total digestible nutrients)	Non-lactating	2.2
	Lactating	2.5
High quality forage (> 59% total digestible nutrients)	Non-lactating	2.5
	Lactating	2.7
Lush, growing pasture	Non-lactating	2.5
	Lactating	2.7
Silage	Non-lactating	2.5
	Lactating	2.7

[1]Intake estimates assume protein requirements are met in the total diet. When protein requirements are not met, forage intake will be lower than the table values.
Adapted from Hibbard and Thrift, 1992.

Dry Matter Intake Adjustment Factors for Specific Environmental Conditions

Environmental Condition	Dry Matter Intake Adjustment Factor[1]
Temperature, degrees Fahrenheit	
> 95 with no night cooling	.65
> 95 with night cooling	.90
77 to 95	.90
59 to 77	1.00
41 to 59	1.03
23 to 41	1.05
5 to 23	1.07
< 5	1.16
Mud, inches	
None	1.00
Mild, 3.9 to 7.9	.85
Severe, 11.8 to 23.6	.70

[1]Multiply factor by predicted dry matter intake to determine adjusted dry matter intake for the condition.

Adapted from NRC. 1987. Predicting Feed Intake of Food-Producing Animals.

Methods to Minimize Forage Losses

- Use management intensive grazing methods
- Reduce leaf shatter at harvest
- Minimize stored forage contact with soil
- Minimize stored forage exposure to weather
- Use hay feeding equipment designed to reduce trampling and waste

As-fed to Dry Matter (DM) Conversion

As-fed basis = as-received basis = forage/feed including moisture content

Dry matter basis = forage/feed excluding water

lb as-fed consumed x % DM = lb DM consumed

Forage/Feed Nitrate Level Guide for Cattle

Nitrate Concentration		**Recommended Management**
0.0 to 0.5%	0 to 5000 ppm	Safe to feed
0.5 to 1.0%	5000 to 10,000 ppm	Risk to pregnant animals and cattle not accustomed to high nitrate containing forage
1.0 to 2.0%	10,000 to 20,000 ppm	Not more than half of the diet
>2.0%	>20,000 ppm	Do not feed

Nitrate concentration conversions:

Nitrate-N = nitrate x 0.23

Potassium nitrate = nitrate x 0.14

Parts per million (ppm):

To convert ppm to percent, move the decimal 4 places to the left.

Example: 5,000 ppm = 0.5%

Forage-related Disorders of Cattle

Disorder	Cause	Signs	Prevention
Ergot poisoning (Dallisgrass staggers)	Consumption of toxin produced by parasitic fungus in the seed heads of bahiagrass, annual ryegrass, small grains, and especially dallisgrass; most common in late summer or fall after wet growing conditions	Lameness, sloughing of tail switch and hooves, elevated body temperature, increased respiratory rate, increased heart rate	Clip pastures to limit seed head development and ergot growth; avoid harvesting fields with large quantities of potentially infected seed heads for hay
Fescue toxicosis	Consumption of alkaloids in toxic-endophyte-infected tall fescue plants	Rough hair coat, depressed weight gain	Removal from or dilution of toxic pastures and hay
Grass tetany	Consumption (especially by lactating cattle) of lush forage containing low levels of magnesium or calcium	Nervousness, muscle twitching around the face and ears, staggering, reduced feed intake, convulsions, death	Provide magnesium and calcium supplement to cattle at least 30 days prior to and during grass tetany season

Nitrate poisoning	Consumption of excessive nitrate from forage (most common in warm-season annual grasses), weeds (especially pigweed), water, or other sources; nitrate is absorbed into red blood cells and combines with hemoglobin to produce a type of hemoglobin that cannot carry oxygen in the blood causing a lack of sufficient oxygen transport to tissues	Bluish skin discoloration, bluish-brown mucous membranes, labored or rapid breathing, tremors, lack of muscle control, staggering, weakness, diarrhea, frequent urination, dark- to chocolate-colored blood, rapid pulse, abortion, coma, suffocation	Avoid grazing livestock on heavily nitrogen-fertilized pastures of suspect species during drought or wet conditions through cool, cloudy weather; observe carefully for signs of nitrate poisoning; test forages of concern for nitrate-nitrogen levels
Prussic acid poisoning	Consumption of prussic acid-containing forage (leaves of johnsongrass, sorghum, sudangrass, sorghum-sudan hybrids, and wild cherry); most likely after frost or drought)	Excessive salivation, rapid, breathing, muscle spasms, death	Avoid toxic forages; prussic acid levels in forages deteriorate over time; feed as hay, 3+ weeks after ensiling, or 1+ week after frost

Nutritional Disorders of Cattle

Disorder	Cause	Signs	Prevention
Acidosis	Shift from a forage-based diet to a high concentrate-based diet or excessive consumption of fermentable carbohydrates causing low rumen pH	Slowing or stopping of gut movement, diarrhea, dehydration, weakness, incoordination, gray and foamy manure, poor nutrient absorption, reduced but variable feed intake, decreased performance, heart and lung failure, death	Limit feed consumption; introduce high-concentrate feeds gradually over 3 to 4 weeks; keep at least 10% roughage in the final diet; feed a combination of grains, feed dry grain with high-moisture grain; feed ionophores
Frothy (feedlot) bloat	Foam development in rumen from high-grain diet prevents belching and leads to suffocation	Rapid swelling on left side, display of discomfort (kicking at sides, stomping feet), sudden death	Slowly adapt cattle from forage-based diets to grain-based diets over a period of at least 3 weeks, manage nutrition of chronic bloaters carefully

Pasture (legume) bloat	Foam development in rumen from diet with high levels of soluble protein (alfalfa, winter annual grasses, white clover) prevents belching and leads to suffocation	Rapid swelling on left side, display of discomfort (kicking at sides, stomping feet), sudden death	Fill cattle on hay before turning out on lush legume or winter-annual grass pastures, feed poloxalene or monensin, manage nutrition of chronic bloaters carefully
Hardware disease	Sharp, heavy object consumed punctures reticulum wall, diaphragm, and/or heart sac causing damage to and infection of the abdominal cavity, heart sac, or lungs	Loss of appetite, depression, reluctance to move, arched back, indications of pain, grunting when forced to walk, bloat appearance on upper left side with fluid accumulation on lower right, fluid accumulation in brisket, death	Keep pastures, paddocks, and feed bunks free of wire, nails, fencing staples, and other sharp objects (even heavy plastic items) that could be swallowed; place magnets on feeding equipment; administer an intraruminal magnet

Mycotoxins Affecting Cattle

Mycotoxin	Risk Conditions	Risk Feeds	Effects on Cattle	Signs of Toxicosis
Aflatoxin (most common mycotoxin in MS)	Hot, dry conditions	Corn, cottonseed, peanuts, sorghum	Causes cancer, inhibits protein production, suppresses immune system, disrupts rumen function	Dry muzzle, decreased body temperature, young cattle more susceptible
Fumonisin	Cool, wet following hot, dry weather	Corn, particularly screenings	Damages liver	Elevated serum liver enzymes, liver lesions
Vomitoxin (Deoxynivalenol, DON)	Cool, wet conditions	Wheat, barley, rye, oats	Inhibits protein production, affects digestive tract and immune system	No apparent adverse effects at low levels in ruminating cattle

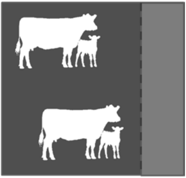
Ochratoxin A	Hot, dry conditions	Corn, barley, wheat, rye	Possibly causes cancer, causes frequent urination leading to kidney damage	Increased water consumption and urination
Zearalenone (F-2 toxin, giberella toxin)	Cool, wet conditions	Corn, wheat, barley, oats	Produces estrogenic effect	Infertility, estrous cycle disruptions

FDA Action Levels for Total Aflatoxins in Livestock Feed

Animal Class	Feed	FDA Action Level
Finishing beef cattle	Corn and peanut products	300 ppb
Beef cattle, swine, or poultry	Cottonseed meal	300 ppb
Corn and peanut products	Corn and peanut products	100 ppb
Immature animals	Animal feeds and ingredients, excluding cottonseed meal	20 ppb
Dairy animals or unknown use	Animal feeds and ingredients	20 ppb

Grazing Methods

Continuous stocking



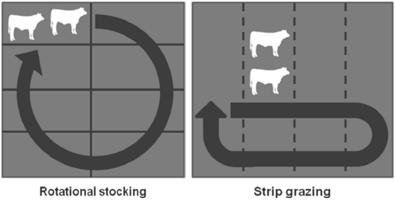
Continuous stocking with fenced off area during forage surplus growth period

Continuous stocking

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

Continuous stocking with fenced off area during forage surplus growth

Areas can be fenced off from continuous stocking during periods of surplus forage growth to help keep the forage being grazed from becoming overmature. The stockpiled forage can then be either grazed at a later date or harvested for hay. Stockpiling forage (deferred grazing) is where forage is allowed to accumulate for grazing at a later period.

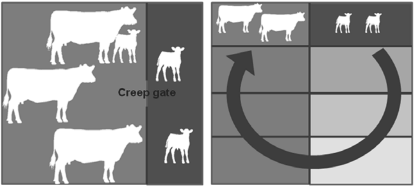


Rotational stocking

Rotational stocking is a grazing method that utilizes recurring periods of grazing and rest among 2 or more paddocks in a grazing management unit through the period when grazing is allowed.

Strip grazing

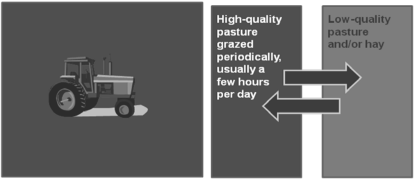
Strip grazing involves confining animals to an area of grazing land to be grazed in a relatively short period of time, where the paddock size is varied to allow access to a specific land area. Mob grazing is a variation of strip grazing where a large number of animals are grazed on a relatively small number of acres to rapidly remove forage from the paddock. Mob grazing is useful when forage growth needs to be removed prior to sodseeding another forage crop in the same paddock.



Creep grazing Forward creep grazing

Creep grazing is a form of preweaning supplementation of nursing calves. It is the practice of allowing nursing calves to graze areas that their dams cannot access at the same time. This is accomplished through use of a creep gate that the calves can pass through freely but their dams cannot.

Forward creep grazing is a method of creep grazing in which dams and calves rotate through a series of paddocks with calves as first grazers and dams as last grazers. Calves have more opportunity for selectivity than their dams. This is a specific form of forward grazing. Forward grazing (leader-follower, preference-follower, top and bottom grazer, first-last grazing) is a method of utilizing 2 or more groups of animals, usually with different nutritional requirements, to graze sequentially on the same land area.



Greenchop Limit grazing

Greenchop is where green, actively growing forage is chopped mechanically and fed to livestock. This method reduces waste by grazing animals so that more animals can be fed per acre. However, forage selectivity is reduced, and individual animal performance is often lower. Equipment, fuel, and labor costs are higher with this forage harvest method.

Limit grazing is where livestock are maintained on lower quality pasture but allowed to access a higher quality pasture (typically winter annual grass pasture) for a few hours each day or every few days. Waste from trampling is reduced with this method. This method provides good nutrition at relatively low cost as the area needed for high quality pasture is relatively small. Cattle learn to move to and from paddocks with relative ease after a routine is established.

Grazing Formulas

$$\text{Number of paddocks} = \frac{\text{days of rest}}{\text{days of grazing}} + 1$$

$$\text{Acres required per paddock} = \frac{\text{average animal weight} \times \text{dry matter consumed per animal as \% of body weight} \times \text{number of animals} \times \text{days on pasture}}{\text{dry matter available in grazing area} \times \text{\% of dry matter utilized by grazing}}$$

$$\text{Total acres required} = \text{number of paddocks} \times \text{acres required per paddock}$$

$$\text{Stocking rate} = \frac{\text{number of animals grazed}}{\text{total acres grazed}}$$

$$\text{Stocking density} = \frac{\text{number of animals grazed}}{\text{paddock size in acres}}$$

Body Condition Score (BCS)

- Tool used to evaluate nutritional status
- Body condition (fat cover) indicates the energy reserves of an animal
- Females in thin body condition at calving are slower to rebreed, produce less colostrum, may not have sufficient nutrient reserves for maximum milk production, and are less likely to wean a live calf
- Over-conditioning is expensive and can result in calving problems and lower dry matter intake early in lactation
- Easily evaluated by visual appraisal
- Does not require cattle handling

Recommended body condition scores at calving:

- mature cows: BCS 5
- first-calf heifers: BCS 6

Ideal times to body condition score beef cattle:

- When calves are weaned
- 45 days after weaning
- 90 days prior to calving
- At calving
- At the start of the breeding season

BCS 1 = Emaciated: No palpable fat is detectable over the spinous processes, transverse processes, ribs, or hooks. The tailhead and ribs appear very prominent.

BCS 2 = Poor: Animal is still somewhat emaciated but the tailhead and ribs are less prominent. Individual spinous processes are still sharp to the touch. Some tissue cover is present over the ribs towards the top of the back.

BCS 3 = Thin: Individual ribs including foreribs are easily identified but are not quite as sharp to the touch. Some fat can be felt along the spine and over the tailhead. Some tissue cover is present over the ribs towards the top of the back.

BCS 4 = Borderline: Individual ribs may not be visually obvious. Individual spinous processes can be felt when palpated but feel rounded rather than sharp. Some fat cover is present over the ribs, transverse processes and hooks.

BCS 5 = Moderate: Overall appearance is generally good. Fat cover over ribs feels spongy. Palpable fat cover is present on either side of the tailhead.

BCS 6 = High moderate: A high degree of palpable fat exists over the ribs and around the tailhead. Firm pressure is needed to feel the spinous processes.

BCS 7 = Good: Considerable fat cover is present with a fleshy overall appearance. Fat cover over the ribs and around the tailhead is very spongy. Fat “pones” or “rounds” may be starting to form alongside the tailhead.

BCS 8 = Fat: The animal is very fleshy and appears over-conditioned. Palpation of the spinous processes is near impossible. Large fat deposits are present over the ribs and around the tailhead. Fat pones around the tailhead are obvious.

BCS 9 = Extremely fat: The overall appearance is blocky with extremely wasty and patchy fat cover. The tailhead and hooks are buried in fatty tissue with fat pones protruding. Bone structure is no longer visible and barely palpable. Large fatty deposits may even impair animal mobility.

Nutrient requirements to increase body condition score of beef cows from 4 to 5 during the last 90 days of pregnancy[1]

Animal Description	Dry Matter Intake		Diet Nutrient Density			Daily Nutrients per Animal		
Mature BW at body condition score 5, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	CP, % DM	TDN, lb	NE_m, Mcal	CP, lb
1,000	20.5	2.1	60	.59	7.7	12.3	12.1	1.57
1,100	22.0	2.0	60	.58	7.5	13.2	12.8	1.65
1,200	23.5	2.0	59	.58	7.4	13.9	13.6	1.74

[1]BW = shrunk body weight or 96% full body weight, DMI = dry matter intake, TDN = total digestible nutrients, NE_m = net energy for maintenance, CP = crude protein, Ca = calcium, P = phosphorus
Adapted from NRC, 2000. NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Nutrient requirements to increase body condition score of non-pregnant beef cows[1]

Animal Description	Body Condition Score		Dry Matter Intake		Diet Nutrient Density			Daily Nutrients per Animal		
Mature BW at BCS 5, lb	BCS	Days to gain 1 BCS	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	CP, % DM	TDN, lb	NE_m, Mcal	CP, lb
1,000	3	30	18.8	1.9	64	.65	6.1	12.0	12.2	1.14
		60	17.7	1.8	57	.55	6.4	10.1	9.8	1.14
	4	30	20.5	2.1	66	.67	5.9	13.5	13.8	1.21
		60	19.0	1.9	58	.56	6.4	11.0	10.7	1.21
1,100	3	30	20.3	1.8	65	.66	6.0	13.2	13.4	1.22
		60	19.0	1.7	58	.56	6.4	11.0	10.6	1.22
	4	30	22.2	2.0	67	.69	5.9	14.9	15.3	1.30
		60	20.4	1.9	58	.57	6.4	11.8	11.6	1.30
1,200	3	30	21.0	1.8	65	.69	6.2	13.7	14.5	1.30
		60	20.3	1.7	58	.56	6.4	11.8	11.3	1.30
	4	30	23.5	2.0	67	.68	5.9	15.7	16.0	1.38
		60	21.8	1.8	58	.56	6.3	12.6	12.3	1.38

[1]BCS = body condition score, DMI = dry matter intake, BW = shrunk body weight or 96% full body weight, TDN = total digestible nutrients, NE_m = net energy for maintenance, CP = crude protein

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

Beef Cattle Water Intake Estimates

Weight, lb	Water intake estimates, gallons					
	Temperature, ^oF					
	40	50	60	70	80	90
Growing beef calves						
400	4.0	4.3	5.0	5.8	6.7	9.5
600	5.3	5.8	6.5	7.8	8.9	12.7
800	6.3	6.8	7.9	9.2	10.6	15.0
Finishing cattle						
600	6.0	6.5	7.4	8.7	10.0	14.3
800	7.3	7.9	9.1	10.7	12.3	17.4
1,000	8.7	9.4	10.8	12.6	14.5	20.6
Pregnant cows						
900[1]	6.7	7.2	8.3	9.7	NA	NA
Lactating Cows						
900	11.4	12.6	14.5	16.9	17.9	16.2
Mature bulls						
1,400	8.0	8.6	9.9	11.7	13.4	19.0
1,600+	8.7	9.4	10.8	12.6	14.5	20.6

[1]NA = not available. *Adapted from NRC, 2000. NRC Nutrient Requirements of Beef Cattle,7th rev. ed.*

Adequate Water Availability

- adequate number and size of water sources
- do not allow supplies to run low or out
  - livestock may go thirsty
  - livestock may damage water troughs
  - water quality declines
- check daily

Stock Tank Capacity

Stock Tank Capacities (Height = 2 ft)				
Circular Type		Round-end Type		
Diameter, ft	Capacity, gallons	Width, ft	Length, ft	Capacity, gallons
3	100	2	4	95
3 ½	140	2	5	120
4	185	2	6	140
4 ½	235	2	7	185
5	290	2	8	195
5 ½	350	2	10	250
6	420	3	5	175
6 ½	495	3	6	220
7	570	3	7	260
7 ½	660	3	8	300
8	750	3	10	385
9	950	3	12	475
10	1170	3	14	560

Adapted from NCBA.2001. IRM Pocket Reference. 1st ed.

Acceptable Drinking Water for Cattle

- pH: 6.5 to 8.0
- ≤3,000 ppm total dissolved solids
- ≤100 ppm nitrate-nitrogen
- <500 mg sulfate per liter (contribute to <0.4% total dietary sulfur on a dry matter basis)
- ≤1 coliform per 10 mL water
- Free of nutrient enrichment, blue-green algae

Growing Steer and Heifer Nutrient Requirements: 1,100 lb at Finishing[1]

			Diet Nutrient Density		Daily Nutrients / Animal	
Body weight, lb	ADG, lb	DMI, lb/day	TDN, % dry matter	CP, % dry matter	TDN, lb	CP, lb
300	0.5	7.9	54	9.2	4.3	0.73
	1.0	8.4	59	11.4	5.0	0.95
	1.5	8.6	64	13.6	5.5	1.17
	2.0	8.6	69	16.2	5.9	1.39
	2.5	8.5	75	18.9	6.4	1.61
	3.0	8.2	83	22.2	6.8	1.83
400	0.5	9.8	54	8.7	5.3	0.85
	1.0	10.4	59	10.4	6.1	1.08
	1.5	10.7	64	12.1	6.8	1.30
	2.0	10.7	69	14.1	7.4	1.51
	2.5	10.6	75	16.3	8.0	1.72
	3.0	10.2	83	19.0	8.5	1.94
500	0.5	11.6	54	8.4	6.3	0.97
	1.0	12.2	59	9.8	7.2	1.19
	1.5	12.6	64	11.2	8.1	1.41
	2.0	12.7	69	12.8	8.8	1.63
	2.5	12.5	75	14.7	9.4	1.84
	3.0	12.1	83	16.9	10.0	2.05

600	0.5	13.2	54	8.2	7.1	1.08
	1.0	14.0	59	9.4	8.3	1.31
	1.5	14.4	64	10.6	9.2	1.53
	2.0	14.6	69	11.9	10.1	1.74
	2.5	14.4	75	13.6	10.8	1.95
	3.0	13.8	83	15.7	11.5	2.17
700	0.5	14.9	54	8.0	8.0	1.19
	1.0	15.8	59	9.0	9.3	1.42
	1.5	16.2	64	10.1	10.4	1.64
	2.0	16.3	69	11.4	11.2	1.85
	2.5	16.1	75	12.8	12.1	2.06
	3.0	15.5	83	14.6	12.9	2.27

[1]ADG = average daily gain; DMI = dry matter intake; TDN = total digestible nutrients; CP = crude protein

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

- Lightweight and early-weaned calves need
  - More nutrient dense diets
  - Greater % crude protein
  - Good source of digestible energy
- Provide acceptable levels of critical nutrients with extra care for stressed calves
- Minimize potential for nutritional disorders
  - Keep concentrate level <55% in receiving diets

Growing Steer and Heifer Nutrient Requirements: 1,200 lb at Finishing[1]

			Diet Nutrient Density		Daily Nutrients / Animal	
Body weight, lb	ADG, lb	DMI, lb/day	TDN, % dry matter	CP, % dry matter	TDN, lb	CP, lb
300	0.5	7.8	54	9.4	4.2	0.73
	1.0	8.3	58	11.5	4.8	0.95
	1.5	8.6	63	13.7	5.4	1.17
	2.0	8.6	68	16.2	5.8	1.40
	2.5	8.6	73	18.7	6.3	1.61
	3.0	8.3	80	22.0	6.6	1.83
400	0.5	9.7	54	8.8	5.2	0.85
	1.0	10.3	58	10.4	6.0	1.07
	1.5	10.6	63	12.2	6.7	1.30
	2.0	10.7	68	14.1	7.3	1.51
	2.5	10.7	73	16.1	7.8	1.72
	3.0	10.4	80	18.7	8.3	1.94
500	0.5	11.5	54	8.4	6.2	0.97
	1.0	12.2	58	9.8	7.1	1.19
	1.5	12.6	63	11.2	7.9	1.41
	2.0	12.6	68	12.9	8.6	1.63
	2.5	12.6	73	14.6	9.2	1.84
	3.0	12.2	80	16.8	9.8	2.05

600	0.5	13.2	54	8.2	7.1	1.08
	1.0	14.0	58	9.3	8.1	1.31
	1.5	14.4	63	10.6	9.1	1.52
	2.0	14.4	68	12.1	9.8	1.74
	2.5	14.4	73	13.5	10.5	1.95
	3.0	14.0	80	15.4	11.2	2.16
700	0.5	14.8	54	8.0	8.0	1.18
	1.0	15.7	58	9.0	9.1	1.42
	1.5	16.2	63	10.1	10.2	1.64
	2.0	16.3	68	11.3	11.1	1.85
	2.5	16.2	73	12.7	11.8	2.05
	3.0	15.8	80	14.4	12.6	2.27

[1]ADG = average daily gain; DMI = dry matter intake; TDN = total digestible nutrients; CP = crude protein

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

- Encourage consumption
  - Use very palatable feeds/forages
  - Proper feed and water placement
  - May prefer dry over wet feeds at first
- Receiving diets
  - At least maintenance requirements for protein, vitamins, and minerals when feed consumption is 1.0 to 1.5% of body weight
  - Keep fat less than 4% total dietary dry matter
  - Non-protein nitrogen is not recommended for calves <600 lb.
  - Avoid heat-damaged feeds

Growing Bull Nutrient Requirements: 2,000-lb Mature Weight[1,2]

			Diet Nutrient Density		Daily Nutrients / Animal	
Body weight, lb	ADG, lb	DMI, lb/day	TDN, % dry matter	CP, % dry matter	TDN, lb	CP, lb
300	0.5	8.0	55	9.1	4.4	0.73
	1.0	8.3	58	11.4	4.8	0.95
	1.5	8.5	61	13.8	5.2	1.17
	2.0	8.6	65	16.3	5.6	1.40
	2.5	8.7	68	18.5	5.9	1.61
	3.0	8.6	72	21.3	6.2	1.83
400	0.5	9.9	55	8.6	5.4	0.85
	1.0	10.3	58	10.5	6.0	1.08
	1.5	10.5	61	12.4	6.4	1.30
	2.0	10.7	65	14.1	7.0	1.51
	2.5	10.7	68	16.2	7.3	1.73
	3.0	10.7	72	18.1	7.7	1.94
500	0.5	11.7	55	8.3	6.4	0.97
	1.0	12.2	58	9.8	7.1	1.19
	1.5	12.5	61	11.3	7.6	1.41
	2.0	12.6	65	12.9	8.2	1.63
	2.5	12.7	68	14.5	8.6	1.84
	3.0	12.6	72	16.3	9.1	2.05

600	0.5	13.4	55	8.1	7.4	1.08
	1.0	13.9	58	9.4	8.1	1.31
	1.5	14.3	61	10.7	8.7	1.53
	2.0	14.5	65	12.0	9.4	1.74
	2.5	14.5	68	13.4	9.9	1.95
	3.0	14.5	72	14.9	10.4	2.16
700	0.5	15.1	55	7.9	8.3	1.19
	1.0	15.6	58	9.1	9.0	1.42
	1.5	16.0	61	10.3	9.8	1.64
	2.0	16.3	65	11.4	10.6	1.86
	2.5	16.3	68	12.7	11.1	2.07
	3.0	15.3	72	13.9	11.7	2.27
800	0.5	16.7	55	7.7	9.2	1.28
	1.0	17.3	58	8.7	10.0	1.51
	1.5	17.7	61	9.7	10.8	1.72
	2.0	18.0	65	10.7	11.7	1.93
	2.5	18.1	68	11.8	12.3	2.13
	3.0	18.0	72	12.9	13.0	2.33
900	0.5	18.2	55	7.5	10.0	1.37
	1.0	18.9	58	8.3	11.0	1.57
	1.5	19.4	61	9.1	11.8	1.77
	2.0	19.6	65	9.9	12.7	1.95
	2.5	19.7	68	10.9	13.4	2.14
	3.0	19.6	72	11.9	14.1	2.33

[1]For bulls less than 12 months of age

[2]ADG = average daily gain; DMI = dry matter intake; TDN = total digestible nutrients; CP = crude protein

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

Growing Yearling Nutrient Requirements: 1,200 lb at Finishing[1]

Body weight, lb	ADG, lb	Dry matter intake, lb/day	Diet Nutrient Density: TDN, % dry matter	Diet Nutrient Density: CP, % dry matter	Daily Nutrients / Animal: TDN, lb	Daily Nutrients / Animal: CP, lb
660	0.7	17.5	50	7.3	8.8	1.28
	2.0	18.4	60	10.2	11.0	1.88
	3.0	18.0	70	13.0	12.6	2.34
	3.8	17.0	80	15.8	13.6	2.69
	4.2	15.7	90	18.4	14.1	2.89
720	0.7	18.6	50	7.1	9.3	1.32
	2.0	19.7	60	9.7	11.8	1.91
	3.0	19.2	70	12.2	13.4	2.34
	3.8	18.2	80	14.6	14.6	2.66
	4.2	16.8	90	17.0	15.1	2.86
780	0.7	19.8	50	6.9	9.9	1.37
	2.0	20.9	60	9.2	12.5	1.92
	3.0	20.4	70	11.4	14.3	2.33
	3.8	19.3	80	13.6	15.4	2.62
	4.2	17.8	90	15.8	16.0	2.81

840	0.7	20.9	50	6.8	10.5	1.42
	2.0	22.1	60	8.8	13.3	1.94
	3.0	21.6	70	10.8	15.1	2.33
	3.8	20.4	80	12.8	16.3	2.61
	4.2	18.8	90	14.7	16.9	2.76
900	0.7	22.0	50	6.6	11.0	1.45
	2.0	23.3	60	8.4	14.0	1.96
	3.0	22.7	70	10.2	15.9	2.32
	3.8	21.5	80	12.0	17.2	2.58
	4.2	19.8	90	13.8	17.8	2.73
960	0.7	23.1	50	6.5	11.6	1.50
	2.0	24.4	60	8.1	14.6	1.98
	3.0	23.9	70	9.7	16.7	2.32
	3.8	22.5	80	11.3	18.0	2.54
	4.2	20.8	90	13.0	18.7	2.70

[1]ADG = average daily gain; TDN = total digestible nutrients; CP = crude protein

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

- Project and monitor cost of gain
- Determine target weight gains
- Place bulls on test to evaluate growth
- Match nutrition program with animal requirements
- Monitor weight gains periodically
- Do not allow heifers to lose weight or become too fat during development

Pregnant Replacement Heifer Nutrient Requirements[1]

			Diet Nutrient Density		Daily Nutrients / Animal	
Mature body weight, lb	Months since conception	Dry matter intake, lb/day	TDN, % dry matter	CP, % dry matter	TDN, lb	CP, lb
1,000	1	16.7	50.1	7.2	8.4	1.20
	2	17.2	50.2	7.2	8.6	1.24
	3	17.7	50.4	7.2	8.9	1.27
	4	18.2	50.7	7.2	9.2	1.31
	5	18.7	51.3	7.3	9.6	1.37
	6	19.4	52.3	7.6	10.1	1.47
	7	20.0	54.0	8.0	10.8	1.60
	8	20.7	56.8	8.7	11.8	1.80
	9	21.3	61.3	10.0	13.1	2.13
1,200	1	19.3	50.5	7.2	9.7	1.39
	2	19.8	50.5	7.2	10.0	1.43
	3	20.3	50.7	7.2	10.3	1.46
	4	20.9	50.9	7.2	10.6	1.50
	5	21.5	51.4	7.3	11.1	1.57
	6	22.2	52.3	7.5	11.6	1.67
	7	23.0	53.8	7.9	12.4	1.82
	8	23.7	56.2	8.5	13.3	2.01
	9	24.4	59.9	9.6	14.6	2.34

1,400	1	21.7	50.7	7.3	11.0	1.58
	2	22.3	50.8	7.2	11.3	1.61
	3	22.9	50.9	7.2	11.7	1.65
	4	23.5	51.2	7.2	12.0	1.69
	5	24.2	51.6	7.3	12.5	1.77
	6	24.9	52.4	7.5	13.0	1.82
	7	25.8	53.7	7.8	13.9	2.01
	8	26.6	55.8	8.4	14.8	2.23
	9	27.4	59.0	9.3	16.2	2.55

[1]TDN = total digestible nutrients; CP = crude protein

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

- Feed heifers separately from mature cows
    - Keeps heifers from being bossed out of feed trough by cows (feeding competition)
    - Allows better matching of nutritional resources to different cattle classes
- Target 85 to 90% of mature body weight at first calving
- Pregnant heifer nutrient requirements increase throughout gestation and are greatest in the last trimester

Two-year-old Lactating First-calf Heifer Nutrient Requirements[1,2]

			Diet Nutrient Density		Daily Nutrients / Animal	
Mature body weight, lb	Months after calving	DMI, lb/day	TDN, % dry matter	CP, % dry matter	TDN, lb	CP, lb
1,000	1	20.4	61.0	10.6	12.4	2.16
	2	21.2	62.1	11.1	13.2	2.36
	3	21.8	59.8	10.4	13.0	2.26
	4	21.2	58.5	9.7	12.4	2.06
	5	20.7	57.1	9.0	11.8	1.87
	6	20.3	56.0	8.4	11.4	1.71
1,200	1	22.9	60.4	10.2	13.8	2.34
	2	23.8	61.4	10.7	14.6	2.55
	3	24.5	59.2	10.0	14.5	2.44
	4	24.0	58.0	9.4	13.9	2.25
	5	23.4	56.8	8.8	13.3	2.05
	6	23.0	55.8	8.3	12.8	1.90
1,400	1	25.3	60.0	10.0	15.2	2.52
	2	26.2	60.9	10.4	16.0	2.72
	3	27.1	58.7	9.7	15.9	2.62
	4	26.6	57.6	9.1	15.3	2.43
	5	26.1	56.5	8.5	14.7	2.23
	6	25.7	55.7	8.1	14.3	2.08

[1]20 lb daily peak milk production

[2]TDN = total digestible nutrients; DMI = dry matter intake; CP = crude protein

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

Two-year-old Dry (Non-lactating) First-calf Heifer Nutrient Requirements[1]

			Diet Nutrient Density		Daily Nutrients / Animal	
Mature body weight, lb	**Months after calving**	**DMI, lb/day**	**TDN, % dry matter**	**CP, % dry matter**	**TDN, lb**	**CP, lb**
1,000	7	18.8	48.6	6.9	9.1	1.29
	8	18.9	49.4	7.0	9.3	1.33
	9	19.1	50.7	7.3	9.7	1.39
	10	19.4	52.7	7.7	10.2	1.50
	11	19.9	55.5	8.3	11.0	1.66
	12	20.6	59.1	9.3	12.2	1.92
1,200	7	21.5	48.9	6.9	10.5	1.48
	8	21.7	49.7	7.1	10.8	1.53
	9	22.0	51.0	7.3	11.2	1.61
	10	22.3	53.1	7.8	11.8	1.73
	11	22.8	55.9	8.5	12.7	1.93
	12	23.7	59.7	9.4	14.1	2.23
1,400	7	24.2	49.1	6.9	11.9	1.67
	8	24.4	49.9	7.0	12.2	1.72
	9	24.7	51.3	7.3	12.7	1.81
	10	25.1	53.4	7.8	13.4	1.96
	11	25.7	56.4	8.5	14.5	2.19
	12	26.7	60.2	9.5	16.1	2.54

[1]TDN = total digestible nutrients; DMI = dry matter intake; CP = crude protein

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

Mature Lactating Cow Nutrient Requirements: 20 lb/day peak milk[1]

			Diet Nutrient Density		Daily Nutrients / Animal	
Body weight, lb	Months after calving	DMI, lb/day	TDN, % dry matter	CP, % dry matter	TDN, lb	CP, lb
1,000	1	24.0	59.6	10.5	14.3	2.53
	2	25.0	60.9	11.2	15.2	2.79
	3	25.4	58.6	10.4	14.9	2.64
	4	24.4	57.0	9.7	13.9	2.36
	5	23.5	55.4	8.9	13.0	2.08
	6	22.7	54.0	8.2	12.3	1.85
1,200	1	26.8	58.7	10.1	15.7	2.71
	2	27.8	59.9	10.7	16.7	2.97
	3	28.4	57.6	9.9	16.4	2.82
	4	27.4	56.2	9.3	15.4	2.54
	5	26.5	54.7	8.5	14.5	2.26
	6	25.7	53.4	7.9	13.7	2.04
1,400	1	29.5	58.0	9.8	17.1	2.88
	2	30.5	59.1	10.3	18.0	3.14
	3	31.3	56.8	9.6	17.8	2.99
	4	30.3	55.5	8.9	16.8	2.70
	5	29.4	54.1	8.3	15.9	2.44
	6	28.6	53.0	7.7	15.2	2.21

[1]TDN = total digestible nutrients; DMI = dry matter intake; CP = crude protein

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

Mature Dry (Non-lactating) Cow Nutrient Requirements[1]

			Diet Nutrient Density		Daily Nutrients / Animal	
Body weight, lb	Months after calving	DMI, lb/day	TDN, % dry matter	CP, % dry matter	TDN, lb	CP, lb
1,000	7	19.5	46.8	6.5	9.1	1.26
	8	19.8	47.2	6.6	9.3	1.30
	9	20.3	47.9	6.7	9.7	1.35
	10	21.1	48.9	6.9	10.3	1.45
	11	21.0	52.1	7.7	10.9	1.61
	12	21.4	55.9	8.7	12.0	1.86
1,200	7	22.4	46.9	6.5	10.5	1.45
	8	22.8	47.3	6.5	10.8	1.49
	9	23.3	47.9	6.7	11.2	1.56
	10	24.3	49.0	6.9	11.9	1.67
	11	24.1	52.3	7.7	12.6	1.86
	12	24.6	56.2	8.8	13.8	2.16
1,400	7	25.2	46.9	6.5	11.8	1.63
	8	25.6	47.3	6.5	12.1	1.67
	9	26.2	48.0	6.7	12.6	1.75
	10	27.3	49.1	6.9	13.4	1.89
	11	27.0	52.6	7.8	14.2	2.11
	12	27.6	56.6	8.9	15.6	2.45

[1]TDN = total digestible nutrients; DMI = dry matter intake; CP = crude protein
Adapted from NRC, 2000. NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Growing and Mature Bull Nutrient Requirements: 2,000-lb Mature Weight[1,2]

			Diet Nutrient Density		Daily Nutrients / Animal	
Body weight, lb	Average daily gain, lb	DMI, lb/day	TDN, % dry matter	CP, % dry matter	TDN, lb	CP, lb
1,000	0.5	23.8	50	6.1	11.9	1.44
	1.7	25.2	60	7.5	15.1	1.89
	2.8	24.6	70	9.1	17.2	2.23
	3.5	23.2	80	10.5	18.6	2.46
1,200	0.5	27.3	50	5.8	13.7	1.59
	1.7	28.9	60	6.8	17.3	1.96
	2.8	28.2	70	7.9	19.7	2.22
	3.5	26.6	80	9.0	21.3	2.40
1,400	0.5	30.7	50	5.7	15.4	1.74
	1.7	32.4	60	6.3	19.4	2.03
1,600	0.5	33.9	50	5.5	17.0	1.88
	1.7	35.8	60	5.8	21.5	2.09
1,800	0.5	37.0	50	5.5	18.5	2.02
	1.7	39.1	60	5.5	23.5	2.16
2,000	0.0	37.2	46	5.6	17.1	2.07
	0.5	40.1	50	5.2	20.1	2.15

[1]For bulls that are at least 12 months of age and weigh more than 50 percent of their mature weight

[2]Body weight = shrunk body weight; DMI = dry matter intake; TDN = total digestible nutrients; CP = crude protein

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

Mineral Maximum Tolerable Concentrations in Beef Cattle

Mineral Element	Maximum Tolerable Concentration
Aluminum	1000 ppm
Arsenic	50 ppm (100 ppm for organic forms)
Bromine	200 ppm
Cadmium	0.5 ppm
Chromium	1000 ppm
Cobalt	10 ppm
Copper	100 ppm
Fluorine	40 to 100 ppm
Iodine	50 ppm
Iron	1000 ppm
Lead	30 ppm
Magnesium	0.4%
Manganese	1000 ppm
Mercury	2 ppm
Molybdenum	5 ppm
Nickel	50 ppm
Potassium	3%
Selenium	2 ppm
Strontium	2000 ppm
Sulfur	0.4%
Zinc	500 ppm

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

Mineral and Vitamin Levels

Mineral/ Vitamin	Recommended Level in Supplement	Comments
Ca	1.6:1 Ca:P ideal (1:1 to 4:1 acceptable)	Forages high in Ca, Grains high in P
P	4 to 8%	More needed with poor forage
Mg	2% (low quality forage); 4% (intermediate quality forage)	At least 10% for grass tetany prevention (preferably 13-14%)
K	Not critical on pasture	Needed on high-concentrate diets
NaCl (Salt)	10 to 25% of supplement	Dietary levels ≥6.5% reduce feed intake; Be aware of water salt content
Co	15 ppm (4-oz intake supplement)	
Cu	1250 ppm (4-oz intake supplement)	
I	50 ppm (4-oz intake supplement)	Max legal EDDI rate 50 mg/hd/day
Mn	2000 ppm (4-oz intake supplement)	
Se	Use max legal rate in deficiency areas	No more than 0.3 ppm complete feeds or 120 ppm in salt-mineral mix

Zn	4000 ppm (4-oz intake supplement)	
Vitamin A	100,000 to 200,000 IU (4-oz intake supplement)	Deficiency most likely when lush forage for grazing is lacking
Vitamin D	7,500 to 20,000 IU (4-oz intake supplement)	Not of practical importance for cattle housed outdoors
Vitamin E	50 to 100 IU (4-oz intake supplement)	Particularly important for stressed calves

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

To increase mineral/vitamin supplement intake

- Do not let supplement run out
- Add salt
- Move away from water and loafing areas
- Change mineral mix
- Break up hardened loose supplement

To decrease mineral/vitamin supplement intake

- Add dry molasses or protein meal
- Make sure salt is not offered separately
- Move closer to water and loafing areas
- Change mineral mix

Nutritive Values of Selected Beef Cattle Feeds on a Dry Matter Basis[1]

Feedstuff	Dry Matter %	Total Digestible Nutrients %	Crude Protein %	Crude Fiber %	Crude Fat %	Calcium %	Phosphorus %
Energy Feeds							
Whole Shelled Corn	90	90	9	2	4	0.03	0.32
Hominy Feed	90	91	11	7	8	0.06	0.58
Soybean Hulls	90	80	12	39	2	0.60	0.17
Wheat Midds	89	77	18	9	5	0.15	1.00
Rice Bran	90	70	16	12	15	0.10	1.73
Cane Molasses	74	72	6	1	0	0.01	0.10
Citrus Pulp	90	80	6.5	13	4	1.90	0.13
Protein Feeds							
Corn Gluten Feed	90	83	24	10	4	0.07	0.95
Whole Cottonseed	93	90	24	22	18	0.20	0.73
Cottonseed Meal	92	76	41	13	3	0.18	1.21
Soybean Meal	90	84	48	7	2	0.34	0.70

Peanut Meal	88	77	53	2	2	0.32	0.66
Dried Distillers Grains	92	86	27	12	10	0.26	0.83
Brewers Grains	24	69	26	15	11	0.30	0.57
Roughages							
Cottonseed Hulls	91	42	4	48	2	0.10	0.07
Cotton Gin Trash	92	46	8	38		0.60	0.20
Peanut Hay	91	48	11	33		1.20	0.15
Peanut Hulls	91	22	9	63		0.20	0.07
Corn Stalks	85	50	6.6	34	2	0.50	0.10
Soybean Stubble	88	40	5	44		1.00	0.06
Wheat Straw	92	40	4	42	2	0.17	0.04

[1]The nutritive values presented are intended as a general guide to nutritive values of feedstuffs. Significant variation in nutritive values exists among different feed sources.

Feed Storage Requirements for Selected Beef Cattle Feedstuffs

	Feed Storage Requirement		
Feedstuff	**lb/bushel**	**lb/ft^3**	**ft^3/ton**
Wet brewers grains	81	65	31
Whole corn	56	45	44
Soybean meal	52	42	48
Soybean hulls, pelleted	50	40	50
Cottonseed meal	47	38	53
Corn silage	44	35	57
Corn gluten feed	41	33	61
Hominy feed	35	28	71
Soybean hulls, loose	35	28	71
Oats	32	26	77
Whole cottonseed	31	25	80
Wheat midds	25	20	100
Rice bran	25	20	100
Cottonseed hulls	19	15	133
Dried brewers grains	19	15	133
Dried distillers grains	19	15	133
Peanut skins	14	11	182
Cotton gin trash	9	7	286

Commodity Shed Considerations

- Able to accommodate ~24-ton loads
    - Walking-floor, dump, or auger trailer
- Road for 53-foot trailer to maneuver
- Minimum 14 feet of vertical clearance
- Minimum bay width of 12 to 14 feet
- Clearance on sides for truck to open doors
- Feeds typically piled 6 to 8 feet high
- Front loader may be needed to move feed
- Allow for 25% extra space beyond storage requirements based on feed bulk density

Hay Storage Considerations

- Use hay storage sheds when possible
- Bale tightly-packed (dense) bales
- Avoid high-moisture bales: heating/fire risk
- Place on rock or pallets (avoid soil contact)
- Cover tops and sides of bales
- Store on gently sloping, well-drained site
- Store out from under shade or trees
- Butt flat ends tightly together
- Run bale rows down slope with north/south orientation and southern exposure
- Do not allow rounded bale sides to touch
- Maintain 3 feet of space between rows
- Keep away from lightning attractants
- Eliminate vegetation 3 feet around hay

Feeder Space Requirements

Feeding Management	Cattle Class	Feeder Space Requirements
Hand-feeding supplement	Cows	30 linear inches/head
	Calves	24 linear inches/head
Free-choice feeding	Nursing calves	6 linear inches/head
	Weaned calves	12 linear inches/head
Creep feeding	Nursing calves	Creep gate openings 16 to 20 inches wide and 36 to 42 inches high

Calculating $/Unit of Nutrient of a Feed

To calculate the price of a feedstuff on a $/lb of crude protein (CP) basis:

2000 lb x %CP of feed = lb CP in ton of feed
Price/ton ÷ lb CP in ton of feed = $/lb CP of feed

Example:
For a 20% CP supplement at $233/ton:
2000 lb × 0.20 CP = 400 lb CP
$233/ton ÷ 400 lb CP = $0.58/lb CP

Price Conversions

$/ton ÷ 20 = $/cwt = ¢/lb
$/ton ÷ 2000 = $/lb

Relative Feedstuff Value with Selected Corn and Soybean Meal Prices[1]

	Corn Price, $/ton					
Feedstuff	**175**	**200**	**225**	**250**	**275**	**300**
Whole cottonseed	$207 $220 $233	$225 $238 $251	$243 $256 $269	$261 $274 $288	$280 $293 $306	$298 $311 $324
Cottonseed hulls	$82 $83 $83	$94 $94 $94	$105 $106 $106	$117 $117 $117	$128 $129 $129	$140 $140 $140
Soybean hulls	$149 $153 $157	$167 $171 $175	$185 $189 $193	$203 $207 $211	$221 $225 $229	$239 $243 $247
Corn gluten feed	$182 $197 $211	$196 $210 $225	$210 $224 $239	$224 $238 $252	$238 $252 $266	$251 $266 $280
Hominy feed	$166 $167 $169	$188 $189 $191	$210 $212 $213	$232 $234 $235	$254 $256 $258	$276 $278 $280
Dried distillers grains	$209 $227 $245	$223 $241 $259	$237 $255 $273	$251 $269 $288	$265 $283 $302	$279 $298 $316
Wheat midds	$172 $182 $191	$189 $198 $208	$205 $215 $224	$222 $231 $241	$238 $248 $257	$255 $264 $274
Rice bran	$142 $149 $155	$156 $163 $170	$170 $177 $184	$185 $192 $198	$199 $206 $213	$213 $220 $227
Cane molasses	$104 $103 $102	$120 $119 $117	$136 $134 $133	$152 $150 $149	$168 $166 $165	$184 $182 $181

[1]Top, middle, and bottom values are estimated based on soybean meal costing $300/ton, $350/ton, and $400/ton, respectively.

$/cwt = ¢/lb; $/ton ÷ 20 = $/cwt; $/ton ÷ 2000 = $/lb

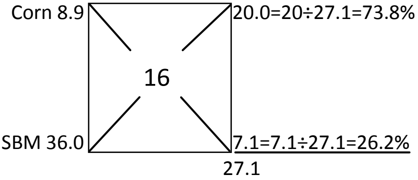
Basic Ration Balancing

With one nutrient and two ingredients:

<u>Pearson Square Method</u>

1. Place the nutrient concentration of the final ration in the middle of the square
2. List the feed ingredients and their nutrient concentration on the right side of the square
3. Subtract diagonally across the square for each feed ingredient, and place values on the right side of the square
4. Divide each number on the right hand side by the sum of the two right hand values and multiply by 100 to convert it to a percentage

Example:



The 16% CP ration contains:
73.8% corn and 26.2% SBM

When a known amount of hay/feed will be fed:
<u>Modified Algebra Method</u>

1. Determine animal requirements
2. Determine amount of known feed(s)
3. Determine nutrient content of feeds included in the ration
4. Determine amount of total ration
5. Make a table and set up equation

Ingredient:	**Corn**	**Soybean Meal**	**Hay**	**Diet**
% CP	10	49	9	12
Amount	x	90-x	10	100
Equation	10x	4410-49x	90	1200

6. Solve equation for x to determine amount of unknown feeds

Example:

For 100 lb of a 12% CP ration, using the table;
Solve the equation for x:

$10x + 4410 – 49x + 90 = 1200$

$4320 – 39x = 1200$

$-39x = -3120$

$x = 80$

The 12% CP ration contains:
80% corn, 10% soybean meal, and 10% hay

Limiting Feed Intake

- Limit feed offering (hand feed)
  - Added labor for daily feeding
  - Feeding space (trough) requirements
  - Timid cattle may consume less than others
- Use intake limiting ingredients in diet
  - Makes self-feeding practical
  - Add bulky ingredients such as cottonseed hulls or hay to the diet
  - Add salt or commercial limiter to diet
- Salt as an intake limiter
  - Not a precise intake regulator
  - Cattle consume about 0.1 pounds of salt per 100 pounds of body weight
  - Uniform distribution in mix needed
  - Cattle may consume less mineral if separate
  - Corrosive to metal equipment

Expected Daily Salt Consumption by Cattle

Body Weight, lb	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
1,100	0.8	1.1	1.3
1,300	0.9	1.3	1.5
1,500	1.0	1.5	1.6

Feed Additive Intake

Daily Supplement Consumption, ounces	Daily Additive Consumption, mg/head/day	
	1,200 g/ton supplement	1,620 g/ton supplement
1	37.5	50.6
2	75.0	101.3
3	112.5	151.9
4	150.0	202.5
5	187.5	253.1
6	225.0	303.8
7	262.5	354.4
8	300.0	405.0

$$mg/head/day = \frac{ounces\ consumed}{16} \times \frac{g/ton}{2}$$

Feed Additives

Additive Type	Purpose(s)	Example(s)
Antibiotic	Prevention and treatment of diseases, improvements in rate of gain and efficiency	Chlorotetracycline, oxytetracycline, bacitracin, tylosin
Bloat prevention aid	Prevent bloat on legume and other lush pasture	Poloxalene
Buffer	Reduce fluctuations in rumen pH to decrease acidosis risk	Sodium bicarbonate
Estrus suppressant	Suppress estrus (heat or cyclic sexual activity) for estrus synchronization or to reduce heifer riding behavior in feedlot, improve gain and feed efficiency in females	Melengestrol acetate (MGA®)
Fly control	Kill fly larvae as they hatch in the manure	Insect growth regulators

Ionophore	Improve feed efficiency; improve average daily gain; “spare” protein; reduce incidence of coccidiosis, acidosis, and bloat	Monensin (Rumensin®), lasalocid (Bovatec®), Laidlomycin propionate (Cattlyst®), bambermycin (Gainpro®), and virginiamycin (V-max®)
Nutrient repartitioning agent (Beta-agonist)	Redirects nutrients that would have become fat and makes them into protein; increase live weight gain, improve feed efficiency, and increase red meat yield	Ractopamine hydrochloride (Optaflexx®)
Worm control	Deworming when animal handling for direct dewormer delivery is difficult	Safe-Guard® dewormer block
Yeast cultures	Possibly improve feed efficiency, gain, and health	*Saccharomyces cerevisiae*

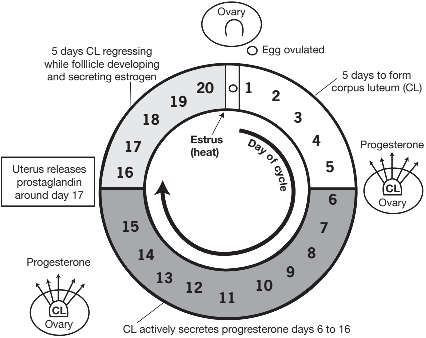
Stages of Female Reproduction in Cattle

Stage	Description	Comments
Prepubertal	non-cycling, growing heifers	do not overfeed or underfeed; do not implant replacement heifers
Puberty	first estrus (begins normal cycles)	average age at puberty 10 to 12 months; age at puberty ranges from 6 to 24 months; varies by breed
Estrous cycles	continued cycles with even intervals	normal cycle averages 21 days and ranges from 17 to 24 days
Gestation	pregnancy duration (not cycling)	length averages 283 days and ranges from 273 to 290 days; varies with breed
Parturition	birth (calving)	
Postpartum	recovery after calving (not cycling or "short" cycling)	interval to first heat after calving averages 45 days and ranges from 16 to 90+ days; must rebreed in ~82 days to maintain annual calving cycle

Normal reproductive life is 10 years. Cows may reproduce through 15 years of age but rarely longer.

Normal Estrous Cycle of Cattle

Estrous cycle: period from one estrus (standing heat, sexual receptivity phase) to the next estrus



Day 1: egg ovulated from a follicle on ovary
Day 5: site of ovulation develops into a CL
Days 6 to 16: CL secretes progesterone
Day 17: in non-pregnant animal, uterus secretes prostaglandin causing CL to regress;
in pregnant animal, embryo prevents prostaglandin release, CL continues secreting progesterone, and pregnancy maintained
Days 17 to 21: CL regressing; new egg-containing follicle develops and secretes estrogen
Day 20 or 21: animal comes into standing heat

Measures of Reproductive Efficiency

Measure	Calculation	Management
Conception rate	Number of females conceiving ÷ Number of females exposed to breeding x 100	• Percent conceived • Typically not measured due to difficulty in determining if conception has taken place • Cattle may conceive and then suffer early embryonic death; challenging to distinguish from cattle that never conceived
Pregnancy rate	Number of females diagnosed pregnant ÷ Number of females eligible for pregnancy x 100	• Percent pregnant • Measure of breeding season success
Live calving rate	Number of live calves born ÷ (Number of females exposed to breeding – Number of breeding herd females sold or died + Number of pregnant females purchased) x 100	• Percent birth calf crop • Measure of collective results of breeding and calving seasons • Cattle must not only conceive, but they must also give birth to live, healthy calves • Reproductive losses between breeding and calving may be due to reproductive disease

Weaning rate	(Number of calves weaned + Number of calves sold preweaning) ÷ (Number of females exposed to breeding – Number of breeding herd females sold or died + Number of pregnant females purchased) x 100	• Percent calf crop weaned • Single most descriptive measure of herd reproductive performance • Evaluates conception, pregnancy, calving, and preweaning success or failure
Calving interval	(Age in days at first calving – Age in days at last calving) ÷ Number of calvings	• Number of days between successive calvings • Measures reproductive success over the last year • Ideally 365 days or less and not average more than 365 days over multiple years to maintain the desired calving season and produce a marketable calf on an annual basis

Timeline for Estrus (Heat) Signs in Cattle

	Coming into Heat (8 hours)	Standing Heat (18 hours)	Going out of Heat (14+ hours)
Heat Signs	• Stands and bellows • Curious • Smells other cows • Headbutts other cows • Attempts to ride other cows but will not stand to be mounted • Red, moist, slightly swollen vulva • Clear mucous discharge from vulva	• Stands to be mounted • Rides other cows • Bellows frequently • Nervous and excitable	• Attempts to ride other cows but will not stand to be mounted • Smells other cows • Clear mucous discharge from vulva

Estrous Synchronization

Estrous synchronization is a reproductive management tool. It involves manipulating females' estrous cycles with one or more hormones for the purpose of bringing cattle into estrus (heat) within a short period of time. It is used to conveniently time the breeding of cattle in artificial insemination and embryo transfer programs.

For specific synchronization protocols: http://beefrepro.unl.edu/resources.html

Bovine Estrous Synchronization Hormones

Hormone	Function	Commercial Names
GnRH	stimulates ovulation through release of LH	Cystorelin®, Factrel®, Fertagyl®, OvaCyst®
Progestin	are or act like progesterone; inhibits estrus and ovulation	MGA® (melangestrol acetate), CIDR® (progesterone)
PGF2α	lyses (removes) the CL, thus removing progesterone from the blood and letting ovulation occur	estroPLAN®, Estrumate®, In-Synch®, Lutalyse®, ProstaMate®

Estrus (Heat) Detection Aids

Detection Aid	Application[1]	Detection Method	Management Concerns
Kamar® Heatmount® Detector	Apply with adhesive between tail head and hip bone over sacrum of female	Detector remains white until triggered by weight of mounting animal, then it turns bright red	• Partial activation of detectors makes it hard to tell if heat has occurred • Dislodged detectors
Estrotect™ Heat Detector	Apply with self-adhesive between tail head and hip bone over the sacrum of female	Detector remains silver until friction of mounting animal(s) reveals fluorescent color below scratched-off silver layer	• False positives from low branches, gates, and cattle • Dislodged detectors
Bovine Beacon®	Glue to tail head of female	Contains fluorescent dye that glows in the dark when female is mounted by another animal	• False positives from low branches, gates, and cattle • Dislodged detectors

Tail Head Markers	Smear liberal amounts of crayon, chalk, paste, or paint on tail head	When marker is rubbed off of tail head (hair ruffled and pulled back), female has stood to be mounted	• False positives from low branches, gates, cattle, humidity, and rain • Reapply every few days
Chin-Ball Marker	Fit marker device under the chin of a teaser (gomer) bull or androgenized female	Animal wearing the device mounts and slides off the female in heat, leaving an ink mark on back and hip of female	• Maintenance necessary for continuous use (ink refills) • Broken or stretched harness • Some markings from chin resting instead of mounting
HeatWatch® II System	Place small, digital radio transmitter in a piece of polyester material (patch) and glue onto tail head of female	Mount data (female mounted, date and time, duration) sent from transmitter to radio receiver (base station) then wirelessly to a computer	• Dislodged patches • Transmitters can fall out of patches • Battery replacement • Increased heat detection accuracy over other aids

[1]*Comb the application area first to remove dead or shedding hair.*

Bull Breeding Soundness Evaluation (BSE)

What and when

- Evaluation of bull breeding potential
- 1 to 2 months prior to each breeding season

Components

- Physical examination
- Semen evaluation
    - Minimum 30% motility
    - Minimum 70% normal
- Scrotal circumference measurement
    - Minimums on table on next page

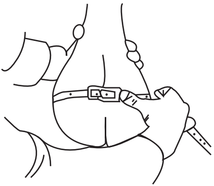
Potential outcomes

- Satisfactory potential breeder
    - Fertile
    - Passed all BSE components
- Unsatisfactory potential breeder
    - Subfertile or sterile
    - Did not pass at least 1 BSE component
- Classification deferred
    - Did not pass at least 1 BSE component but may resolve with time
    - Should recheck at later date

Limitations

- Does not evaluate libido (sex drive)
- Does not guarantee free of disease
- Fertility status may change abruptly with injury, disease, or other factors

Scrotal Circumference Measurement



- Hold testicles at bottom of scrotum with fingers above testicles
- Place scrotal tape around scrotum at widest point
- Read with tape snug

Minimum Recommended Scrotal Circumference

Age, months	Scrotal Circumference, cm
< 15	30
> 15 ≤ 18	31
> 18 ≤ 21	32
> 21 ≤ 24	33
> 24	34

Adapted from Breeding Soundness Evaluation Form. Society for Theriogenology. Hastings, NE.

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+ years)	1:20 to 40

283-day Cattle Gestation Table

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**
Jun	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**
Jul	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**	**Jun**

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		
Jun	**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**		**Jul**
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	
Jul	**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**

Find date of service in upper line. Corresponding bolded date below indicates date due to calve.

Benefits of Controlled Breeding and Calving Season

A controlled calving season facilitates matching nutritional needs of the herd to forage resources, monitoring breeding and calving more intensely, working more calves of a similar age at once (vaccinating, castrating, implanting, collecting performance data), and marketing calves of uniform age in groups to capture sale premiums. Herd sires have time to rest and regain lost body condition, and risk of injury to bulls is reduced.

3-Year Plan for Converting from Year-round to 90-day Calving Season of September, October, and November

	1st Year (6 months breeding)	2nd Year (4 ½ months breeding)	3rd Year (3 months breeding)
Breeding begins			
Heifers	November 2	November 2	November 2
Cows	November 23	November 23	November 23
Breeding ends			
Heifers	January 1	January 1	January 1
Cows	May 21	April 6	February 20
Calving begins			
Heifers	August 12	August 12	August 12
Cows	September 2	September 2	September 2
Calving ends			
Heifers	October 11	October 11	October 11
Cows	February 28	January 14	November 30

3-Year Plan for Converting from Year-round to 90-day Calving Season of November, December, and January

	1st Year (6 months breeding)	2nd Year (4 ½ months breeding)	3rd Year (3 months breeding)
Breeding begins			
Heifers	January 3	January 3	January 3
Cows	January 24	January 24	January 24
Breeding ends			
Heifers	March 3	March 3	March 3
Cows	July 21	June 6	April 22
Calving begins			
Heifers	October 12	October 12	October 12
Cows	November 2	November 2	November 2
Calving ends			
Heifers	December 11	December 11	December 11
Cows	April 30	March 16	January 30

3-Year Plan for Converting from Year-round to 90-day Calving Season of January, February, and March

	1st Year (6 months breeding)	2nd Year (4 ½ months breeding)	3rd Year (3 months breeding)
Breeding begins			
Heifers	March 3	March 3	March 3
Cows	March 24	March 24	March 24
Breeding ends			
Heifers	May 2	May 2	May 2
Cows	September 19	August 5	June 21
Calving begins			
Heifers	December 11	December 11	December 11
Cows	January 1	January 1	January 1
Calving ends			
Heifers	February 9	February 9	February 9
Cows	June 29	May 15	March 31

Description of Reproductive Tract Scores

Reproductive Tract Score	Approximate Size of Ovaries, mm				
	Uterine Horns	Length	Height	Width	Ovarian Structures
1	Immature <20mm diameter, no tone	15	10	8	No palpable follicles
2	20 to 25 mm diameter, slight tone	18	12	10	8 mm follicles
3	20 to 30 mm diameter, good tone	22	15	10	8 to 10 mm follicles
4	30 mm diameter, good tone	30	16	12	>10 mm follicles, possible corpus luteum
5	>30 mm diameter, good tone, erect	>32	20	15	>10 mm follicles, Corpus luteum present

Adapted from Anderson, K. J., D. G. Lefever, J. S. Brinks, and K. G. Odde. 1991. The use of reproductive tract scoring in beef heifers. Agri-Practice 12(4):19.

Characteristics of Open (Non-pregnant) Cow Reproductive Tract

Organ[1]	Size	Shape	Remarks
Vagina	varies with tract position	thin-walled, hollow tube	difficult to palpate
Cervix	2 to 12 inches long; ¾ to 8 inches in diameter; average diameter 1½ inches	tube-like; thick-walled	tube-shaped, but may be funnel-shaped in some cows or bent and crooked; firm, gristle-like feel; good landmark
Uterine Body	interior: ¼ to ¾ inch long; exterior: 1 to 3 inches long	intersecting region of two uterine horns	feels like soft, flat muscle; not as firm as cervix
Uterine Horns	5 to 12 inches long; ½ to1½ inches in diameter	tube-like; sometimes coiled	feels meaty and soft to slightly firm, depending on stage of estrous cycle

Oviducts	1/16 to 1/8 inch in diameter	long, crooked tube	difficult to feel because of small diameter and soft texture
Ovaries	½ inches wide; ¾-inch thick; 1-inch long	rounded or elliptical shape	feels firm and distinct as if holding a grape or plum

[1]It is not necessary to feel the vagina, oviducts, and ovaries when palpating for pregnancy.
Adapted from B. B. Carpenter and L. R. Sprott. 2008.Determining Pregnancy in Cattle. B-1077. Texas AgriLife Extension Service, College Station, TX.

Rectal palpation, ultrasound technology, and tests of body fluids are methods of pregnancy determination. It requires a skilled technician, especially at earlier stages. Physical manipulation at very early stages of pregnancy may cause damage to the embryo or abortion. Positive signs of pregnancy: amniotic vesicle, fetal membrane slip, placentomes (must feel at least 3 to rule out palpating ovary), or fetus. The uterine artery is in the broad ligament and movable unlike the iliac artery.

Characteristics of Pregnancy in Cattle

Gestation length	Amniotic vesicle	Placentome diameter	Fetal membrane slip	Uterine position	Uterine character	Fetal size
30 days	Detectable; less than ½ finger width	Not detectable	Not detectable	Pelvis	Soft walled but has tone	0.3 to 0.4 inch crown to rump
40 days	Detectable; 1 finger width	Not detectable	Detectable; thread size	Pelvis	Soft walled; allows pinching for slip test	0.7 to 1 inch crown to rump
50 days	Detectable; 2 fingers width	Not detectable	Detectable; small string size	Pelvis	Soft walled; allows pinching for slip test	1.4 to 2.2 inches crown to rump
60 days	Detectable; softens; 4 fingers width	Small and difficult to perceive	Both horns may slip; string size	Pelvis	Soft walled; allows pinching for slip test	Mouse size; 2.4 to 3.1 inches crown to rump
70 days		0.5 to 0.75 cm	Both horns may slip; large string size	Descending out of pelvis		2.8 to 3.9 inches crown to rump
80 days		0.5 to 1 cm; pea size	Slip prominent in both horns	Descending	Enlarged; notable tone; bladder-like	3.1 to 5.1 inches crown to rump
90 days		1 to 1.5 cm; dime size	Slip prominent in both horns	Descending		Rat size; 5.1 to 6.7 inches crown to rump

120 days		1.5 to 2.5 cm; quarter size	Slip prominent in both horns	Descending	May “bounce” fetus with hand	Small cat size; lemon size head; 8.7 to 12.6 inches crown to rump
150 days		2.5 to 4 cm; half dollar size	Slip prominent in both horns	On abdominal floor	Buoyant, lumpy surface; artery has detectable “buzz”	Large cat size; 11.8 to 17.7 inches crown to rump
180 days		4 to 5 cm		Descended	Difficult to palpate	Beagle dog size; 15.7 to 23.6 inches crown to rump; movement
210 days		5 to 7.5 cm		Ascending towards pelvis	Can palpate fetal parts; finger thick artery	21.7 to 29.5 inches crown to rump; movement
240 days		6 to 9 cm		Ascending towards pelvis	Thick walled; enclosing bony fetus; artery “buzz” readily felt on pregnant side	23.6 to 33.5 inches crown to rump; movement
270 days		8 to 12 cm		Ascended; readily palpable	Thick walled; enclosing body	27.6 to 39.4 inches crown to rump; movement

Adapted from R. S. Youngquist, Current Therapy in Large Animal Theriogenology.

Stages of Calving

Stage	Duration	Events
Stage I Preparatory	2 to 6 hours	• Uterine contractions (15 minutes apart initially) • Cervical dilation • Cattle appear uncomfortable • Water sac expelled
Stage II Delivery	30 to 60 minutes	• Fetus enters birth canal • Uterine contractions (2 minutes apart) • Calf delivered
Stage III Cleaning	6 to 12 hours	• Cotyledon-caruncle (button) attachments relax • Oxytocin released during suckling • Uterine contractions • Expulsion of afterbirth

Calving Ease Scores

1 = No assistance, calf born normally
2 = Assisted, easy pull
3 = Assisted, very difficult, hard pull
4 = Caesarean delivery
5 = Breech birth, abnormal presentation

Pelvic Area and Calf Birth Weight Ratios for Various Heifer Weights and Ages

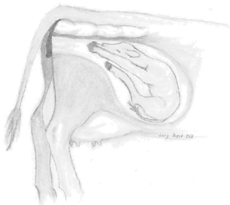
	Age at time of measurement, months			
Heifer weight, lb	8 to 9	12 to 13	18 to 19	22 to 23
500	1.7	2.0	--	--
600	1.8	2.1	--	--
700	1.9	2.2	2.6	--
800	--	2.3	2.7	3.1
900	--	2.4	2.8	3.2
1000	--	2.5	2.9	3.3
1100	--	--	--	3.4

Adapted from Deutscher, G. H. Pelvic measurements for reducing calving difficulty. Nebraska Cooperative Extension Service. NebGuide G88-895.

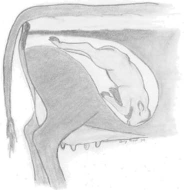
Factors Affecting Calving Difficulty

- Age of dam
- Calf birth weight
- Calf sex
- Dam's pelvic area
- Dam's body size
- Gestation length
- Calf shape
- Sire breed
- Dam breed
- Sire's genotype
- Dam's genotype
- Uterine environment
- Hormonal control
- Nutrition of dam
- Condition of dam
- Position of fetus
- Geographic region
- Season of year
- Environmental temp.
- Feeding time
- Exercise
- Implants
- Feed additives
- Unknown factors

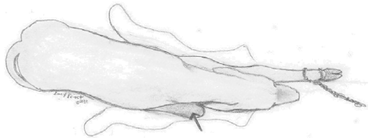
Adapted from H. D. Ritchie and P. T. Anderson. Calving Difficulty in Beef Cattle: Part I. BIF Fact Sheet. Michigan State Univ., East Lansing, MI.



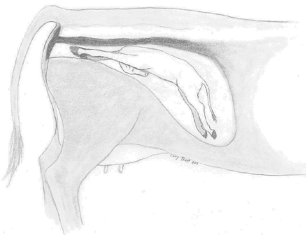
Normal calving presentation: front feet emerging first with the soles of the feet pointing down followed by the calf's head as if the calf were diving out of the birth canal



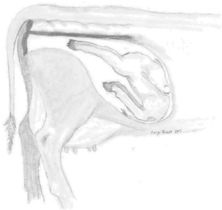
Normal posterior (hindquarters first) presentation: hind legs and tail come first instead of forelegs and head. Make sure the tail is protruding with the hind legs. Consider all posterior (rear feet first) deliveries as emergencies because the umbilical cord is pinched between the fetus and pelvis early in delivery.



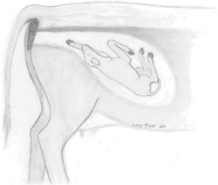
Retained foreleg presentation: one or both forelegs are retained and the head is presented in a normal position. Push the calf back into the female a little ways and use a second arm to reach for the calf’s foreleg. Straighten out the forelegs so that the head rests on top of them before attempting delivery. Guard the hooves in each hand to protect the uterine wall from damage.



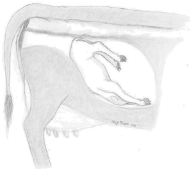
Anterior (head first) head turned down presentation: head is underneath both forelegs. Move the head so that it rests on top of the forelegs for delivery to proceed.



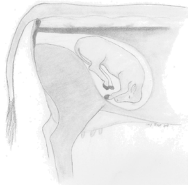
Anterior (head first) head turned back presentation: head is turned back or to the side. Straighten out the neck and place the head on top of the forelegs for delivery to proceed. Grasp the calf's mouth or nostrils to pull the head. Do not use excessive force to keep from breaking the calf's jaw.



Anterior (head first) upside-down retained foreleg presentation: best option often a cesarean section (C-section). Otherwise, attempt to rotate the calf upright. Consider rolling the cow over while keeping the calf in position.



Posterior (hindquarters first) upside-down presentation: The best option is often a cesarean section (C-section). Otherwise, attempt to rotate the calf to an upright position. Consider rolling the cow over while keeping the calf in position.



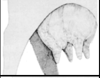
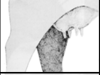
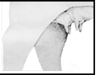
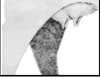
Breech presentation: hindquarters are presented first with both hind legs retained. This is very difficult to correct. Push the calf deep into the female with one arm. With the other arm, reach for a hind leg. Straighten out and place both hind legs and the tail in the birth canal for delivery to proceed. Cover the calf's hooves during manipulation to keep from damaging the uterus.

Proper obstetrical chain placement on calf leg

Key situations to contact a veterinarian for calving assistance:

- calf position cannot be determined
- correct calf position cannot be attained
- calf is presenting in a posterior position
- calf is too large for the birth canal
- reasonable progress in the delivery is not made in a timely manner
    - more than 2 hours after water bag appears
    - more than 30 minutes without progress
- uterine prolapse occurs

Udder Suspension and Teat Size Scores

	Udder Suspension		Teat Size	
Score	**Description**	**Example Image**	**Description**	**Example Image**
1	Very pendulous, broken floor		Very large, balloon-shaped	
3	Pendulous		Large	
5	Intermediate, moderate		Intermediate, moderate	
7	Tight		Small	
9	Very tight		Very small	

Adapted from BIF. 2010. 9th ed. Guidelines for Uniform Beef Improvement Programs. Raleigh, NC.

Unsound udders

- reduced productive life
- inferior calf performance
- major reason for culling cows

Udder and teat scores

- suspension score: udder support
- size score: teat length and circumference
- assign annually within 24 hours of calving
- base on weakest quarter

Animal Identification Methods

Method	Permanence	Placement	Ease of reading	Comments
Hanging ear tag	Removable; easily lost; remove hay bale strings to improve retention	Apply tag inside ear between cartilage ribs halfway between head and ear tip	Can be read at a distance if free of mud	Easily customizable; available in different colors and preprinted or blank
Metal ear tag	Removable	Clamp along edge of ear	Cattle must be restrained to read	Examples: Bangs vaccination orange tag, USDA “Brite” silver tag
Electronic ear tag	Removable	Apply tag inside ear between cartilage ribs and nearer to head than ear tip	Cattle must be restrained or near electronic reader	Unique 15-digit ID

Tattoo	Permanent	Apply in center of ear between cartilage ribs; liberally apply ink	Cattle must be restrained to read	Ensure proper letter/number orientation; may be required by breed associations
Hot-iron brand	Permanent	Place high on the hip; use smallest irons possible to reduce hide damage	Can read at a distance if good brand and hair growth not excessive	Use good technique to avoid illegible scarring; typically 5-digits or less
Freeze brand	Permanent	Place high on the hip; use smallest irons possible to reduce hide damage	Can read at a distance if good brand; harder to read on light hair coats	Use in place of hot-iron brand when possible; typically 5-digits or less

Freeze Branding Steps

1. Gather branding supplies: irons, liquid nitrogen or ice chest of dry ice and denatured alcohol, clippers, spray bottle, rag or brush, timer, and gloves.
2. Match the desired ID, records, and irons.
3. Let irons cool for 20 minutes before first use.
4. Properly restrain the animal.
5. Clip the area to be branded.
6. Brush or wipe the area clean.
7. Spray a liberal coat of alcohol on clipped area.
8. Firmly apply the branding iron for the predetermined amount of time. If the iron moves, reapply it to the depressed area and add a few seconds to the application period.

   Time Irons Should Contact Hide for an Effective Freeze Brand

Iron Cooling Method	**Hair Coat Color**	
	Dark	**Light (bald brand)**
Dry ice/alcohol	45 to 50 seconds	75 to 90 seconds
Liquid nitrogen	20 to 45 seconds	45 to 50 seconds

9. If an iron needs to be used twice (e.g., 77 or MM), let it re-cool for at least 2 minutes between applications.

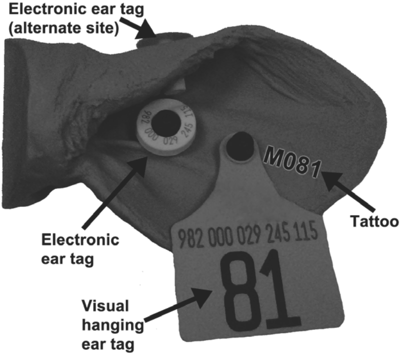
International Letter Designations by Year for Animal Identification[1]

A 1991	S 2006	J 2021
B 1992	T 2007	K 2022
C 1993	U 2008	L 2023
D 1994	W 2009	M 2024
E 1995	X 2010	N 2025
F 1996	Y 2011	P 2026
G 1997	Z 2012	R 2027
H 1998	A 2013	S 2028
J 1999	B 2014	T 2029
K 2000	C 2015	U 2030
L 2001	D 2016	W 2031
M 2002	E 2017	X 2032
N 2003	F 2018	Y 2033
P 2004	G 2019	Z 2034
R 2005	H 2020	A 2035

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

Adapted from Beef Improvement Federation. 2010. Guidelines for Uniform Beef Improvement Programs. 9th ed. Raleigh, NC.

Placement of Identification in Ear



- Avoid puncturing cartilage ribs
- Place tag back (flat button) on back side of ear
- Apply visual hanging tag at least halfway between ear base and tip
- Apply electronic tag between hanging tag and ear base and at least 3 in away from any metal tags
- Apply tattoo between hanging tag and ear tip
- Make sure records match IDs

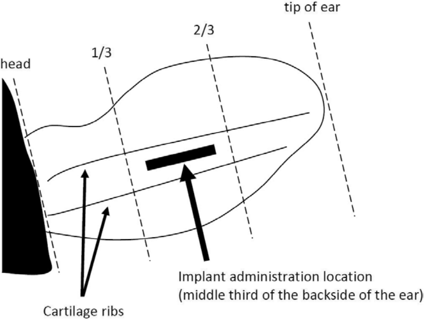
Guidelines for Aging Cattle by Teeth

	Cattle Age at Tooth Stage		
Permanent Teeth	**Tooth Eruption**	**In Wear**	**Neck of Tooth Visible above Gum Line**
First incisors (2 central incisors)	1 ½ to 2 years	2 to 2 ½ years	6 years
Second incisors	2 to 2 ½ years	2 ½ to 3 years	7 years
Third incisors	3 years	3 ½ years	8 years
Fourth incisors (2 outer incisors)	3 ½ to 4 years	4 ½ years	9 years

- Mature cattle have 32 teeth (8 are lower jaw incisors; no upper jaw incisors)
- Temporary teeth (milk teeth) are whiter and smaller than permanent teeth
- The rate of teeth wear depends upon feed conditions
- Several years after a tooth erupts, the neck (a narrow area at the base of the tooth) begins showing above the gum line

Growth-Promoting Implants

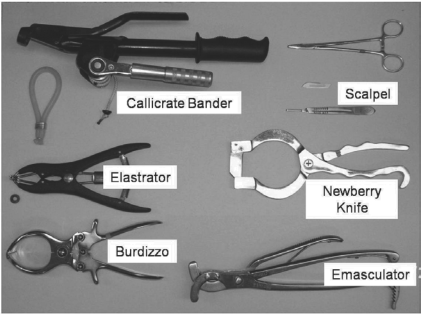
Proper implant administration location in cattle ear between the cartilage and skin



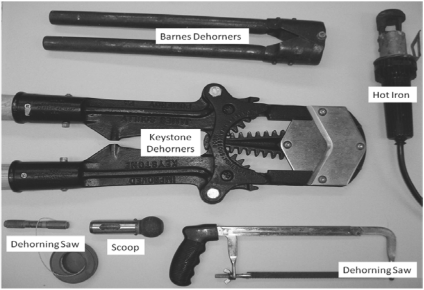
Potential causes for implant ineffectiveness

- missing implant (through the ear)
- partial implant (gun failure or poor technique)
- crushed or bunched pellets
- improper implant site (in cartilage)
- abscess (poor sanitation or technique)
- inadequate implant storage (moisture, refrigeration)
- inappropriate timing or target animal

Castration Tools



Dehorning Tools



Calf Castration Options

Method	Instruments	Procedure	Advantages	Disadvantages
Surgical	Newberry knife, scalpel, emasculator	Open the skin of the scrotum with large incisions or removal of the bottom 1/3 of the scrotum to promote adequate drainage. Grasp and slowly pull the testicles downward until the spermatic cord muscle separates. Do not "dig" for the testicles. In young calves, pull out the testicles until the cord breaks. In older calves, use emasculators to crush the spermatic cord or a dull knife to scrape the cord in a shaving motion. Do not cut the cord, because excessive bleeding may occur. Treat wounds with fly repellant. Release surgically castrated calves to a clean, dry area.	Certainty of complete castration	Blood loss Infections may result if there are drainage problems or irritation from flies. Slower to perform than banding
Emasculatome	Burdizzo, clamps	Move one testicle to the bottom of the scrotum. Locate the spermatic cord above the testicle, and move it to the side of the scrotum. Place the emasculatome	Bloodless Used for older, larger calves	Slow, difficult Sometimes unreliable (stags) Emasculatomes

		over the cord about two inches above the testicle. Pinch the spermatic cord through the skin of the scrotum. The instrument should be 1/3 of the way across the width of the scrotum and never across the middle of the scrotum. The cord should snap apart. Hold the instrument with jaws closed for 30 seconds. Double clamping can increase success rate.		eventually wear out and become ineffective. Do not store an emasculatome in the closed position.
Banding	Elastrators, EZE, Callicrate banders	Place the band on the instrument and press the handles to stretch the band. Hold with the prongs pointed upward. Close the handles to open the band. Slip the band up and over the scrotum. Make sure both testicles are below the band. Allow the band to close on the neck of the scrotum. Pull the instrument out from under the band. Repeat if not done correctly. Administer tetanus and blackleg shots well before banding.	Bloodless	Potential for missed testicles
			Used for older, larger calves	Band may break or not cut off all circulation to testicles
			Easy to perform, newer banders adjust bands to proper tension levels	Infections (tetanus, *Clostridial*).

Calf Dehorning Options

Method	Procedure	Advantages	Disadvantages
Chemical	Apply caustic paste to horn button at 1 day to 3 weeks of age. Cut hair from around horn button before application. Apply petroleum jelly around the area of caustic paste application to minimize chemical burns. Keep the calf separated from its dam until the paste has dried.	Works well on young calves Bloodless	Caustic paste application before a rain can cause eye injury
Hot iron	Heat irons with fire or electricity. Place hot iron over the horn and hold in place with firm pressure. Twist the iron evenly to distribute heat. Apply long enough (usually 20 seconds) to kill all horn cells at the base. The skin should appear copper or bronze. Reapply for 10 seconds if copper color is not present.	May use after the horn button appears up to 4 months of age Works best in calves less than 2 months of age with less than 1 inch of horn growth Bloodless	Must be done when calves are young and horns are small

Tube or spoon dehorners	Cut around the horn and surrounding skin and scoop out.	Effective on very small horns less than 1 ½ inches long Multiple instrument sizes available	Not bloodless
Barnes dehorners	Select an instrument size large enough to remove the horn and a ¼ to ½ inch circle of skin at the horn base. Press the instrument firmly against the calf's head. Quickly open and twist the handles. Stop any bleeding by cauterizing with a hot iron or pulling arteries with forceps.	May use on calves up to or slightly past weaning Multiple instrument sizes available	Not bloodless
Saws, wires, keystone dehorners	Remove a ½ inch circle of skin along with the horn base to prevent regrowth. Stop any bleeding by cauterizing with a hot iron, pulling arteries with forceps, or using coagulant powder. Observe the wound for infection for an extended period of time.	For use in older cattle with large horns	Not bloodless Exposed sinus may become infected

Beef Cattle Breeds

- Breed: a group of animals that have a common ancestral origin and possess certain traits that are readily distinguishable and are transmitted uniformly to their offspring
- Over 100 breeds of cattle: only ~15 breeds have a major influence on the U. S. beef cattle industry
- Breed association: organization that maintains pedigree and performance information, arranges for genetic evaluations, and promotes a breed
- Breeds of cattle website: *www.ansi.okstate.edu/breeds/cattle*

Breed Selection

- Consider climate, feed/forage resources, production system, market end points, market demand, breed complementarity, seedstock cost and availability
- Breeding management considers breed and animal selection as well as crossbreeding system (advantages: heterosis, breed complementarity)

Cattle Breed Descriptions

Cattle Subspecies	Breed Types Included	Example Breeds	Comments
Bos taurus	British (English) Continental (Exotic) Dairy	British: Angus, Hereford, Red Angus Continental: Charolais, Gelbvieh, Simmental Dairy: Guernsey, Holstein, Jersey	British noted for moderate frame size, fleshing ability, carcass quality, and maternal ability; Continental noted for high growth rates, heavy muscling, large frame, and carcass cutability; Dairy noted for milk yield and calving ease
Bos indicus	Brahman, Zebu	Brahman	noted for heat tolerance, mothering ability, insect resistance; “eared”; “humped”
Composites (*Bos taurus × Bos indicus)*	American (Brahman influence)	Beefmaster, Brangus, Santa Gertrudis	exhibit large amounts of heterosis; predominantly present in southern U. S.

Beef Cattle Breed Association Contact Information

Breed	Association[1]	Website	Address	Phone
Angus	American Angus Association	www.angus.org	3201 Frederick Ave. St. Joseph, MO 64506	816.383.5100
Beefmaster	Beefmaster Breeders United	www.beefmasters.org	6800 Park Ten Blvd., Suite 290 West, San Antonio, TX 78213	210.732.3132
Brahman	American Brahman Breeders Association	www.brahman.org	3003 South Loop West, Suite 520, Houston, TX 77054	713.349.0854
Brangus	International Brangus Breeders Association	www.int-brangus.org	P. O. Box 696020, San Antonio, TX 78269-6020	210.696.4343
Braunvieh	Braunvieh Association of America	www.braunvieh.org	3815 Touzalin Avenue, Suite 103, Lincoln, NE 68507	402.466.3292
Charolais	American-International Charolais Association	www.charolaisusa.com	11700 NW Plaza Circle, Kansas City, MO 64153	816.464.5977
Chianina	American Chianina Association	www.chicattle.org	1708 N. Prairie View Road, P. O. Box 890, Platte City, MO 64079	816.431.5381
Gelbvieh	American Gelbvieh Association	www.gelbvieh.org	10900 Dover Street, Westminster, CO 80021	303.465.2333
Hereford	American Hereford Association	www.hereford.org	P. O. Box 014059, Kansas City, MO 64101	816.842.3757

Limousin	North American Limousin Foundation	www.nalf.org	Suite 100, 7383 S. Alton Way, Centennial, CO 80112	303.220.1693
Maine-Anjou	American Maine-Anjou Association	www.maine-anjou.org	204 Marshall Road, P. O. Box 1100, Platte City, MO 64079-1100	816.431.9950
Red Angus	Red Angus Association of America	redangus.org	4201 N. Interstate 35, Denton, TX 76207-3415	940.387.3502
Salers	American Salers Association	www.salersusa.org	19590 E. Main Street, Suite 202, Parker, CO 80138	303.770.9292
Santa Gertrudis	Santa Gertrudis Breeders International	santagertrudis.com	P. O. Box 1257, Kingsville, TX 78364	361.592.9357
Shorthorn	American Shorthorn Association	www.shorthorn.org	8288 Hascall Street, Omaha, NE 68124	402.393.7200
Simmental	American Simmental Association	www.simmental.org	1 Simmental Way Bozeman, MT 59715	406.587.4531
South Devon	North American South Devon Association	www.southdevon.com	19590 E. Main Street, Suite 202, Parker, CO 80138	303.770.3130
Tarentaise	American Tarentaise Association	www.americantarentaise.org	9150 North 216th Street, Elkhorn, NE 68022	402.639.9808

[1]Beef cattle breed associations among the top 15 in U.S. registrations or U.S. breed associations reporting expected progeny differences.

Economically Relevant Traits (ERT)

- direct economic impact to producer
- examples: weaning weight, carcass weight
- direct monetary value associated with traits

Indicator Traits

- do not have direct economic value
- aid in prediction of ERT
- example: birth weight indicator for calving ease

Selection Indices

Based on multiple traits weighted for

- economic importance
- heritability
- genetic associations among traits

Account for both production and economics

- bioeconomic values
- expressed in dollars per head

Customizable selection indices

- rank cattle under user-specified conditions

Economically Relevant Traits and Associated Indicators

Economically Relevant Traits	Indicators
Sale weights: weaning weight, weaning maternal, yearling weight, carcass weight, pounds of retail yield	Birth weight, 205-day weight, 365-day weight, carcass weight, fat thickness, ribeye area
Likelihood of calving ease	Calving ease score, birth weight, gestation length
Feed requirements for maintenance	Mature cow weight, body condition score, milk production, internal organ weight
Productive life or stayability	Calving records, days to calving, milk production, calving interval
Likelihood of heifer pregnancy	Pregnancy diagnosis, scrotal measures
Tenderness	Shear force, marbling, color analysis
Feed efficiency	Feed consumption
Docility	Docility or chute scores

Heritability

- proportion of differences between animals for a trait controlled by additive genetics
- low heritability: environment and non-additive genetics have a larger influence on a trait
- selection progress slower for lowly heritable traits

Heterosis

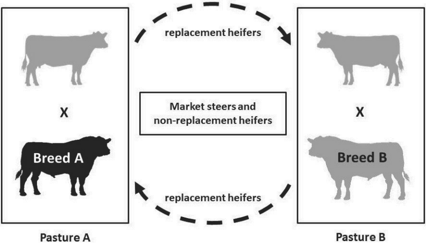
- hybrid vigor
- offspring perform at a higher level than the average of the parental lines
- take advantage of via crossbreeding

Trait Heterosis and Heritability

Trait	Heterosis	Heritability
Maternal ability Reproduction Health Cow longevity Overall cow productivity	High: 10 to 30%	Low
Growth rate Birth weight Weaning weight Yearling weight Milk production	Medium: 5 to 10%	Medium
Carcass/end product Skeletal measurements Mature weight	Low: 0 to 5%	High

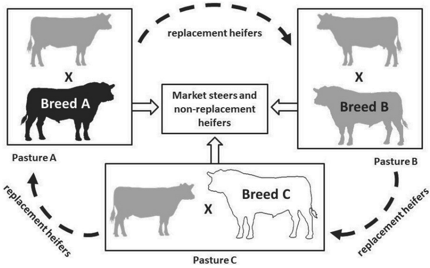
Matching Genetic Potential to Production Environment

Environment		Traits					
Feed Availability	**Stress**	**Milk Production**	**Mature Size**	**Ability to Store Energy**	**Resistance to Stress**	**Calving Ease**	**Lean Yield**
High	Low	M to H	M to H	L to M	M	M to H	H
	High	M	L to H	L to H	H	H	M to H
Medium	Low	M to H	M	M to H	M	M to H	M to H
	High	L to M	M	M to H	H	H	H
Low	Low	L to M	L to M	H	M	M to H	M
	High	L to M	L to M	H	H	H	L to M
Breed role in terminal crossbreeding systems							
Maternal	-	M to H	L to H	M to H	M to H	H	L to M
Paternal	-	L to M	H	L	M to H	M	H



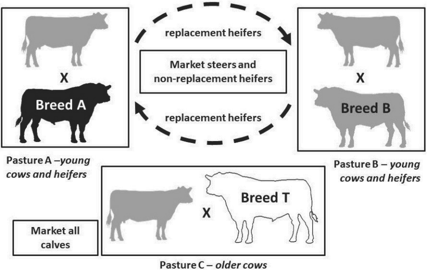
Two-breed (Crisscross) Rotation

- requires 2 breeds and 2 breeding pastures
- minimum herd size is ~50 cows
- mate cows of breed A to bulls of breed B
- mate resulting replacement females (A×B) to bulls of breed A for their lifetime
- mate succeeding generations of females to the opposite breed of their sire
- market steers and non-replacement heifers
- 67% retained heterosis
- expected 16% increase in weaning weight per cow exposed above the average of the parent breeds



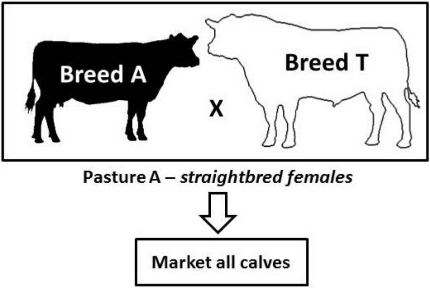
Three-breed Rotation

- requires 3 breeds and 3 breeding pastures
- minimum herd size is ~75 cows
- mate females sired by breed A to breed B bulls
- mate females sired by breed B to breed C bulls
- mate females sired by breed C to breed A bulls
- market steers and non-replacement heifers
- 86% retained heterosis
- expected 20% increase in weaning weight per cow exposed above the average of the parent breeds



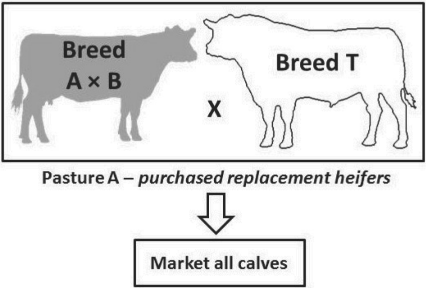
Two-breed Rotational/Terminal Sire

- rota-terminal system
- requires 3 breeds and 3 breeding pastures
- minimum herd size is ~ 100 cows
- two-breed rotational crossbreeding system (½ of herd, youngest females) of maternal breeds A and B to produce replacement females for entire herd
- mate other ½ of cow herd to a terminal sire of a different breed excelling in growth
- market steers and non-replacement heifers
- 90% retained heterosis
- expected 21% increase in weaning weight per cow exposed above the average of the parent breeds



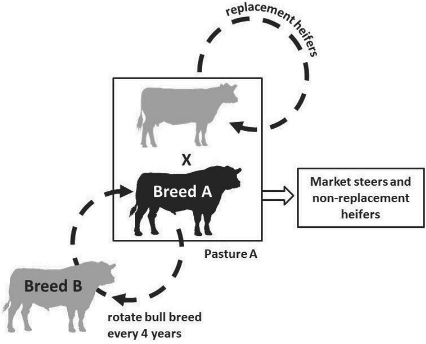
Two-Breed Terminal Sire

- requires 2 breeds and 1 breeding pasture
- no minimum herd size
- mate straightbred females of one breed to terminal sires of another breed
- keep no replacement females
- market all calves
- no benefits of maternal heterosis with straightbred cows
- expected 8.5% increase in weaning weight per cow exposed above the average of the parent breeds



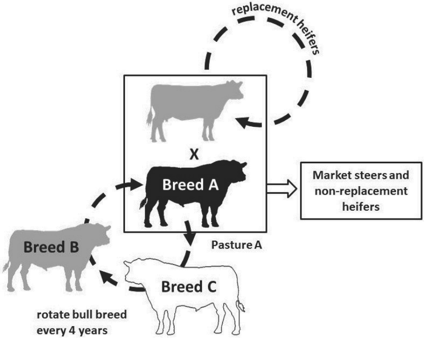
Terminal Cross with Purchased F_1 Females

- requires 3 breeds and 1 breeding pasture
- no minimum herd size
- purchase replacement females
- mate crossbred females to terminal sires of a third breed
- market all calves
- 100% retained heterosis in calf and cow
- expected 24% increase in weaning weight per cow exposed above the average of the parent breeds



Rotate Bull Every 4 Years: A×B Rotation

- requires 2 breeds and 1 breeding pasture
- no minimum herd size
- mate crossbred females to bulls of Breed A for 4 years followed by bulls of Breed B for 4 years, then rotate back to Breed A sires to start cycle again
- market steers and non-replacement heifers
- 50 to 67% retained heterosis
- expected 12 to 16% increase in weaning weight per cow exposed above the average of the parent breeds



Rotate Bull Every 4 Years: A×B×C Rotation

- requires 3 breeds and 1 breeding pasture
- no minimum herd size
- mate crossbred females to bulls of Breed A for 4 years followed by bulls of Breed B for 4 years followed by bulls of Breed C for 4 years, then rotate back to Breed A sires to start cycle again
- market steers and non-replacement heifers
- 67 to 83% retained heterosis
- expected 16 to 20% increase in weaning weight per cow exposed above the average of the parent breed

Performance Data Collection

Cattle Age/Event	Data to Collect
Birth	Birth date, dam ID, sire ID, calf ID, birth weight, calf vigor, calving ease score, dam udder score
Weaning	Weaning date, weaning weight, dam body condition score, disposition score
Yearling	Yearling data collection date, yearling weight, hip height, scrotal circumference, pelvic area, ultrasound body composition scans (intramuscular fat, rump fat, rib fat), disposition score
Mature	Monitor weight and body condition score, standing heat dates, breeding dates, pregnancy status, calving dates, disposition

- Records may be written and/or electronic
- Keep organized, accurate, and up-to-date records (software can help manage records)
- Follow breed association record collection and reporting guidelines for registered cattle
- Use data collected in performance calculations, management decision making, and marketing

Performance Data Calculations

Average daily gain = ADG = (starting weight – ending weight)/number of days

205-day adjusted weaning weight =205-day adj WW =
((weaning wt – birth wt)/ age in days at weaning) x 205 + birth wt + age-of-dam adj.

	BIF Standard Weaning Weight Adjustment Factor	
Age-of-dam at birth of calf, years	**Male**	**Female**
2	+60	+54
3	+40	+36
4	+20	+18
5 to 10	0	0
11 and older	+20	+18

Acceptable weaning age window for 205-day adj. WW calculation = 160 to 240 days
Consult individual breed associations for breed-specific weaning age windows

365-day adjusted yearling weight =365-day adj. YW =
((final wt – weaning wt)/days between weights) x 160+ 205-day adj. weaning wt

Most probable producing ability = MPPA =
100 + (number of calves x 0.4)/(1+ (number of calves – 1) x 0.4) x (average WW ratio - 100)

Performance ratio = (individual performance/group average performance) x 100
Ratio = 100 = average performance
Ratio < 100 = less than average performance
Ratio > 100 = greater than average performance
Rank cattle within a contemporary group

Contemporary group
Common: gender, management system and group, calf age group, age of dam group, and performance data collected on the same dates

Expected Progeny Differences (EPDs)

- genetic selection tool used to rank cattle
- predict expected performance for specific traits of the calves sired by a particular bull (or out of a particular dam) compared to expected performance of calves sired by another bull (dam) or group of bulls (dams)
- based on performance records of an individual, its relatives, and its progeny
- accuracy value indicates reliability of EPD (values closer to 1 are more reliable)

Expected progeny differences can be compared between animals or to a breed average. For illustration, calves sired by Bull A (yearling weight EPD = 82) are expected to be on average 18 pounds lighter at yearling age than calves sired by Bull B (yearling weight EPD = 100) when mated to similar females. This is determined by calculating the difference between the two EPD values: 82 – 100 = -18. Similarly, calves sired by Bull A can be expected to be on average seven pounds heavier at yearling age than calves sired by all other bulls in that same breed when mated to similar females (breed average yearling weight EPD = 75): 82 – 75 = 7.

Expected Progeny Difference Comparisons

	EPD values			EPD comparisons		
EPDs	Bull A	Bull B	Breed Average	Bull A vs. Bull B	Bull A vs. breed average	Bull B vs. breed average
Calving ease direct, %	7	1	5	+6	+2	-4
Birth weight, pounds	1.2	4.2	2.2	-3.0	-1.0	+2.0
Weaning weight, pounds	35	49	40	-14	-5	+9
Yearling weight, pounds	82	100	75	-18	+7	+25
Milk, pounds	22	15	20	+7	+2	-5
Scrotal circumference, cm	.50	-.05	.33	+.55	+.17	-.38
Calving ease maternal, %	0	8	6	-8	-6	+2
Intramuscular fat, %	.25	.05	.12	+.20	+.13	-.07
Ribeye area, inches^2	-.01	.63	.23	-.64	-.24	+.40
Fat thickness, inches	.021	.005	.005	+.016	+.016	0

Production Scenario and Associated Sire Selection Considerations

Scenario: Growth and Carcass Sire	Sire Selection Considerations[1]
• Herd size: 250 cows • Breeding mature cows only • Will <u>not</u> retain heifers as replacements • Sires used to complement the cows in terminal cross • Focus on uniform calf crop • Emphasis on rapid growth and carcass traits • Hired labor on hand • High level of management • Marketing after stocker phase or retaining ownership through finishing depending on market conditions • Utilizes value-based marketing and high level of information transfer to buyers	• Superior yearling weight EPD (rapid growth) • Heavy muscling, natural thickness • High terminal selection indices • Moderately low calving ease EPD (or moderately high birth weight EPD in cases where calving ease EPD is not available) is acceptable (only breeding to mature cows, labor available) • Sensible frame size to maintain acceptable carcass weights • Milk not important (no daughters retained) • Consider carcass EPDs • Complement the cow herd and match the market • Structurally sound and healthy

[1]EPD = expected progeny difference

Production Scenario and Associated Sire Selection Considerations

Scenario: Maternal "All-purpose" Sire	Sire Selection Considerations[1]
• Herd size: 100 cows • Seedstock producer • Will retain heifers as replacements • Desires "all-purpose" sire • Hired labor on hand • Marketing registered bulls as long yearlings and selected females after breeding	• Optimal calving ease, milk, growth, mature size, and carcass traits (balanced trait selection) • Close attention to all traits, EPDs, selection indices, and pedigree (important for seedstock marketing) • Large scrotal size and EPD (negative correlation with daughters' time to first estrus) • Optimal milk EPD (avoid extremes) • Disposition • Adaptability • Muscularity • Structurally sound and healthy

[1] *EPD = expected progeny difference*

Production Scenario and Associated Sire Selection Considerations

Scenario: Calving Ease Sire or "Heifer Bull"	Sire Selection Considerations[1]
• Herd size: 25 cows • Breeding many first-calf heifers • Will retain heifers as replacements • No hired labor • Producer works full-time off farm • Limited cattle handling facilities • Marketing steers at weaning on commodity markets	• Most calving difficulty and associated losses occur in first-calf heifers • Desirable calving ease EPD (or low birth weight EPD in cases where calving ease EPDs are unavailable) • Good calving ease and maternal selection indices • Large scrotal size and EPD (negative correlation with daughters' time to first estrus) • Optimal milk EPD (avoid extremes) • Relatively high weaning weight EPD (curve bender bull with both calving ease and growth advantages) • Reasonable muscling • Manageable disposition • Structurally sound and healthy

[1]*EPD = expected progeny difference*

Traits Controlled or Largely Influenced by One Gene Pair

Trait	Type of Gene Action
Black, red color	Black (B) dominant to red (b)
Color in Shorthorns	Red (R) has no dominance over white (r)
Color dilution	Dilution (D) dominant to nondilution (d)
Pigmentation, albino	Normal pigmentation (A) dominant to albino (a)
Polled, horned condition	Polled (P) dominant to horned (p) in British breeds
Snorter dwarf, normal size	Normal size (D) dominant to dwarf (d)
Hypotrichosis (short hair/hairlessness), normal	Normal (H) dominant to hypotrichosis (h)
Hydrocephalus, normal	Normal (H) dominant to hydrocephalus (h)
Osteopetrosis (marble bone disease), normal	Normal (O) dominant to osteopetrosis (o)
Syndactyly (mulefoot), normal	Normal (S) dominant to mulefoot (s)
Arthrogryposis (palate-pastern syndrome), normal	Normal (A) dominant to palate-pastern (a)
Double muscling, normal	Normal (D) dominant to double muscling (d)

Allele = alternate form of a gene; Coat color example:

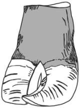
2 black alleles = black (homozygous dominant)

1 black and 1 red allele = black (heterozygous)

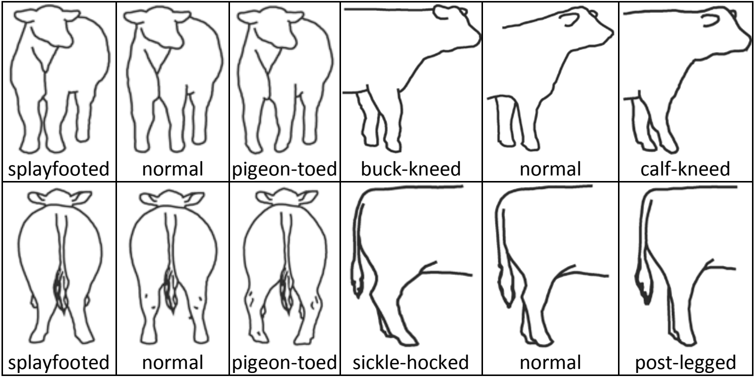
2 red alleles = red (homozygous recessive)

Beef Cattle Conformation

- Visual appraisal important to evaluate potential longevity and functionality of cattle
- Evaluate
  - Feet, legs, and overall skeletal structure
    - Impacts foraging and breeding ability
    - Back feet should step into front footprints when walking
    - Should see same distance between pasterns as between hocks
    - Front and rear feet should face forward without toeing in or out
    - Should have correct angle of front and rear legs into shoulders or hips
    - Avoid straight shoulders
    - Toes should be same width and length
    - Avoid screwclaw (1 toe thinner and grows over other toe; highly heritable)
  - Udder and teats
    - Suspension, size, mastitis
  - Teeth
    - Missing, cracked, overly worn
    - Check if unusual loss of body condition
  - Eyes
    - Pinkeye, cancer eye, injury, vision impair
  - Muscling
    - Average or above (greater value)



Beef Cattle Conformation



Temperament Scores

Cattle with aggressive temperaments

- gain weight at lower rates
- produce carcasses with less marbling
- are more likely to injure handlers or animals
- are less profitable

1 = Docile: Mild disposition. Gentle and easily handled. Stands and moves slowly during processing. Undisturbed, settled, somewhat dull. Does not pull on headgate when in chute. Exits chute calmly.

2 = Restless: Quieter than average, but may be stubborn during processing. May try to back out of chute or pull back on headgate. Some flicking of tail. Exits chute promptly.

3 = Nervous: Typical temperament is manageable, but nervous and impatient. A moderate amount of struggling, movement, and tail flicking. Repeated pushing and pulling on headgate. Exits chute briskly.

4 = Flighty (Wild): Jumpy and out of control, quivers, and struggles violently. May bellow and froth at the mouth. Continuous tail flicking. Defecates and urinates during processing. Frantically runs fence line and may jump when penned individually. Exhibits long flight distance and exits chute wildly.

5 = Aggressive: May be similar to Score 4, but with added aggressive behavior, fearfulness, extreme agitation, and continuous movement which may include jumping and bellowing while in chute. Exits chute frantically and may exhibit attack behavior when handled alone.
6 = Very Aggressive: Extremely aggressive temperament. Thrashes about or attacks wildly when confined in small, tight places. Pronounced attack behavior.

Hair Shedding Scores

Cattle that shed their winter coats later wean lighter calves. The recommended time to score cattle for hair shedding is in late spring.

Hair shedding scoring scale:
1 = **slick, short summer coat**; completely shed
2 = coat is **mostly shed**
3 = coat is **halfway shed**
4 = coat exhibits **initial shedding**
5 = **full winter coat**, no signs of shedding

Frame Score

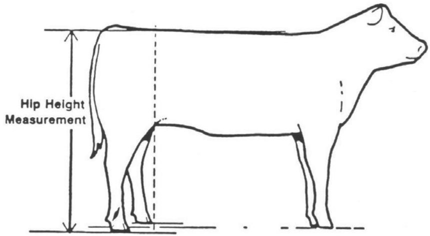
- Calculated from hip height measurement and animal age within gender
- Recommended site for hip height measurement is a point directly over the hooks
- Most cattle maintain the same frame score throughout life
- Frame scores may change for cattle that mature earlier or later than average for their breed

Bull frame score = -11.548 + 0.4878 (hip height) – 0.0289 (days of age) + 0.00001947 (days of age)^2 + 0.0000334 (hip height)(days of age)

Age in	**Bull frame score and hip height in inches**								
months	**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	49.3	51.3	53.3
9	38.2	40.2	42.3	44.3	46.3	48.3	50.3	52.3	54.3
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	51.1	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
18	44.5	46.5	48.5	50.5	52.4	54.4	56.4	58.4	60.3
19	44.9	46.8	48.8	50.8	52.7	54.1	56.7	58.7	60.6
20	45.1	47.1	49.1	51.0	53.0	55.0	56.9	58.9	60.9
21	45.3	47.3	49.2	51.2	53.2	55.1	57.1	59.1	61.0

Heifer frame score = -11.7086 + 0.4723 (hip height) – 0.0239 (days of age) + 0.0000146 (days of age)^2 + 0.0000759 (hip height)(days of age)

Age in	**Heifer frame score and hip height in inches**								
months	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
5	33.0	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	46.4	48.4	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	41.1	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
18	41.7	43.6	45.6	47.5	49.5	51.4	53.4	55.3	57.3
19	41.9	43.9	45.8	47.7	49.7	51.6	53.6	55.5	57.4
20	42.1	44.1	46.0	47.9	49.8	51.8	53.7	55.6	57.6
21	42.3	44.2	46.1	48.0	50.0	51.9	53.8	55.7	57.7



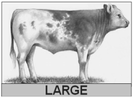
Adapted from Beef Improvement Federation. 2010. Guidelines for Uniform Beef Improvement Programs. 9th ed. Raleigh, NC.

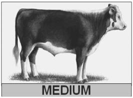
Frame Size

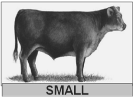
- measure of skeletal structure
- depends on hip height and age
- indicates growth
- related to slaughter weights at which cattle attain a given amount of fat thickness
- impacts the time it takes a calf to finish or reach maturity
  - Larger frame: reach maturity later
  - Larger frame: weigh more at maturity
- feeder calf price discounts for small-frame cattle vs. medium- or large-frame cattle
- largely influenced by genetics

USDA Feeder Cattle Grades for Frame Size

- determined by calf length and height
  - distance from fore to rear flank
  - distance from chest and hip to ground
- "Large" steers finish over 1250 lb
- "Medium" steers finish between 1100 and 1250 lb
- "Small" steers finish at less than 1100 lb
- heifers finish 100 lb lighter than steers







Muscling (muscle thickness)

- muscle to bone ratio at given fatness
- rough indicator of yield grade at maturity
- heavily-muscled calf
    - o wide stance between rear hooves
    - o center quarter wider than top of hip or base width
    - o rectangular when viewed from rear
- light-muscled calf
    - o narrow distance between rear hooves
    - o center quarter is flat
    - o triangular when viewed from rear
- price discounts for light muscling
- largely influenced by genetics

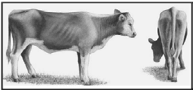
USDA Feeder Cattle Grades for Muscling

- #1: at least moderately heavy muscled
- #2: average amount of muscle
- #3: thin, light-muscled
- #4: extremely light muscled

No. 1

No. 2

No. 3



No. 4

Feeder Calf Grades: Thrifty Classification

For a calf to be assigned any of the 12 combinations of frame and muscle grades, they must be "thrifty." A thrifty animal does not exhibit signs of mismanagement, disease, parasitism, or lack of feed. If a calf is deemed unthrifty, it is assigned the "Inferior" grade but could qualify for frame and muscle grades at a later date if the problem is corrected. Double-muscled cattle are also graded as inferior because they do not produce a carcass with enough marbling to grade Choice.

Factors Affecting Feeder Calf Value

Trait	Expected Effect on Price
Frame size	discounts for small frame
Muscling	discounts for light muscling
Weight	price per pound decreases as calf weight increases
Gut fill	discounts for excess fill
Body condition	discounts for very thin and fat
Gender	steers > bulls > heifers
Horn status	discounts for horns
Health	discounts for sick or lame
Breed type	varies
Color	varies; spotted/striped calves typically least valuable
Group size and uniformity	premiums for truckload lots of uniform calves

Market (Cull) Cow Price Classes

Price Class	Percent Lean Yield	Body Condition Score
Light (small, light muscled, and/or thin)	75 to 90%	1 to 3
Lean	85 to 90%	2 to 4
Boner	80 to 85%	5
Breaker	75 to 80%	6 to 7
Premium White	70 to 75%	7 to 9

Cows in these market classes are further differentiated in price by estimated dressing percentage as low, average, or high dressing (percentage) animals.

General cow price per pound rankings:

Premium White > Breaker > Boner > Lean > Light

High Dress > Average Dress > Low Dress

Beef Cattle Marketing Channels

Channel	Advantages	Disadvantages
Auction market, "sale barn"	• competitive bidding • convenient • open to all sellers and buyers • prompt cash payment • all types of livestock can be marketed • cattle prices are determined and known to all • regulated and uniform weighing and selling conditions (fairness) • requires no market knowledge by producer • no minimum number of cattle	• seller has little control over prices • encourages multi-handling, speculative trading • high overhead cost • possible excessive stress and shrinkage of livestock • lack of volume and uniformity of animals at many markets • hard to get reputation for selling quality cattle • grade and price information difficult to interpret • distance is a limitation • prices are uncertain • commingling of livestock (disease spread risk) • number of buyers may be small, reducing bidding competitiveness
Private treaty	• seller controls marketing process • seller can point out positive aspects of livestock	• requires excellent marketing knowledge by producer • cattle may be overvalued or undervalued

	• producer can establish a reputation (buyers see total program) • encourages marketing innovation • animals are farm fresh and unstressed • minimal disease spread • producer can condition animals to buyer specifications • costs less than other marketing methods	• less market news available • breeder must be an effective salesperson • more haggling • wide variation in selling conditions • unregulated, unsupervised • producer assumes risk of payment collection • may be little or no buyer competition
Graded or pooled sale	• large, economical lots of livestock together • cost savings for buyers passed along to sellers • large numbers of livestock attract more buying competition • may facilitate reputation sales	• grading, sorting, weighing, and penning before sale are time-consuming and expensive • many marketing facilities are not designed for efficient processing for this system • individual producers can lose identity • hard to get producers to agree on terms of sale
Board sale	• potentially increases competition • direct buyer to seller transportation reduces stress, shrinkage, and death loss • reduces buyer cost • reduces marketing cost • flexible delivery • consignor identities preserved	• requires prior producer commitment • reduces marketing flexibility • requires partial or full truckload lots • accurate and dependable descriptions of livestock required (buying sight unseen)

Channel	Advantages	Disadvantages
Video/ Satellite/ Internet, "electronic marketing"	• largest number of potential buyers of all methods • provides entry to small markets • reduced buyer cost possibly passed to seller • direct buyer to seller transportation • delivery schedules very flexible	• generally higher marketing cost than tele-auction • on-farm truckload of uniform cattle needed • buyer hesitation with sight unseen cattle • possible technical difficulties
Consignment sale	• several potential customers come together • consignors can visit with prospective customers • sale costs divided among consignors • could increase private treaty sales • helps establish value of private treaty cattle • opportunity to expand market area • sale arranged by professionals	• cattle compared to other breeders' cattle • sale management may not be professional • cattle must be well displayed to be competitive • consignor may not select the right cattle or plan far enough in advance
Production sale	• buyers see total program • breeder controls sale arrangements • cattle not competing with those of other breeders	• need at least 40 to 50 lots to have a good sale and reduce per lot sale costs • encouraged to sell inferior cattle • may not attract enough buyers • an unsuccessful sale impacts an entire season or year of production

Open house sale	• buyers see total program • breeder controls sale arrangements • cattle not competing with those of other breeders • can set minimum prices and sell only cattle that receive bids at or above minimum prices • can retain ownership of some cattle for sale at a later date while selling other cattle if desired prices are offered	• marketing lower end cattle may be difficult

To **promote value** in market cows and bulls, producers should

- **manage** their cow herds to minimize quality shortcomings and defects
- **monitor** the health and condition of market cows and bulls, and
- **market** cows and bulls in a timely manner.

Adapted from National Cattlemen's Beef Association. 1999. National Market Cow and Bull Beef Quality Audit. Centennial, CO.

Mississippi Livestock Markets

Billingsley Auction Sales, Inc.
Sale Day: Thursday, 11:30 AM
Senatobia, MS (Tate Co.)
662-562-8229

Double L Cattle Auction
Sale Day: Saturday, 12:00 Noon
Thaxton, MS (Pontotoc Co.)
662-489-4343

East MS Farmers Livestock Co.
Sale Day: Tuesday, 12:00 PM
Philadelphia, MS (Neshoba Co.)
601-656-6732

Farmers Livestock Marketing
Sale Day: Wednesday, 1:00 PM
Carthage, MS (Leake Co.)
601- 267-7884

Glenwild Stockyard
Sale Day: Monday, 1:00 PM
Grenada, MS (Grenada Co.)
662-226-1900

Gowan Stockyards
Sale Day: Wednesday, 1:00 PM
Kosciusko, MS (Attala Co.)
662-289-9727

Lincoln Co. L/S Commission Co.
Sale Day: Tuesday, 1:00 PM
Brookhaven, MS (Lincoln Co.)
601-833-2654

Lipscomb Brothers Livestock Market
Sale Day: Wednesday, 7:00 PM
Como, MS (Panola Co.)
662-526-5362

Livestock Producers Assn. #1
Sale Day: Tuesday, 12:15 PM
Tylertown, MS (Walthall Co.)
601-876-3465

Lucedale Livestock Producers
Sale Day: Wednesday, 11:00 AM
Lucedale, MS (George Co.)
601-947-3352

Macon Stockyards, Inc.
Sale Day: Monday, 12:30 PM
Macon, MS (Noxubee Co.)
662-726-5153

Meridian Stockyards
Sale Day: Monday, 1:00 PM
Meridian, MS (Lauderdale Co.)
601-482-7275

Peoples Livestock Auction
Sale Day: Monday, 1:00 PM
Houston, MS (Chickasaw Co.)
662-456-3018

Pontotoc Stockyard, Inc.
Sale Day: Saturday, 11:00 AM
Pontotoc, MS (Pontotoc Co.)
662-489-4385

Rutland Livestock, LLC
Sale Day: Tuesday, 1:00 PM
Mize, MS (Smith Co.)
601-733-0112

Southeast Mississippi Livestock
Sale Day: Monday, 12:30 PM
Hattiesburg, MS (Forrest Co.)
601-268-2587

Stockyard, Inc.
Sale Day: Wednesday, 12:30 PM
Tupelo, MS (Lee Co.)
662-842-0522

Tadlock Stockyard
Sale Day: Monday, 12:00 PM
Forest, MS (Scott Co.)
601-469-3642

Walnut Sales Co.
Sale Day: Saturday, 1:00 PM
Walnut, MS (Tippah Co.)
662-223-4351

West Point Livestock Auction, Inc.
Sale Day: Monday, 12:30 PM
West Point, MS (Clay Co.)
662-494-6635

Winona Stockyard
Sale Day: Tuesday, 12:00 PM
Winona, MS (Montgomery Co.)
662-283-1652

Price Risk Management

Forward contract: contractual arrangement between a cattle buyer and seller to exchange cattle for a prearranged price at a future date
Futures market hedge: a means of managing price risk by taking a position in the futures market opposite that held in the cash market
Feeder cattle option: legally binding contract which gives the option buyer the right, but not the obligation, to buy or sell a feeder cattle futures contract under specific conditions in exchange for the payment of a premium
Call (put) option: right to buy (sell) a futures contract at a specific price during the option life

Enterprise Budget

Estimate of costs and returns associated with a production enterprise
Enterprise examples: cow-calf, calf preconditioning, stockering, cattle finishing

Partial Budget

The best way to assess potential profitability of a proposed management change is to develop a partial budget comparing the two practices for the specific operation. Partial budgeting consists of totaling additional returns and reduced costs of adopting the management change and then subtracting out the reduced returns and additional costs associated with the management change. Proposed management changes may include technology adoption, enterprise expansion, enterprise diversification, production practice changes, capital improvements, or marketing plan changes. A **breakeven analysis** is a specialized partial budget to evaluate cattle purchase and sale decisions

Effect on net returns = (additional returns + reduced costs) – (additional costs + reduced returns)

Example partial budget for changing from traditional weaning to early weaning

Additional returns	Amount	Additional costs	Amount
Increased calf sales from increased cow conception rate next year	A	Increased labor costs	I
Increased calf weaning weights next year	B		
Increased sales of replacement heifers	C	Increased calf feed costs	J
Increased quality grade premiums (retained calf ownership, grid marketing)	D		
Reduced costs	**Amount**	**Reduced returns**	**Amount**
Decreased cow feed costs	E	Decreased market cow sales	K
Decreased replacement female costs	F	Decreased carcass weights and values (retained calf ownership)	L
Decreased feedlot feed costs (retained calf ownership)	G		
Total additional returns and reduced costs	**A + B + C + D + E + F + G = H**	**Total additional costs and reduced returns**	**I + J + K + L = M**
Net returns from changing from traditional weaning to early weaning			**H - M**

Beef Cattle Enterprise Financial Statements

Financial Statement	Purpose	Key Information
Balance sheet	Statement of financial condition of business at a specific time	*Assets – Liabilities = Net Worth (Equity)*; Current, intermediate, and long-term assets and liabilities
Cash flow statement	Used to evaluate cash inflows and outflows to determine when, how much, and for how long cash deficits or surpluses will exist	Cash inflows: cash operating and capital receipts Cash outflows: operating and capital outlays, loan payments
Income statement (profit and loss statement)	Summary of income and expenses that occurred during a specific accounting period	Income: cash and noncash Expenses: cash and noncash

Annual Payments ($ of Principal and Interest) to Amortize a $1,000 Loan

Interest rate, %	Length of loan, years									
	1	2	3	4	5	7	10	15	20	30
1	1,010.00	507.51	340.02	256.28	206.04	148.63	105.58	72.12	55.42	38.75
2	1,020.00	515.05	346.75	262.62	212.16	154.51	111.33	77.83	61.16	44.65
3	1,030.00	522.61	353.53	269.03	218.35	160.51	117.23	83.77	67.22	51.02
4	1,040.00	530.20	360.35	275.49	224.63	166.61	123.29	89.94	73.58	57.83
5	1,050.00	537.80	367.21	282.01	230.97	172.82	129.50	96.34	80.24	65.05
6	1,060.00	545.44	374.11	288.59	237.97	179.14	135.87	102.96	87.18	72.65
7	1,070.00	553.09	381.05	295.23	243.89	185.55	142.38	109.79	94.39	80.59
8	1,080.00	560.77	388.03	301.92	250.46	192.07	149.03	116.83	101.85	88.83
9	1,090.00	568.47	395.05	308.67	257.09	198.69	155.82	124.06	109.55	97.34
10	1,100.00	576.19	402.11	315.47	263.80	205.41	162.75	131.47	117.46	106.08
15	1,150.00	615.12	437.98	350.27	298.32	240.36	199.25	171.02	159.76	152.30

Beef Cattle Enterprise Financial Measures

Measure	Calculation	Desirable Value	Cautionary Value	Undesirable Value
Asset turnover ratio	$\frac{\text{Gross farm revenue}}{\text{Average farm assets}}$	≥40%	20 to 39%	<20%
Current ratio	$\frac{\text{Current farm assets}}{\text{Current farm debt}}$	≥2	1 to 1.9	<1
Debt to asset ratio	$\frac{\text{Total farm debt}}{\text{Total farm assets}}$	<40%	40 to 70%	>70%
Interest expense ratio	$\frac{\text{Interest expense}}{\text{Gross farm revenue}}$	<10%	10 to 20%	>20%
Net farm income	Gross cash farm income - total cash farm expense - depreciation +/- inventory change	>0	0	<0

Operating expense ratio	$\frac{\text{Gross farm expense} - \text{farm interest expense} - \text{depreciation expense}}{\text{Gross farm revenue}}$	<60%	60 to 80%	>80%
Operating profit margin	$\frac{\text{Net farm income} + \text{farm interest expense} - \text{value of operator labor \& mgmt.}}{\text{Gross revenue}}$	>5%	0 to 5%	<0%
Rate of return on farm assets	$\frac{\text{Net farm income} + \text{farm interest expense} - \text{value of operator labor \& mgmt.}}{\text{Average farm assets}}$	>5%	0 to 5%	<0%
Rate of return on farm equity	$\frac{\text{Net farm income} - \text{value of operator labor \& mgmt.}}{\text{Average farm equity}}$	>10%	5 to 10%	<5%

Adapted from D. M. Gimenez et al. Alabama Beef Cattle Pocket Guide. 2008. ANR-1323. Alabama Cooperative Extension System. Auburn, AL.

Veterinary Services and Advice

A veterinarian plays a critical role in preventing, diagnosing, and treating disease. Local veterinarians can develop herd health programs to fit specific ranch needs. Establish a valid veterinarian-client-patient relationship.

- veterinarian responsible for herd health care
- follow veterinarian's treatment and drug withdrawal instructions
- veterinarian familiar with animals on farm
- veterinarian available for follow-up visits

Veterinarians can assist with

- vaccination program development and implementation
- parasite control program development and implementation
- calving difficulty
- injured or ill animal care
- Breeding Soundness Evaluations
- pregnancy diagnosis
- disease monitoring program certifications
- necropsies

Importance of Cattle Health

Cattle are susceptible to health problems

- infectious diseases, metabolic disorders, toxins, parasites, dystocia, injury
- control programs help maintain healthy herds

Health problems cause economic losses

- increased medication costs
- reduced performance
- lower product value
- death losses

Health Terms

Extra-label use: giving a drug or other substance in a way that is not printed on the label

Metaphylaxis: administration of an antimicrobial product to an animal at high risk of developing a bacterial disease before clinical signs are present

Necropsy: a post-mortem examination performed on cattle; also referred to as posting

Pathogen: an infectious microorganism such as a bacterium, fungi, or virus that causes disease in its animal host

Persistently infected (PI): an animal that persistently harbors a pathogen for long periods of time, and may shed the pathogen in urine, feces, milk, or respiratory secretions. Example: BVD-PI = cattle persistently-infected with Bovine Viral Diarrhea Virus.

Withdrawal period: interval between the time of last administration of a drug or vaccine and the time when the animal can be harvested for food or the milk can be safely consumed

Biological Risk Management (Biosecurity)

Biosecurity is the overall process of awareness education, evaluation, and management of risk of infectious diseases entering or spreading through an animal facility.

- Designed to improve disease control and minimize risk
- Easy and inexpensive to implement
- Operation specific

Plan development steps

- Evaluate facility/operation
- Identify challenges
- Tailor management plan
- Prioritize control measures

General disease prevention steps

- Limit herd contact with other animals
- Maintain effective fences
- Establish biosecurity protocols for delivery vehicles and personnel
- Lock gates
- Isolate ill animals immediately
- Quarantine newly introduced animals
- Determine isolation time with veterinarian
- Test for key diseases before placing with rest of herd

Vaccines

- Available for many diseases
- Not all diseases are a routine threat
- Some vaccines not sufficiently effective to justify their use
- Every operation has unique vaccination requirements based on individual herd goals
- Properly store and administer vaccines
- Consult a veterinarian for appropriate vaccine selection and use instructions

Vaccine Label Claims

"Aid in disease control": shown to alleviate disease severity, reduce disease duration, or delay disease onset

"Aid in disease prevention": shown to prevent disease in vaccinated and challenged animals by a clinically significant amount

"Prevention of disease": shown to be highly effective in preventing clinical disease in vaccinated and challenged animals; estimate of efficacy must be at least 80%

"Prevention of infection": able to prevent all colonization or replication of the challenge organism in vaccinated and challenged animals

"Other": having beneficial effects other than direct disease control, such as control of disease through reduction of pathogen shedding

Advantages and Disadvantages of Different Vaccine Types

Advantages	Disadvantages
Killed Vaccines (KV) and Toxoids	
• 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
Modified-Live Vaccines (MLV)	
• One initial dose may be sufficient, but boosters are sometimes required • Stimulate more rapid, stronger, and	• Risk of causing abortion or transient infertility, therefore should generally be administered 6 to 8 weeks prior to

longer-lasting immunity than KV products • Less likely to cause allergic reactions and postvaccination lumps • Usually less expensive than KV products	breeding season • Must be mixed on-farm and used within about 30 minutes
Chemically Altered Vaccines	
• Many of the advantages of MLV products • Safety is similar to killed vaccines • 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 • Often more costly than MLV products • Must be mixed on-farm and used within about 30 minutes

Adapted from D. M. Gimenez et al. Alabama Beef Cattle Pocket Guide. 2008. ANR-1323. Alabama Cooperative Extension System. Auburn, AL

Cattle Diseases

Disease	Cause	Signs	Management[1]
Anaplasmosis (Yellow bag, Yellow fever)	Blood parasite (*Anaplasma species*); blood transmission (needles, biting insects)	Anemia, abortion, weight loss, bull infertility, death; signs more severe in older cattle	Vaccination, insect control, chlortetracycline feeding, oxytetracycline injections
Blackleg (*Clostridial* disease)	Bacterial infection: *Clostridium species*; contaminated feed ingestion	Depression, swelling and lameness of affected limb(s), perception of air under skin, death; affects cattle 6 months to 2 years old	Vaccination, proper carcass disposal of animals dead from blackleg
Bovine leukosis	Viral infection: bovine leucosis virus (BLV); blood-borne	Malignant tumors (lymphosarcomas), eye protrusion,	Change needles and palpation sleeves between animals,

		lymph node enlargement, weight loss, hind limb paralysis, infertility	avoid feeding milk or colostrum from infected cows
Bovine respiratory disease (BRD)	Viral infection: IBR (Infectious Bovine Rhinotracheitis, Rednose), PI3 (Parainfluenza-3), BVD (Bovine Virus Diarrhea), BRSV (Bovine Respiratory Syncytial Virus); Bacterial infection: *Mannheimia haemolytica*, *Pasteurella multocida*, *Histophilus somnus*	Nasal/eye discharge, coughing, fever, depressed appetite, breathing difficulty and noise, rapid breathing, depression, droopy ears	Minimize stress, adequate nutrition, internal parasite control, vaccination (preconditioning), minimize exposure to diseased and unfamiliar cattle
Brucellosis (Bangs)	Bacterial infection: *Brucella abortus*; consuming or licking contaminated forage, calves, or fetuses	Late-term abortions, retained placentas, weak calves	Vaccination (heifers), herd testing (certification)

Cattle Diseases (Cont.)

Disease	Cause	Signs	Management[1]
Calf scours	Infectious agents: bacteria, viruses, protozoan parasites, yeasts, molds; nutritional shortcomings, inadequate newborn environment	Diarrhea, dehydration, acidosis	Proper nutrition during gestation, good calving management
Campylobacteriosis (Vibrio)	Bacterial infection: *Campylobacter fetus*; sexual transmission from bull prepuce	Infertility, endometritis, rare late term abortions	Vaccination, use virgin bulls, test older herd sires, use artificial insemination
Johne's disease	Bacterial infection: *Mycobacterium avium subspecies paratuberculosis*; spread through feces	Profuse, persistent diarrhea; chronic weight loss despite normal appetite; typically seen in cattle >2 years old	Herd testing; biosecurity; culling; reduce fecal contamination of udders, water, feed

Leptospirosis	Bacterial infection: *Leptospira interrogans*; contaminated feed and water	Infertility, stillbirths, late-term abortions	Vaccination; clean water source; reduce contact with rodents, dogs, wildlife
Pinkeye (Infectious Bovine Keratoconjunctivitis, IBK)	Bacterial infection: *Moraxella bovis*; spread by face flies, direct contact	Excessive tearing, light avoidance, squinting, eye ulceration, depressed appetite, weight loss	Control flies, remove eye irritants (pasture clipping, hazard removal), vaccination
Trichomoniasis (Trich)	Protozoan infection: *Tritrichomonas foetus*; sexual transmission from bull prepuce	Repeat breeders, embryonic death, early-term abortion	Use virgin or tested bulls, use AI, cull or rest infected cows
Tuberculosis (TB)	Bacterial infection: *Mycobacterium bovis*; spread via coughing, sneezing, milk, feces, inhalation or ingestion	Lung and lymph node lesions, weight loss, coughing, difficult breathing, death	Surveillance, herd testing (certification)

[1]Consult a veterinarian for disease diagnosis and treatment advice.

Internal Parasites

Major internal parasites of cattle

- brown stomach worm (*Ostertagia*)
- coccidia (intestinal protozoa)
- liver fluke (*Fasciola hepatica*)

Effects of internal parasites on cattle

- disease (clinical or subclinical)
- lower growth, milking, or reproductive performance
- reduced appetite and intake
- tissue damage, protein loss, tissue fluid loss
- anemia (iron deficiency)
- impaired immune function

External Parasites

Major external parasites of cattle

- flies (horn, stable, face, horse, deer)
- lice
- grubs (warbles)
- ticks

Effects of external parasites on cattle

- disease spread
- reduced performance (growth, milk, reproduction)
- hide damage
- anemia (iron deficiency)

Identifying Sick or Injured Cattle

Proper and timely ID

- minimize unnecessary treatment
- prevent current and future production losses

Signs of illness

- elevated body temperature
- depressed appetite
- drooping head and ears
- lagging behind herd
- difficult breathing
- coughing
- eye/nasal discharge
- bloody or mucous tinged diarrhea

Signs of injuries

- lameness
- reluctance to move
- inability to stand or walk
- appetite changes
- tissue swelling
- lacerations (cuts)
- bruises
- behavioral changes

Beef Quality Assurance (BQA) Marketing Code of Ethics

I will only participate in marketing cattle that:

- ✓ Do not pose a known public health threat
- ✓ Have cleared proper withdrawal times
- ✓ Do not have a terminal condition (including advanced lymphosarcoma, septicemia, etc.)
- ✓ Are not disabled
- ✓ Are not severely emaciated
- ✓ Do not have uterine/ vaginal prolapses with visible fetal membrane
- ✓ Do not have advanced eye lesions
- ✓ Do not have advance Lumpy Jaw

Furthermore, I will:

- ✓ Do everything possible to humanely gather, handle, and transport cattle in accordance with accepted animal husbandry practices

Finally, I will:

- ✓ Humanely euthanize cattle when necessary to prevent suffering and to protect public health.

Mississippi BQA Program

- Purpose: to identify areas in beef production where defects in quality occur and provide guidelines for improvement
- Certification available

msucares.com/livestock/beef/bqa

Cow Evaluation Checklist

Use to make culling or treatment decisions

- **Pregnancy**—Perform yearly; cull open cows.
- **Eyes**—Bovine Ocular Neoplasia or “cancer eye” is a common cause of cow carcass condemnation. It can rapidly become severe (resulting in blindness) and spread to other body parts (leading to carcass condemnation).
- **Mouth**—Must have adequate teeth to harvest forage for body condition maintenance and milk production to support calf growth.
- **Feet and legs**—Lame cows have difficulty grazing and walking to feed bunks or water. As a result, they lose body condition, wean poor calves, and do not rebreed.
- **Udder**—A good udder is needed 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 have trouble rebreeding and bruise more easily.
- **Disposition**—Cows with bad dispositions often produce excitable calves that do not gain as well and may produce undesirable “dark cutting” meat. They can also make cattle handling difficult and dangerous.

Needle Selection Guide

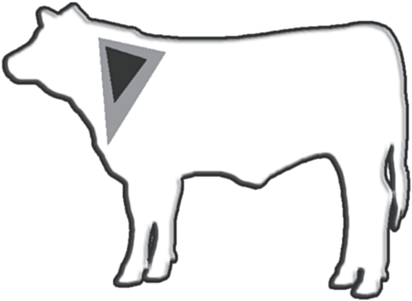
Needle Dimension	Route of Administration					
	Subcutaneous (SubQ)			Intramuscular (IM)		
	Cattle Weight, lb					
	<300	300 to 700	>700	<300	300 to 700	>700
Gauge[1]	18	16 to 18	16	18	16 to 18	16 to 18
Length, inches	½ to ⅝	½ to ⅝	½ to ⅝	¾ to 1	¾ to 1	¾ to 1

[1]Gauge indicates needle diameter. Needle size decreases as gauge increases.

Adapted from D. M. Gimenez et al. Alabama Beef Cattle Pocket Guide. 2008. ANR-1323. Alabama Cooperative Extension System. Auburn, AL.

- Select the smallest practical needle size that fits cattle size without bending
- Do not use a contaminated, bent, burred, or dull needle
- Do not share needles among cattle with known blood-borne infectious disease

Acceptable Injection Sites for Cattle



■ Subcutaneous (under the skin) ■ Intramuscular (in the muscle)

- Properly restrain cattle before injecting
- Select appropriate needle size
- Check for proper dosage before injecting
- Keep all injections in front of shoulder
- Never inject in buttock or top of rump
- Inject subcutaneous when possible
- Use tenting technique for subcutaneous injections
- Never inject more than 10 mL (cc) per site
- Keep injection sites at least 5 inches apart
- Avoid injecting in wet or manure-covered areas

Dosage by Animal Body Weight[1]

	Dosage rate, mL/100 lb of body weight														
	0.9	**1**	**1.1**	**1.3**	**1.5**	**1.8**	**2**	**2.3**	**3**	**3.4**	**4**	**4.5**	**5**	**5.7**	**6**
Animal weight, lb	**Body weight per 1 mL dose, lb**														
	110	100	90.9	75	66.7	55	50	43.5	33.3	29.4	25	22	20	17.5	16.7
	Dose volume, mL														
300	2.7	3	3.3	4	4.5	5.5	6	6.9	9	10.2	12	13.5	15	17.1	18
350	3.2	3.5	3.9	4.7	5.3	6.4	7	8.1	10.5	11.9	14	15.8	17.5	20	21
400	3.6	4	4.4	5.3	6	7.3	8	9.2	12	13.6	16	18	20	22.8	24
450	4.1	4.5	5.0	6.0	6.8	8.2	9	10.4	13.5	15.3	18	20.3	22.5	25.7	27
500	4.6	5	5.5	6.7	7.5	9.1	10	11.5	15	17	20	22.5	25	28.5	30
550	5	5.5	6.1	7.3	8.3	10	11	12.7	16.5	18.7	22	24.8	27.5	31.4	33
600	5.5	6	6.6	8.0	9	10.9	12	13.8	18	20.4	24	27	30	34.2	36
650	5.9	6.5	7.2	8.7	9.8	11.8	13	15	19.5	22.1	26	29.3	32.5	37.1	39
700	6.4	7	7.7	9.3	10.5	12.7	14	16.1	21	23.8	28	31.5	35	39.9	42
750	6.8	7.5	8.3	10.0	11.3	13.6	15	17.3	22.5	25.5	30	33.8	37.5	42.8	45
800	7.3	8	8.8	10.7	12	14.6	16	18.4	24	27.2	32	36	40	45.6	48

850	7.7	8.5	9.4	11.3	12.8	15.5	17	19.6	25.5	28.9	34	38.3	42.5	48.5	51
900	8.2	9	9.9	12.0	13.5	16.4	18	20.7	27	30.6	36	40.5	45	51.3	54
950	8.6	9.5	10.5	12.7	14.3	17.3	19	21.9	28.5	32.3	38	42.8	47.5	54.2	57
1,000	9.1	10	11	13.3	15	18.2	20	23	30	34	40	45	50	57	60
1,100	10	11	12.1	14.7	16.5	20	22	25.3	33	37.4	44	49.5	55	62.7	66
1,200	10.9	12	13.2	16.0	18	21.8	24	27.6	36	40.8	48	54	60	68.4	72
1,300	11.8	13	14.3	17.3	19.5	23.6	26	29.9	39	44.2	52	58.5	65	74.1	78
1,400	12.7	14	15.4	18.7	21	25.5	28	32.2	42	47.6	56	63	70	79.8	84
1,500	13.6	15	16.5	20.0	22.5	27.3	30	34.5	45	51	60	67.5	75	85.5	90
1,600	14.6	16	17.6	21.3	24	29.1	32	36.8	48	54.4	64	72	80	91.2	96
1,700	15.5	17	18.7	22.7	25.5	30.9	34	39.1	51	57.8	68	76.5	85	96.9	102
1,800	16.4	18	19.8	24.0	27	32.7	36	41.4	54	61.2	72	81	90	102.6	108
1,900	17.3	19	20.9	25.3	28.5	34.6	38	43.7	57	64.6	76	85.5	95	108.3	114
2,000	18.2	20	22	26.7	30	36.4	40	46	60	68	80	90	100	114	120

[1]Read product label for dosing instructions; 1 mL = 1 cc; Dose volumes rounded to the nearest 0.1 mL; Do not inject more than 10 mL per injection site.

Diagnostic Labs

CVM - Diagnostic Laboratory Services

- full-service, all species laboratory
- provides diagnostic laboratory support to Mississippi State University College of Veterinary Medicine Animal Health Center
- serves as teaching laboratory and research and development laboratory

P.O. Box 6100, 240 Wise Center Drive
Mississippi State, MS 39762
Phone: (662) 325-1104
Fax: (662) 325-4548
www.cvm.msstate.edu

MS Veterinary Research and Diagnostic Lab

- full-service, all species laboratory
- serves as the central reference laboratory
- provides regulatory tests to satisfy state and federal regulatory requirements in regard to animal health and export regulations

3137 Highway 468 West
Pearl, MS 39208
Phone: (601) 420-4700
Fax: (601) 420-4719

Livestock Carcass Disposal

Mississippi Board of Animal Health guidelines for disposal of livestock carcasses are as follows:

1. Carcass(es) must be buried at a depth sufficient to prevent offensive odors, fly breeding, and unearthing by other animals, and shall be covered under at least 2 feet of compacted earth. After settling, more dirt shall be placed over surface to prevent a ponding effect.
2. Carcass(es) shall be buried on the owner's property, or on another's property with specific approval of the owner, or in permitted landfills. The carcass(es) shall be buried at least 150 feet from adjoining landowners' property, at least 300 feet from an inhabited dwelling, or on land not in cultivation.
3. Alternative disposal options must be approved by the State Veterinarian and/or DEQ on a case-by-case basis.
4. In case of the disposal of large numbers of animal carcasses due to catastrophe, contact the Board of Animal Health for approval of the disposal site. A trench or pit shall be constructed in such a manner not to allow rainwater to drain and must be approved by the State Veterinarian.

www.mbah.state.ms.us or 1-888-722-3106

Shade

- Reduces thermal heat load on cattle
- Provide at least
  - 18 ft^2 per head for 400-pound calves
  - 25 ft^2 per head for 800-pound calves
  - 30 to 40 ft^2 per head for mature cows
- Avoid cattle crowding under limited shade
- Minimum 10 feet high
- Ensure adequate ventilation
- Use at least 80% shade cloth
- Location affects pasture utilization
- Can develop mud problems
- Natural, artificial (permanent or portable)

Heat Stress

- Increases as temperature or humidity increase
- Increases as wind speed decreases
- Cattle more likely to get sick and die
- Feed intake declines
- Consider breed heat stress tolerance
- Consider region of origin and adaptability
- Avoid breeding during summer
- Provide adequate water (intake increases)
- Avoid handling cattle in extreme conditions
- Handle cattle earlier in the day
- Limit time cattle spend in handling facilities
- Use shades and sprinklers

- Avoid hauling cattle in extreme conditions
- Avoid unnecessary stops
- Stop only during cooler parts of the day
- Select shaded areas for stops
- Make stop durations as short as possible
- Reduce trailer stocking densities
- Handle cattle gently and patiently

Cold Stress

- Contributors to cold stress
    - Cold temperature, wind, wet hair coat
- Increases cattle energy requirements
- % increase in TDN requirement per F° below lower critical temperature
    - 1% with dry winter hair coat
    - 2% with wet or summer hair coat

Mud

- Impacts feeding behavior
    - Suction on hooves, difficult to move
- 4 to 8 inches of mud
    - Feed intake reduced 4 to 8%
    - Average daily gain reduced 14%
- Belly deep mud
    - Feed intake reduced 30%
- Creates disease and health risk
    - Foot rot, scours, naval ill
    - Cattle born into or trapped in mudholes

Animal Welfare

- Ranchers are responsible for the basic requirements of animals they raise
  - access to ample feed and clean water
  - timely and appropriate veterinary care to prevent and treat disease
  - practice appropriate and efficient movement, restraint, and transport of livestock
- Animal care and stewardship improves
  - perception
  - production

Managing Cattle Comfort

- Adequate space
  - comfort, socialization, environmental management
- Pasture, pen, and facilities
  - mud/dust reduction, extreme weather protection
  - safe design and sufficient maintenance/cleaning
- Timely marketing
- Stress reduction
- Sufficient nutrition
- Euthanasia considering animal welfare

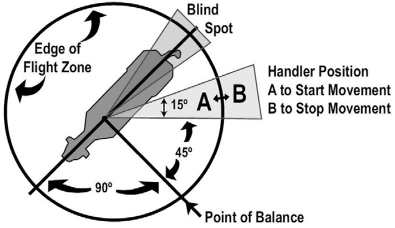
Cattle Handling Techniques

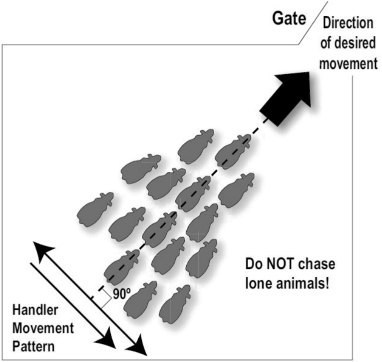
To reduce stress during cattle handling

- assess cattle flow
- use proper, maintained facilities
- have solid footing
- familiarize cattle with facilities
- move cattle carefully
- work cattle in groups
- use point of balance concepts
- call cattle rather than drive them
- prevent noise and distractions
- avoid stark lighting changes
- remove sharp objects
- use experienced people
- treat cattle with respect
- stay alert and calm
- watch for kicks and head butts
- limit use of prods
- use products carefully
- move cattle into chute easily
- prevent backing in working chute
- prevent turning in working chute
- properly restrain cattle when working them

Flight Zone

- distance cattle can be from humans and still feel comfortable
- use to quietly move cattle

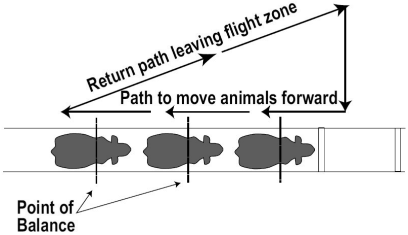


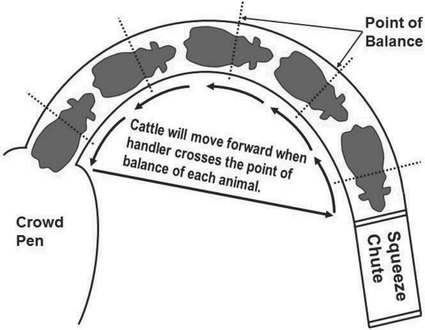


Adapted from NCBA. The Cattle Industry's Guidelines for the Care and Handling of Cattle.

Point of Balance

- point on shoulder
- use to encourage cattle to go backward and forward





Adapted from NCBA. The Cattle Industry's Guidelines for the Care and Handling of Cattle.

Shrink

- liveweight loss from feed and water deprivation and transportation
- weight recovery takes 5 to 30 days
- affected by transit time, transit distance, environmental conditions, cattle handling, cattle management, gut fill, frame size, gender, age, body condition
- ~0.75% of cattle body weight will be lost per day with feed and water deprivation
- cattle shrink ~1% per hour for the first 3 to 4 hours and then ~0.25% per hour for the next 8 to 10 hours without feed and water
- transport increases weight loss several-fold
- manage with preconditioning, low stress cattle handling, efficient shipping, rest during and after transit, electrolyte solutions, water

Effect of Cattle Handling on Shrink

Handling Conditions	**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

Adapted from D. M. Gimenez et al. Alabama Beef Cattle Pocket Guide. 2008. ANR-1323. Alabama Cooperative Extension System. Auburn, AL.

Cattle Handling Facilities

Factors to consider in facilities construction

- intended uses
- location
- access
- efficiency (animals worked in a given period)
- drainage
- fence placement
- utilities
- handler and animal safety
- neighbors
- cost

Loading Chute Dimensions for Cattle Receiving and Shipping

Loading Chute Aspect	**Dimensions**
Width	26 to 30 inches
Length (minimum)	12 feet
Rise	3.5 inches per foot
Ramp height	
Stock trailer	15 inches
Pickup truck	28 inches
Stock truck	40 inches
Tractor-trailer	48 inches
Double-deck trailer	100 inches

Adapted from Iowa State University. 1987. Midwest Service Plan. Beef Housing and Equipment Handbook. MWP S-6. Iowa State Univ. Ames, IA.

Size and Space Requirements for Cattle Handling Facilities

Component	Size/Space Item	Dimensions by Cattle Weight		
		Up to 600 lb	600 to 1,200 lb	Over 1,200 lb
Holding pen	Space per head, sq ft	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	Space per head, sq ft	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	Width, in	18	22	28
	Length, minimum ft	20	20	20
Working chute, sloped sides	Width at 4 ft height, in	20	24	28
	Width inside at bottom, in	15	16	18
	Minimum length, ft	20	20	20
Working chute fence	Post spacing, ft	7	7	7
	Post depth in ground, in	36 to 48	36 to 48	36 to 48

	Solid wall height, in	54 to 60	54 to 60	60
	Top rail height for gentle cattle, in	54 to 60	60	60
	Top rail height for aggressive cattle, in	60 to 72	60 to 72	60 to 72
Holding/squeeze chute	Height, in	45	50	50
	Straight sides width, in	18	22	28
	V-shaped sides width at bottom, in	6 to 8	8 to 12	14 to 16
	Length including head gate, ft	5	5 to 8	5 to 8
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-in x 2-in cleats, in	8	8	8
	Trailer ramp height	15	15	15
	Pickup truck ramp height	28	28	28
	Large truck ramp height	40	40	40
	Tractor-trailer ramp height	48	48	48
	Double-deck trailer ramp height	100	100	100

Adapted from J. R. Bicudo et al. 2002.Cattle Handling Facilities: Planning, Components, & Layouts. Univ. KY, Coop. Ext. Serv., Lexington, KY.

Cattle Transportation

Before traveling with cattle

- obtain necessary paperwork
- carefully plan the route
- make sure cattle are standing

During the trip

- make gentle turns
- gently accelerate and brake
- avoid heavy traffic
- check cattle periodically
- minimize stops

Cattle Loading and Unloading

Use low-stress handling techniques

- allow cattle to flow onto trailer

Use proper facilities

Sort into loading groups

- size, sex, horns, source
- load heavy cattle towards front

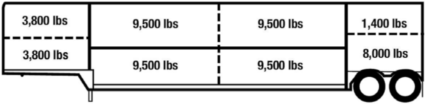
Load at edge of operation

Make sure cattle are fit to load

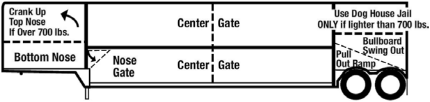
- physically sound, adequate health
- adhere to product withdrawal times
- no late gestation females

Feeder Cattle Loading

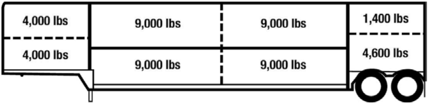
53 ft – 55,000 lb Gross – Feeder Cattle Lighter Than 700 lbs



48 ft – 50,000 lb Gross – Feeder Cattle Lighter Than 700 lbs

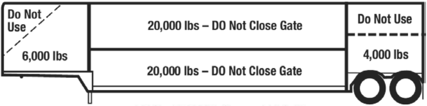


48 ft – 50,000 lb Gross – Feeder Cattle Lighter Than 700 lbs

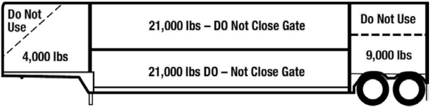


Fat Cattle Loading

48 ft – 50,000 lb Gross – Fat Cattle



53 ft – 55,000 lb Gross – Fat Cattle



Adapted from NCBA. Stock Trailer Transportation of Cattle.

Maximum Recommended Number of Cattle for Various Trailer Dimensions[1]

Trailer Size, ft		Cattle weight under, lb													Load weight, lb
Length	**Width**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**	**1400**	**1500**	**1600**	**Max[2]**
14	**6**	16	13	11	9	8	7	6	6	5	5	5	4	4	<6,500
16	**6**	18	15	12	11	9	8	7	7	6	6	5	5	5	<7,400
18	**6**	21	17	14	12	10	9	8	8	7	6	6	6	5	<8,400
20	**6**	23	18	15	13	12	10	9	8	8	7	7	6	6	<9,300
22	**6**	25	20	17	15	13	11	10	9	8	8	7	7	6	<10,200
24	**6**	28	22	18	16	14	12	11	10	9	9	8	7	7	<11,100
26	**6**	30	24	20	17	15	13	12	11	10	9	9	8	8	<12,000
28	**6**	32	26	22	18	16	14	13	12	11	10	9	9	8	<13,000
30	**6**	35	28	23	20	17	15	14	13	12	11	10	9	9	<13,900
32	**6**	37	30	25	21	18	16	15	13	12	11	11	10	9	<14,800

34	**6**	39	31	26	22	20	17	16	14	13	12	11	10	10	<15,700
20	**7**	27	22	18	15	13	12	11	10	9	8	8	7	7	<10,800
22	**7**	30	24	20	17	15	13	12	11	10	9	8	8	7	<11,900
24	**7**	32	26	22	18	16	14	13	12	11	10	9	9	8	<13,000
26	**7**	35	28	23	20	18	16	14	13	12	11	10	9	9	<14,000
28	**7**	38	30	25	22	19	17	15	14	13	12	11	10	9	<15,100
30	**7**	40	32	27	23	20	18	16	15	13	12	12	11	10	<16,200
32	**7**	43	34	29	25	22	19	17	16	14	13	12	11	11	<17,300
34	**7**	46	37	31	26	23	20	18	17	15	14	13	12	11	<18,400

[1]Reduce trailer stocking density by 5 percent for cattle with horns, and reduce the number of head loaded during hot conditions.

[2]The maximum weight of cattle for each trailer size with these calculations. Do not exceed the Gross Vehicle Weight Rating for the truck and trailer.

Adapted from NCBA. Stock Trailer Transportation of Cattle.

Comparison of Common Fences

Type	Strands	Wire Gauge	Height, inches	Stay Spacing, inches	Cost Index[1]	Fence Life[2], years	Upkeep
Barbed wire, 2-point	3	12 ½		4	132	33	high
	4	12 ½		4	143	33	high
	5	12 ½		4	154	33	high
	3	14		4	121	18	high
Barbed wire, 4-point	3	12 ½		5	132	33	high
	4	12 ½		5	143	33	high
	5	12 ½		5	154	33	high
Woven wire, light weight	top, bottom	11	26	6	154	19	high
	filler	14 ½	32	6	165	19	high
Woven-wire, medium weight	top, bottom	10	26	6	176	30	medium
	filler	12 ½	32	6	187	30	medium
	filler	12 ½	39	6	198	30	medium
	filler	12 ½	47	6	220	30	medium

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, permanent	3	12 ½			44	30	medium
	4	12 ½			55	30	medium
	5	12 ½			66	30	medium
	8	12 ½			110	30	medium
High tensile wire, temporary	2	12 ½			20 to 35	30	medium
	1	12 ½			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

[1]Labor costs are included, but costs of electric controllers are not included. One post per 16 feet.

[2]Fence life based on combination of post and wire life expectancy in a humid climate.

Adapted from Buschermohle et al., EP-10-95, University of Tennessee Extension, Knoxville, TN.

Life Expectancy in Years of Wood Posts

Wood Type	Untreated	Pressure Treated	Soak Treated
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

Adapted from Buschermohle et al., EP-10-95, University of Tennessee Extension, Knoxville, TN.

Post Spacing for Cattle Fences

Fence Type	Post Spacing[1], 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

[1]Driven posts are 1.7 times as strong as tamped posts.
[2]Post spacing depends upon terrain. Use battens (stays or droppers).

Adapted from Buschermohle et al., EP-10-95, University of Tennessee Extension, Knoxville, TN.

Fence Post Characteristics

Post Type	Strength	Expected Life	Initial Cost	Fire Resistance	Maintenance
Steel-T, concrete	fair	25 to 30 years	medium	good	low
Steel rod, ⅜" diameter	poor	15 to 20 years	low	good	medium
Heavy-duty fiberglass-T	fair (flexible)	25 to 30 years	high	poor	low
Light-duty fiberglass-T	poor (flexible)	15 to 20 years	low	poor	medium
Pressure-treated wood	good	30 to 35 years	medium	poor	very low
Untreated wood	good	7 to 15 years	low	poor	high

Wire Spacing for Cattle Fences

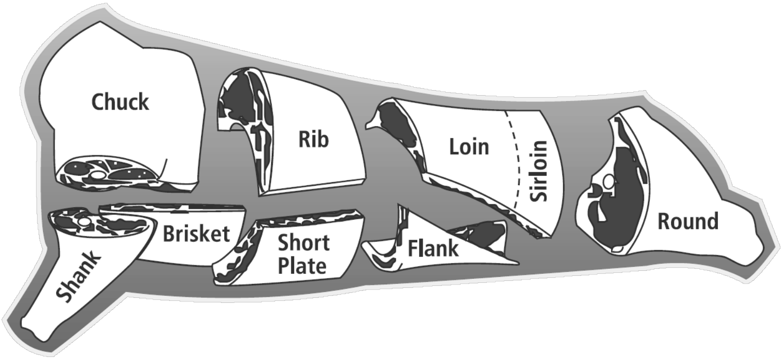
	Distance from Ground for Wire Number, Inches				
Cattle Type	Wire 1	Wire 2	Wire 3	Wire 4	Wire 5
Cows	30				
Cow and calves	17	38			
Hard-to-hold cattle	17	27	38		
Boundary fence	5	10	17	27	38

Adapted from Buschermohle et al., EP-10-95, University of Tennessee Extension, Knoxville, TN.

Hurricane Preparedness Checklist

- Gulf Coast hurricane season: June 1 to November 30
- ensure that cattle are uniquely and permanently identified
- keep good records and photos of cattle
- maintain appropriate insurance
- keep cattle current on vaccinations
- make sure trailers are in good repair
- keep fences and facilities in good repair
- gather cattle feed and health supplies
- put emergency supplies in a secure location
- cover sharp edges of equipment with hay bales or other “padding”
- secure loose items to minimize airborne hazards (fill troughs with water)
- protect feed/hay supplies from water damage
- place liquid fuel and other chemicals in secure locations
- evacuate cattle when possible
- turn cattle loose in pastures with high ground and adequate drinking water
- do not compromise human safety by checking on livestock during a storm
- beware of hazards after a storm
- inventory/inspect/treat cattle after a storm
- ensure safe water and feed supplies

Beef Carcass Primal (Wholesale) Cuts



Live Weight

- Weight of the animal just prior to harvest

Hot Carcass Weight

- Weight of the carcass after removal of the hide, head, feet, and internal organs

Dressing Percentage

Animal	Factor	Typical Dressing Percentage
Market (cull) cow	Small amount of muscle/fat	47 to 50
Grass-fed/ short-fed steer	Small amount of fat	58 to 62
Typical YG3 feedlot steer	Mostly fat	62 to 64
Overly fat/ double-muscled steer	Great amount of muscle/fat	63 to 67
Bulls	Great amount of muscle	65 to 69

Dressing % = hot carcass wt/live wt x 100

- measure of beef carcass yield

Beef Carcass Yield Grade

- classifies carcasses for differences in cutability or yield of boneless, closely trimmed retail cuts (BCTRC) from round, loin, rib, and chuck
- numbered 1 (greatest cutability) to 5 (least cutability) and rounded to nearest tenth

Yield Grade *= 2.50 + (2.5 x adjusted fat thickness, inches) + (0.2 x percentage kidney, pelvic and heart fat) + (0.0038 x hot carcass weight, pounds) – (0.32 x area of ribeye, square inches)*

Relative Yield of BCTRC

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

Factors Affecting Beef Carcass Yield Grade

Trait	Change in Trait	Resulting Yield Grade Change
Fat thickness	Increase	Increase
Percentage kidney, pelvic, and heart fat	Increase	Increase
Carcass weight	Increase	Increase
Ribeye area	Increase	Decrease

Beef Carcass Quality Grade

- determination of the eating quality of meat from a beef carcass
- determined by evaluating carcass maturity and marbling
- maturity
  - chronological age of animal
  - determined by evaluation of exposed bony cartilage and lean texture of carcass, not by birth records or actual age
  - connective tissue increases as animal ages
- marbling
  - little flecks of fat within muscle
  - intramuscular fat
  - determined by trained grader or instrument
  - improves eating quality by improving flavor, juiciness, and somewhat tenderness

USDA Maturity Scores by Cattle Age

Maturity Score	Approximate Cattle Age
A	9 to 30 months (2½ years)
B	30 to 42 months (2½ to 3½ years)
C	42 to 72 months (3½ to 6 years)
D	72 to 96 months (6 to 8 years)
E	older than 96 months (> 8 years)

Effects of Maturity and Marbling on Beef Carcass Quality Grade[1]

Degrees of Marbling	Maturity[2]				
	A[3]	B	C	D	E
Very abundant					
Abundant					
Moderately abundant					
Slightly abundant	Prime			Commercial	
Moderate					
Modest	Choice				
Small				Utility	
Slight	Select				
Traces					
Practically devoid	Standard			Cutter	

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

Standard Measurements

Length (linear measure)

1 ft = 0.3048 m = 30.48 cm = 304.8 mm
1 ft = 12 in
1 in = 0.0254 m = 2.54 cm = 25.4 mm
1 yard = 3 ft = 0.9144 m = 91.44 cm = 915.4 mm
1 m = 39.37 in = 3.2808 ft = 1.0936 yards
1 cm = 0.3937 in
1 mm = 0.03937 in
1 km = 3280.84 ft = 1093.61 yards = 0.62137 mile
1 mile = 1.609344 km = 5,280 ft = 1,760 yards
1 mile = 8 furlongs = 320 rods
1 furlong = 0.125 mile
1 rod = 16.5 ft
1 hand (equine) = 4 in = 10.16 cm

Surface (area)

1 sq ft = 144 sq in
1 sq yard = 9 sq ft
1 sq rod = 30.25 sq yards = 272.25 sq ft
1 acre = 160 sq rods = 1 rod wide & 0.5 mile long
1 acre = 43,560 sq ft = 0.4047 hectares
1 hectare = 107,639 sq ft = 2.4711 acres
1 sq acre = 208.71 ft wide & 208.71 ft long
½ sq acre = 147.58 ft wide & 147.58 ft long
¼ sq acre = 104.355 ft wide & 104.355 ft long
1 circular acre = 235.504 ft in diameter

U. S. Government Land Measures
1 township = 36 sections
1 section = 640 acres = 1 sq mile
¼ section = 160 acres = ½ mile long & wide
⅛ section = 80 acres = ½ mile long & ¼ mile wide
1/16 section = 40 acres = ¼ mile long & wide

Surveyors' Measures
1 link = 7.92 in
1 rod = 25 links
1 chain = 4 rods = 66 ft
1 acre = 10 sq chains
1 mile = 80 chains

Cubic Measure (volume)
1 cubic ft = 1,728 cubic in
1 cubic yard = 27 cubic ft
1 board ft = 1 in x 12 in x 12 in
1 cord (wood) = 128 cubic ft
1 bushel grain or shelled corn = 1.25 cubic ft
1 cubic ft grain or shelled corn = 0.8 bushels
1 bushel ear corn = 2.5 cubic ft
1 cubic ft ear corn = 0.4 bushels
1 cubic yard concrete = 81 sq ft for a 4-in floor
1 cubic yard concrete = 54 sq ft for a 6-in floor

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

Liquid Measure
1 cup = 8 fluid oz = 16 tablespoons = 0.2366 L
1 pint = 2 cups = 16 fluid oz = 0.4732 L
1 quart = 2 pints = 32 fluid oz = 0.9464 L
1 gallon = 4 quarts = 128 fluid oz = 3.7854 L
1 gallon = 0.1337 cubic ft = 231 cubic in
1 cubic ft = 7.48 gallons
1 barrel = 32 ½ gallons
1 U.S. gallon = 0.8327 imperial gallons (British)
1 imperial gallon (British) = 1.201 U.S. gallons
1 gallon water (20°C) = 8.33 lb
1 ft of water (4°C) = 0.4335 lb per sq in
1 cubic ft = 62.427 lb of water (4°C)
1 teaspoon = 0.17 fluid oz = ⅙ oz
1 tablespoon = ½ oz = 3 teaspoons
1 fluid oz = 2 tablespoons
Acre in of water = 27,154 gallons = 3,360 cubic ft

Weight
1 gram = 15.43 grains = 1,000 mg
1 oz = 28.35 grams = 437.5 grains
1 lb = 16 oz = 454 grams = 7,000 grains
1 kg = 1,000 grams = 2.205 lb
1 cwt = 100 lb
1 ton = 2,000 lb
1 ton (long) = 2,240 lb = 1.016 metric tons

Yield or Rate
1 ton (U.S.)/acre = 2.2417 tonne (metric)/hectare
1 tonne (metric)/hectare = 0.4461 ton (U.S.)/acre
1 lb/acre = 1.1209 kg/ha

Calculations
Diameter of a circle = circumference x 0.31831
Circumference of a circle = diameter x 3.1416
Area of a circle = diameter x diameter x 0.7854
Surface of a ball = diameter x diameter x 3.1416
Doubling the diameter of a pipe increases its capacity 4 times
Degrees Fahrenheit = (1.8 x degrees C) +32
Degrees Centigrade = (degrees F – 32) x 0.56

Metrix Prefixes
mega = 1,000,000
kilo = 1,000
hecto = 100
deca = 10
basic metric unit = 1
deci = 0.1 = 1/10
centi = 0.01 = 1/100
milli = 0.001 = 1/1,000
micro = 0.000001 = 1/1,000,000

Adapted from D. Hofstrand. 2007. Agricultural Measurements and Conversions. File C6-84. Iowa State University Extension. Ames, IA.

Information Resources

Mississippi State University Extension Service
Animal and Dairy Sciences Department
Box 9815, Mississippi State, MS 39762
662-325-3516, 662-325-2802

MSUcares Beef Cattle Website
msucares.com/livestock/beef

Mississippi Beef Cattle Improvement Association
msucares.com/livestock/beef/mbcia

MS State Univ. Dept. of Animal and Dairy Sciences
www.msstate.edu/dept/ads

Mississippi State Univ. College of Veterinary Medicine
240 Wise Center Drive, P. O. Box 6100
Mississippi State, MS 39762
662-325-3432
www.cvm.msstate.edu

Mississippi Cattlemen's Association
680 Monroe Street, Suite A
Jackson, MS 39202
601-354-8951
www.mscattlemen.org

Mississippi Beef Council
Same address as Mississippi Cattlemen's Association
601-353-4520
www.msbeef.org

Mississippi Farm Bureau Federation
6311 Ridgewood Road
Jackson, MS 39211
601-957-3200, 800-227-8244
www.msfb.com

Mississippi Department of Agriculture and Commerce
121 North Jefferson Street
Jackson, MS 39201
601-359-1100
www.mdac.state.ms.us

Mississippi Board of Animal Health
P. O. Box 3889
Jackson, MS 39207
601-359-1170, 888-646-8731
Animal Disaster Hotline: 888-722-3106
www.mbah.state.ms.us

Mississippi Market Bulletin
P.O. Box 1118
Jackson, MS 39215
601-359-1123
www.msmarketbulletin.org

Mississippi Coliseum and Fair Grounds
1207 Mississippi Street
Jackson, MS 39202
601-961-4000

Mississippi Beef Cattle Seedstock Directory
msucares.com/livestock/beef/seedstock.html

Mississippi Commodity Feed Directory
msucares.com/livestock/beef/feedsources.html

Mississippi Hay Directory
msucares.com/livestock/beef/mshay.html

Mississippi State Chemical Laboratory
1145 Hand Lab, 310 President's Cr, P.O. Box CR
Mississippi State, MS 39762-5622
662-325-3428
www.mscl.msstate.edu

Mississippi Agricultural Statistics Service
www.nass.usda.gov/Statistics_by_State/Mississippi

USDA Memphis Weekly Feed Report
www.ams.usda.gov/mnreports/lr_gr210.txt

USDA Southeast Weekly Hay Report
www.ams.usda.gov/mnreports/MG_GR310.txt

Beef Improvement Federation
www.beefimprovement.org

National Beef Cattle Evaluation Consortium
www.nbcec.org

Ultrasound Guidelines Council
www.ultrasoundbeef.com

Cattle Learning Center
www.cattlelearningcenter.org

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By **Dr. Jane A. Parish**, Associate Extension Professor, and **Dr. Brandi M. Bourg**, Assistant Extension/Research Professor, Animal and Dairy Sciences.

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MSUcares.com

Mississippi Beef Cattle Improvement Association

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