MP184

Beef Cattle Production

DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

University of Arkansas, United States Department of Agriculture, and County Governments Cooperating

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Chapter 1

Introduction

All Cattle and Calves

As of January 1, 2015, Arkansas' inventory of cattle and calves was 1.6 million head (Table 1-1). The record for herd size in the state was recorded on January 1, 1975, with a total of 2.68 million head. Cattle production ranks as the fourth highest income-producing commodity in Arkansas (Figure 1-1). Cash receipts from the marketing of cattle and calves in the state in 2014 were $766 million.

Arkansas is a cow-calf state. Most cattle producers are in the business of selling calves from their herd for further growth and finishing in feedlots. A certain portion, about 20 percent, of the calves are kept to replenish the breeding herd, with the remainder shipped to other states for finishing and slaughter. Arkansas' climate and most of its soil and terrain are suited for the production of grass and other forage necessary for this type of cattle production. Many areas in Arkansas are suited for grazing stocker calves on winter pastures of wheat and other cool-season grasses. Stocker cattle are put on pasture to increase size before placement in feedlots. The stocker calves will eventually go to feedlots in the Plains. Cattle production is a good way to use land not suited for crop production. Arkansas cattle are of the quality and type that have a ready market.

TABLE 1-1. Beef Cattle Numbers in Arkansas

Year	Total Inventory[1]	Beef Cows[2]	Calf Crop[3]
2015	1,640[4]	863[4]	
2014	1,650	862	750[4]
2013	1,600	851	760
2012	1,670	909	760
2011	1,720	928	800
2010	1,910	937	800
2009	1,800	905	820
2008	1,810	960	770
2007	1,750	940	820
2006	1,710	920	800
2005	1,860	990	850

[1]All cattle and calves
[2]Cows and heifers that have calved
[3]During previous year
[4]Thousands head

Source: *Arkansas Agricultural Statistics Service*

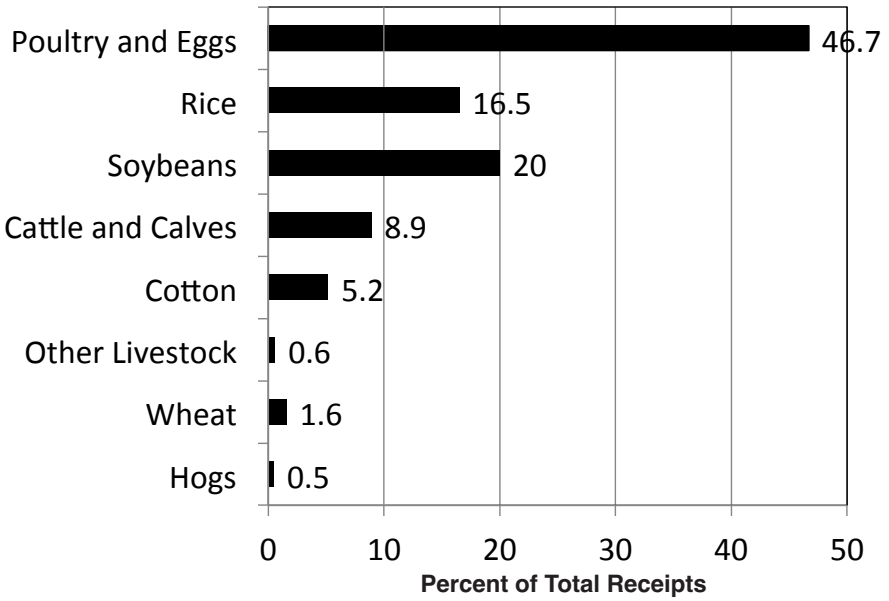


FIGURE 1-1. Cash receipts in Arkansas – 2014 (as a percent of total receipts).
Source: *Arkansas Agricultural Statistics Service*

Although cattle herds can be found in every county in the state, the greatest concentration of beef cattle production is in the Ozark Mountains of northwest Arkansas (Figure 1-2). This region accounts for roughly 54 percent of the total beef cow numbers. Benton and Washington Counties are the two largest counties in terms of all cattle and calves numbers, 120,000 and 86,000 head, respectively. The Ouachita Mountain region, in west central and southwest Arkansas, accounts for over 30 percent of the beef cow numbers (Figure 1-3). These areas provide good pasture growth for native and improved grasses, thanks to the combination of timely rainfall and soil type. Also, these areas produce the hay needed for feeding cattle during the winter months when pastures are dormant.

Raising cattle lends itself well to other agricultural enterprises. Poultry production and beef cattle fit well together on the same operation. Poultry production, especially broilers, requires small amounts of land for production facilities but requires a method of waste product disposal. Cattle production requires land, which can be around and among poultry facilities, and the land benefits from waste products of the poultry enterprise as pasture fertilizer. These enterprises complement each other in labor requirements. Labor is not intensive on a continual basis for each enterprise.

Arkansas produces a wide diversity of breeds of cattle. These include traditional European breeds: Hereford, Angus and Shorthorn; the Indian breed: Brahman; the Exotic: Charolais, Limousin, Simmental, etc.; and the U.S. breeds: Brangus, Beefmaster, etc. There is no perfect breed for the state. Selection of breed is based on personal preference, environmental conditions, adaptability, longevity, reproductive efficiency, milking ability, size, ability to gain weight and other traits that fit personal preferences. All of these breeds, as well as commercial-type cattle, thrive in the hospitable climate of Arkansas. Commercial cattle are mixtures of two or more pure breeds. Each breed in the combination is selected for certain traits, e.g., a Hereford and Brahman cross is used in the more humid areas of the state. Brahman adapts well to heat, and Hereford is used to maintain carcass quality and feed conversion.

Cattle production continues to be a flourishing enterprise in Arkansas. Improvements in the production of cattle, pastures and marketing ensure that this enterprise continues to be a major part of Arkansas agriculture.

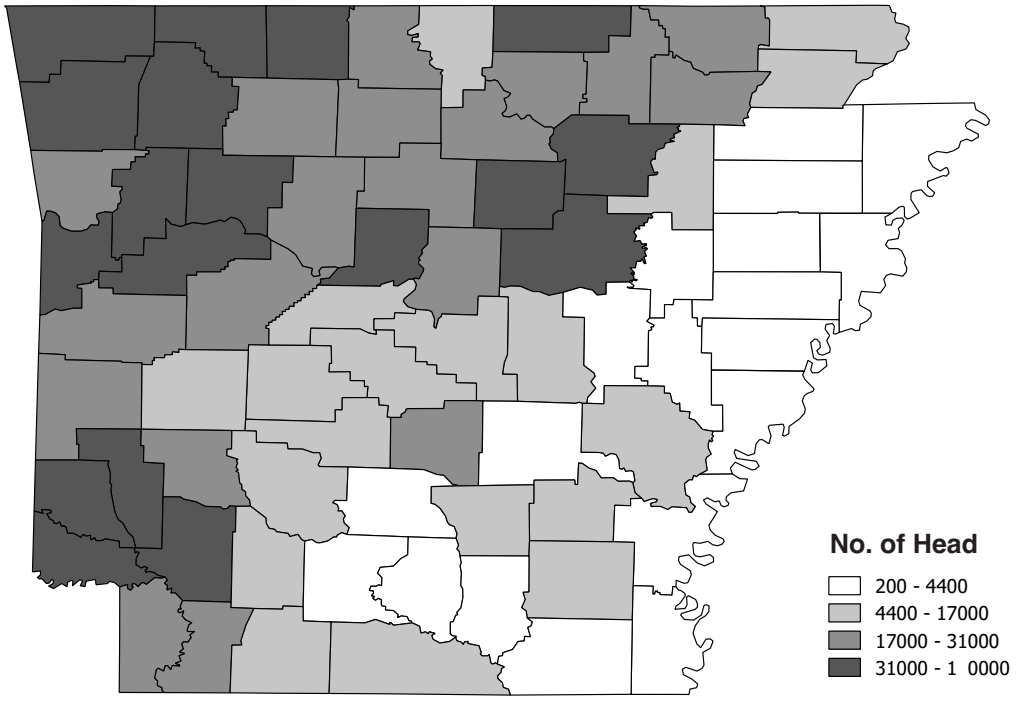


FIGURE 1-2. All cattle and calves on Arkansas farms. January 1, 2015

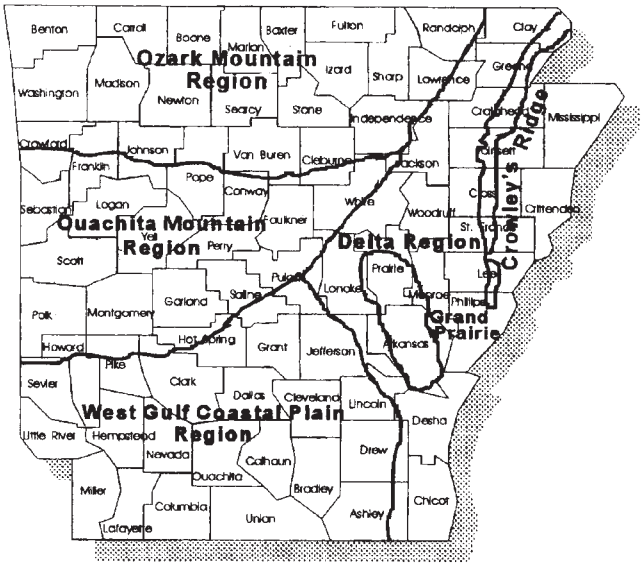


FIGURE 1-3. Geological regions of Arkansas.

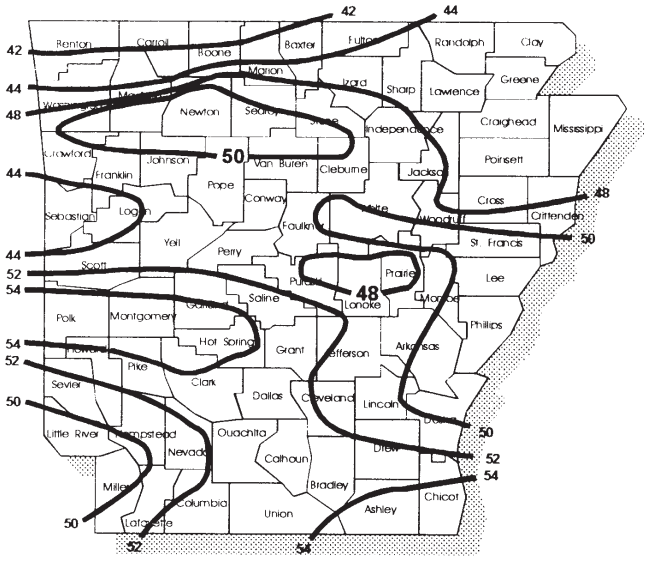


FIGURE 1-4. Mean annual precipitation (inches).

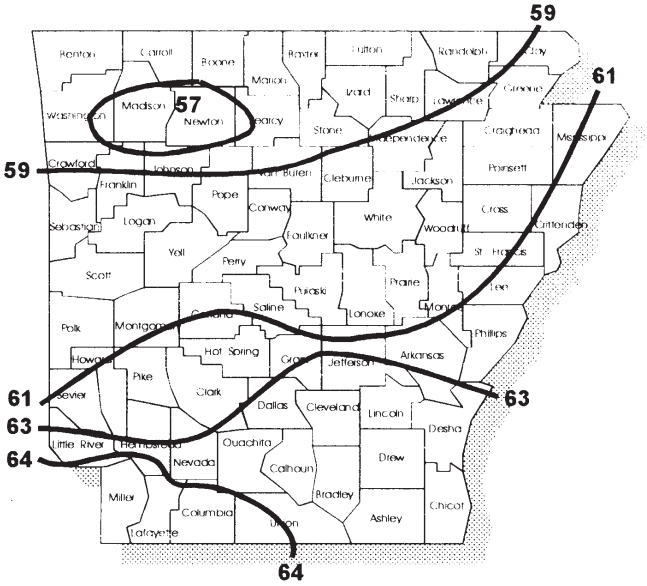


FIGURE 1-5. Annual mean temperature (˚F).

Chapter 2

Systems of Beef Cattle Production

Systems of commercial beef cattle production may be divided into three general categories: (1) the cow-calf segment which produces weaned feeder calves for further grazing and/or feeding, (2) the backgrounding or stocker phase of production in which body weight is added to recently weaned calves, resulting in feedlot-ready yearlings and (3) the finishing phase of production in which cattle are fattened for slaughter.

The cow-calf and backgrounding categories are best suited for Arkansas conditions. Both calf and yearling production utilize forages as the primary feed. The climate, soil and terrain in Arkansas are well suited for forage production. Many cattle producers view their cattle enterprise as a way to market forage, their greatest resource.

In contrast to feeder calf and stocker production, finishing cattle for slaughter requires large amounts of feed grains and a relatively dry climate. Feed grain production in Arkansas is not sufficient to finish large numbers of cattle. Large quantities of feed grains are shipped in from other states to supply the poultry and swine industries. Furthermore, the Arkansas climate is not well suited to cattle feeding due to excessive rainfall and accompanying mud in the winter, and high heat and humidity in the summer. Situations do exist in which cattle can be profitably finished in Arkansas, but it is generally more efficient to transport feeder and yearling cattle from Arkansas to cattle-feeding states where feed is more abundant and the climate is more desirable for finishing cattle.

Cow-Calf Phase
(Feeder Calf Production)

In 2015, Arkansas had 863,000 beef cows on approximately 23,000 farms. Feeder calf production provides a supplemental source of income for many Arkansans. Although certain parts of the year (e.g., calving season and fall roundup) can be relatively labor intensive, a minimum amount of labor is generally required.

Two important factors that affect the profitability of a cow-calf enterprise are (1) calf crop percentage and (2) calf weaning weight. Together, these two factors represent the reproductive efficiency of a herd, which is defined as the total number of pounds of calf weaned divided by the number of cows exposed during the breeding season. Table 2-1 illustrates the influence of calf crop percentage and weaning weight on productivity of any given herd.

TABLE 2-1. Total Pounds of Calf Produced Per Cow

Calf Crop Percentage	Weaning Weight		
	600	500	400
100	600	500	400
95	570	475	380
90	540	450	360
85	510	425	340

Calf crop percentage varies widely throughout Arkansas. Overall, calf weaning weights have increased over the last several years; however, improving reproductive performance and thus calf crop percentage presents a larger challenge. Calf crop percentage is affected more by herd management than by individual animal performance traits.

The failure of cows to become pregnant and the loss of calves at or shortly after parturition are the leading causes of low calf crop percentages. Proper nutrition during late gestation and during the early postpartum period has a tremendous impact on conception and pregnancy rates of cows. Likewise, close observation and timely intervention and management can greatly reduce the number of calves lost during the calving season.

Cow-calf producers should strive for at least a 90 percent calf crop, and an emphasis should be placed on cows delivering a live calf every 12 months. Cows that calve at intervals greater than 12 months are usually not profitable.

Feeder calves that typically bring a premium price at cattle auctions are medium- to large-framed, #1 muscled, crossbred calves. The following types of calves are usually discounted at the market: light-muscled calves with poor structure and conformation, calves that are too small (early-maturing) or too large (late-maturing), calves with too much flesh,

FIGURE 2-1. Typical crossbred cow.

straightbred calves and calves with horns. Also, steer calves are usually 10 cents per pound higher than heifer calves and 4 to 6 cents per pound higher than bull calves.

The ideal time of year for calving season in any given cow-calf operation depends on the forage and/or feed supply, available labor and the intended marketing dates. More important than the time of calving season is a controlled, scheduled calving season (60 to 90 days), as opposed to a year-round calving season. With a controlled, scheduled calving season, (1) most herd management practices can be performed at the same time, (2) use of time and labor can be more concentrated and efficient, (3) slow- or non-breeding cows can be more easily identified and (4) a more uniform calf crop can be produced.

In Arkansas, most calves are born in late winter or spring and marketed in the fall. Late winter calving fits a slack labor period on most farms, and this system makes use of abundant summer pasture. Cows are on pasture during the breeding season, thus forages are heavily utilized. Also, in this system most cows are non-lactating and thus have their lowest nutritional requirements in midwinter (a point in time when feed costs are highest). The demand for calves to graze winter annual pasture is usually strong in the fall, but this is also when most feeder calves are marketed, so calf prices often weaken during the fall.

Fall calving is better suited for some operations. In this system, calves are born in mid to late fall (September and October) and marketed anywhere from late spring to early summer. Calves are old and large enough by spring and early summer to utilize grass pastures. Fall calves are typically heavier at weaning than spring calves, but the greater cost of feeding a lactating cow (the stage of production where her nutrient requirements are highest) through the winter may offset any additional value in the heavier calf. Also, fall calving may interfere with harvesting field crops on some farms.

Maintenance of accurate and complete records is an often overlooked but yet an important part of cow-calf management. These records should include calving dates, calving intervals, production costs and proper identification of cows and calves so that calf weaning weights can be traced back to each dam. Commercial computer software is available that is specifically designed for record keeping in cow-calf herds.

The successful cow-calf operation depends on permanent pasture or other low-cost roughage for feed. To optimize production, other recommended management strategies such as the use of growth implants, ionophores, dewormers, etc., should be followed.

Backgrounding Phase
(Stocker Cattle Production)

Backgrounding may be most often defined as the process of growing and developing calves from weaning weights (450 to 600 lb) to yearling weights of 700 to 850 lb when the cattle are ready to enter a feedyard for finishing. As a rule, starting with lighter, thinner calves is more profitable. Basic principles involved in backgrounding beef cattle are (1) adding 200 to 300 pounds of weight per calf, (2) extensive and intensive use of high-quality forage rather than the more expensive high-energy feed sources, (3) assembly of calves into more marketable groups – uniformity in breeding, gender, weight and quality and (4) more marketing flexibility for calf/yearling owners. The backgrounding phase usually represents a period of efficient, predominantly lean growth.

Arkansas' forage resources make it well suited for backgrounding cattle. There is tremendous potential for winter grazing either wheat, rye, ryegrass or combinations thereof. Young calves that have just been weaned perform well on high-quality forage. Fescue provides a good permanent winter pasture but must be supplemented with grain for stocker calves to make adequate growth. Average daily gains from 1.5 to 2.25 lb/day should be targeted in a backgrounding operation.

Several variations of production systems exist for producers. Some cow-calf producers may choose to sell their heaviest calves at weaning and background their lighter calves (in addition to purchased light calves) to heavier weights before selling them. This option spreads out cash flow and market risks.

Other backgrounding systems besides the more standard fall to spring method include a program in which fall-weaned calves are "roughed" through the

FIGURE 2-2. Typical feeder calves.

winter with minimal inputs and costs, then placed on spring and summer pasture where they achieve efficient, compensatory growth, and then marketed in the fall. "Pay day" is delayed with this system, but it makes good use of summer pasture.

While most backgrounding operations utilize grass for feed, some producers (especially in the major cropland areas of Arkansas) develop calves on harvested forages. For example, hay or corn silage, when supplemented with the necessary grain and protein supplement for a balanced ration, can be fed to enable calves to grow but not fatten. The cost of gain in this type of program is typically higher than when the cattle are allowed to harvest forage; however, when grain prices are low, this approach has some merit.

Finishing/Feedlot Phase

Cattle are usually finished for slaughter confined in a drylot on full feed with grain and limited roughage. Cattle usually go on feed as yearlings weighing 700 to 850 lb, average gaining 3 lb or more per day in the feedlot and finish weighing between 1,250 and 1,400 lb. Most cattle feeders strive for a finish sufficient to grade U.S. Choice. The feeding period often spans 180 days, although large-framed, late-maturing cattle require a longer period and small-framed, early-maturing cattle finish sooner.

Calves that wean at heavy weights (650 to 750 lb) may be placed directly into the feedlot and finished for slaughter over a 180- to 200-day period. The finishing ration is usually altered for calves to include more roughage and less concentrate early in the feeding period, but working up to high concentrate feeding during the last 120 days.

Some Arkansas producers have had success finishing cattle with grain while they are still on pasture (i.e., "grain on grass"). This system typically does not achieve the high degree of finish that is attained in the feedlot since roughage consumption is difficult to control and the cattle expend energy during movement within the pasture.

The Purebred Herd

Purebred herds are important for providing breeding stock to commercial cattle producers. Purebred cattle production is a long-term endeavor. Progress in beef cattle improvement through selection and culling is slow. Many top purebred breeders have been in business over 20 years.

The successful purebred breeder should have a good understanding of animal breeding and nutrition and be dedicated to improving the breed. Progressive purebred breeders use artificial insemination, EPDs (expected progeny differences), cow herd performance records, performance test young bulls, obtain carcass data on offspring of sires, ultrasound scan yearling cattle for carcass measures and, in some cases, utilize embryo transfer and genetic testing.

FIGURE 2-3. Purebred Hereford bull.

Breeding purebred cattle requires a greater capital outlay to get established and more money to operate than a commercial herd. Bulls suitable for herd improvement are often more costly to buy. The value of the average cow and the cost to properly raise and develop purebred calves are greater than in a commercial herd. Advertising to attract potential buyers is expense purebred breeders have that is rarely a part of commercial production. In addition, purebred breeders must maintain extensive pedigree and performance records for the buyers' use in selection. Facilities must be attractive and well kept to display the cattle well. Maintaining a high level of customer service is also essential in building a strong customer base.

A person entering purebred cattle production should consider the expense, the long-term requirements and exacting demands of purebred cattle production. These considerations should be balanced against greater financial returns, personal satisfaction and possible prestige in a successful purebred business.

Chapter 3

Beef Cattle Selection

The goal of beef cattle production is to provide highly desirable beef for consumption in the most efficient manner. Knowledge of breeding, feeding, management, disease control and the beef market is fundamental to the economical production of desirable beef.

The beef cattle industry is composed of six basic segments: (1) the purebred breeder, (2) the commercial producer, (3) stocker or backgrounding operations, (4) the cattle feeder, (5) the beef packer and (6) the retailer. The purebred breeder maintains seedstock to provide bulls and, occasionally, females for the commercial producer. The commercial producer provides feeder calves and yearlings to the stocker operator who, in turn, furnishes the cattle feeder who provides the packer with finished cattle ready for slaughter. The packer slaughters the cattle and provides the retailer with either dressed carcasses or wholesale cuts from these carcasses. The retailer cuts, trims and packages the beef for the consumer. Interdependence exists among these segments because each affects cost of production or desirability of product or both. The profits that accrue to all segments of the beef cattle industry depend on continued improvement in productive efficiency and carcass merit.

Major Performance Traits

All traits of economic value should be considered when selecting beef cattle. The major traits influencing productive efficiency of desirable beef are:

- reproductive performance or fertility
- maternal ability
- growth rate
- feed efficiency
- body measurements
- longevity
- carcass merit, and
- conformation or structural soundness

Maximum production efficiency is not necessarily related to maximum performance levels in all of these traits due to unfavorable genetic associations between certain traits. For example, high levels of milk production and large cow size are associated with rapid growth rate in the calf but are not desirable when feed supplies are limited because reproduction in the cow is adversely affected.

Fertility

A high level of fertility, or reproductive performance, is fundamental to an efficient beef cattle enterprise. Fertility is commonly measured in terms of calf crop percentage, and no single factor in commercial cow-calf operations has greater bearing on production efficiency than the number of calves weaned per cow in the herd. The percentage calf crop can easily range from 70 to 95 percent. However, as noted in Table 4-1 in Chapter 4 (Animal Breeding), the heritability of calving interval or fertility is low (10 percent). Therefore, most of the variation in calving percentage results from environmental factors such as feeding, management or herd health.

Fertility is a complex trait. Many environmental and genetic factors affect fertility from the time a cow is turned with a bull until her calf is weaned. Basic cow herd records should report calf crop percentage to determine if a problem exists. Where fertility or calf crop percentage is low, very detailed records should be kept on reproductive traits to identify management, nutrition, herd health or genetic problems that can be modified to improve reproductive performance in the herd.

The association between fertility and other performance traits, both positive and negative, should be recognized. For example, selection for heavy weaning weight can result in increased milk production or larger cow size in the herd or both and necessitate a higher nutritional level for the cow herd to maintain a satisfactory fertility level. On the other hand, culling open cows or problem breeders to improve reproductive performance in the herd with no regard for the specific cause for low reproductive performance will decrease the average milk production and cow size in the herd. Also, increased birth weight is associated with increased rate of gain and mature size. Calving difficulty as a result of heavy birth weights can cut deeply into calf crop weaned by reducing calf survival at birth and conception rate in the cow the following breeding season.

Maternal Ability

The ability of a cow to wean a healthy, vigorous calf is vital to efficient beef production. Increased milk production increases weaning weight per calf, and heavier weaning weights can increase efficiency of production in relation to fixed costs for the total herd.

However, feed requirements and costs per cow are closely related to cow size and level of milk production. Thus, milk production must be matched with feed resources to maximize efficiency of production. Optimum milk production is neither maximum nor minimum milk production in most situations. Increased weaning weight per calf from milk production can be detrimental if weaning weight per cow is reduced as a result of poor rebreeding performance or market value is diminished by a wasty condition.

Growth Rate

Growth rate is important because of its high association with economy of gain in relation to fixed costs. Growth rate has usually been measured in time-constant, post-weaning feeding tests. A reasonably high level of feeding for at least 112 days is desirable to appraise differences in growth rate most accurately.

Genetic correlations among measures of growth or size at different ages usually are high. Selection for rapid rate of gain in post-weaning feeding tests usually increases both birth weight and mature size. Increases in birth weight contribute to increased calving difficulty. Increased mature size decreases carcass quality when slaughtered at normal market weights and increases the nutrient requirements for maintenance of the cow herd.

Ideally, the beef animal should be of moderate weight at birth, grow rapidly, but mature and finish for slaughter early. But, the selection criterion to obtain such a growth curve is complex.

Feed Efficiency

Feed efficiency is a trait of great economic importance in beef cattle. Feed efficiency is difficult to evaluate because individual feeding and adjustments for differences in weight are required. Increased weight is associated with higher feed requirements per unit of gain. To be meaningful, feed efficiency should be measured in feeding tests designed within the framework of present-day cattle feeding and marketing practices.

Breeders largely depend on differences in rate of gain as an indicator of feed efficiency rather than incur the added expense of individual feeding. Some bull testing stations obtain individual feed consumption information to measure the pounds of feed required per pound of animal gain.

Body Measurements

Objective body measurements can be useful selection aids. Some common measurements of cattle include backfat, height at the shoulder, height at the hips, length of body, depth of body, scrotal circumference and pelvic size.

Linear body measurements are helpful in matching mature animal size to production resources. Body measurements were never intended to be used only for the purpose of selecting for a larger size. These measurements should also never be interpreted as a replacement for the weight of a beef animal at a given age. No one specific size for an animal will be ideal for all feed and management resources, breeding systems and feed costs. Reproductive rate and market weight ultimately determine the optimum range in size for a given set of feed and management resources, breeding systems and production costs.

Hip height measurement is the most commonly used body measurement in selection programs. The recommended point for measurement of height is directly over the hip bones, or hooks (Figure 3-1). These measurements may be converted to frame scores using the bull and heifer hip height tables in the Appendix.

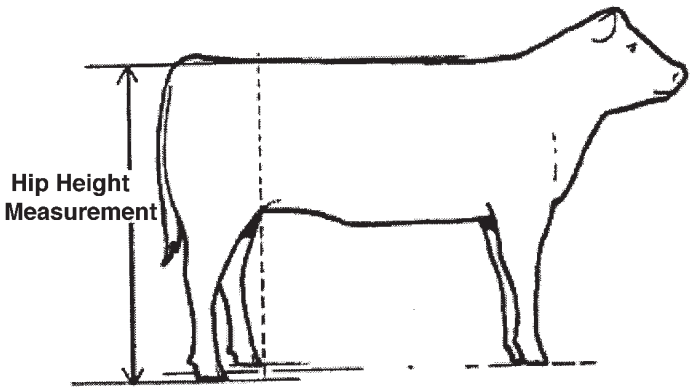


FIGURE 3-1. Hip height measurement.

Longevity

The longer animals remain productive in a herd, the fewer replacements will be needed. Thus, the cost of growing replacements to productive age is reduced. Longevity is especially important in the commercial cattle herd.

The major factors affecting longevity of cows are infertility, unsoundness of feet and legs, udder troubles and unsound mouth.

Purebred breeders should be concerned with making genetic improvement in longevity for the benefit of the commercial beef cattle population. However, animals retained in purebred herds to an old age increase the generation interval which reduces the possible rate of genetic improvement from selection. Selection for longevity should be confined primarily to such indicators as structural soundness.

Carcass Merit

Carcass merit is of basic importance to the beef cattle industry. The desirability of the beef product

determines the price consumers are willing to pay and the amount they are willing to purchase at that price.

Consumers desire beef with a high percentage of lean as compared to fat and bone, and the lean must be tender, flavorful and juicy. The difference in the percentage of lean, often called cutability, is a major factor influencing differences in carcass value. It is not uncommon for carcasses of the same quality to range from 10 to 30 percent fat trim. However, such differences in composition are due to both environmental and genetic variations.

Beef quality, which includes such characteristics as tenderness, flavor and juiciness, can have an important influence on consumer acceptance and value. Beef quality is determined by marbling, texture, color, firmness and maturity.

The genetic association between cutability and quality is negative. Selection for high quality will usually diminish cutability, and selection for high cutability will often lower beef quality. Also, selection for rate of gain or mature size often will diminish carcass quality.

Conformation and Structural Soundness

Conformation and structural soundness are performance traits to the extent that they contribute to functionality and longevity, feed efficiency and carcass merit. Conformation in live cattle is normally a subjective evaluation of thickness of natural fleshing or muscling. Differences in conformation or muscling can be used to reflect potential differences in carcass cutability without having to obtain carcass data. Also, feed efficiency relates to muscling among cattle of similar growth pattern and mature size. Structural soundness is particularly important for productive grazing and pasture breeding. Sound hips, hocks, shoulders and feet are valuable for longevity in the herd.

Selection Methods

Three approaches to selection are (1) tandem selection, (2) selection based on independent culling levels and (3) selection based on an index of net merit.

Tandem is selection in which useful traits are selected sequentially. When the desired level of performance is reached in one trait, a second trait is given primary emphasis, etc. This is the least effective of the three types of selection. Its major disadvantage is that by selecting for only one trait at a time, other traits may suffer as a result. This method of single trait selection is not recommended.

Selection based on independent culling levels requires that specific levels of performance be obtained in each trait before an animal is kept for replacement. This is the second most effective type of selection. However, selecting for specific levels of performance in all traits does not allow for slightly substandard performance in one trait to be offset by superior performance in another.

Selection based on an index of net merit gives weight to the traits in proportion to their relative economic importance and their heritability and recognizes the genetic association among traits. This can be the most effective type of selection, but the importance of each individual trait in the index should vary depending upon the needs and desires of each individual producer. This balanced selection approach considers multiple economically relevant traits at one time. The dollar ($) EPDs that many breed associations calculate are based upon this selection principle.

Buying a Herd Bull

Purchasing the next herd sire is one of the most important decisions that a cattle producer makes. Because every calf in the herd gets half of its genetic makeup from the sire and half from its dam, the sire is said to be half the herd. In actuality, studies of selection experiments have shown that the sire may be responsible for as much as 90 percent of the change in a trait such as weaning weight. The sire influences the herd in two ways. First, he changes the current calf crop. Secondly, he influences later calf crops through daughters that are retained for use as brood cows. The sire's influence may be either in a positive or negative direction. A commercial cattle producer should consider many questions when buying a bull.

1. Should I buy a performance-tested bull?

Performance testing is nothing more than keeping a record of performance on the traits of interest and using these records to make selection decisions. Performance testing programs provide cattle producers with reliable information for identifying animals with superior genetic potential for the traits of production measured by the test. By using the information as a basis for herd sire selection, a breeder can greatly increase the chances of obtaining a bull that will sire rapid-gaining, more efficient, high-quality calves. Such calves can increase profits for both the breeder and the feeder.

2. Do I buy a young bull or an older proven bull?

Usually more weanling and yearling bulls are available to select from than older, proven bulls. Obviously, more performance information is available on an older bull; but in some cases, the older bull is for sale because of poor performance. Occasionally, an

outstanding older bull is for sale by a breeder that has retained replacement heifers from him. Usually, buying yearling bulls will offer the greatest number of bulls with the most complete records from which to select. Use of virgin bulls is helpful in limiting the introduction of diseases into the breeding herd.

3. What performance information should I expect?

The records maintained by purebred breeders range from none to very elaborate record keeping systems. Basic performance information should include birth date, birth weight, weaning weight, yearling weight and number in the contemporary group on all bulls. Sufficient records to evaluate the bull's sire and dam are preferred. Expected progeny differences (EPDs) are a valuable selection tool that should be used when available. Structural soundness, type and conformation can be evaluated visually. Always conduct a breeding soundness evaluation on yearling or older bulls.

4. What performance levels should I require in the bull?

When selecting a herd sire, buy bulls that are above average of the respective breed in the traits of interest. Individual records are meaningful but may be greatly influenced by the environment in which the bull was tested. Comparison to other animals tested in the same environment provides some indication of genetic difference. EPDs give estimations of genetic merit for many economically relevant traits and allow comparisons to be made between bulls within the same breed or with breed averages.

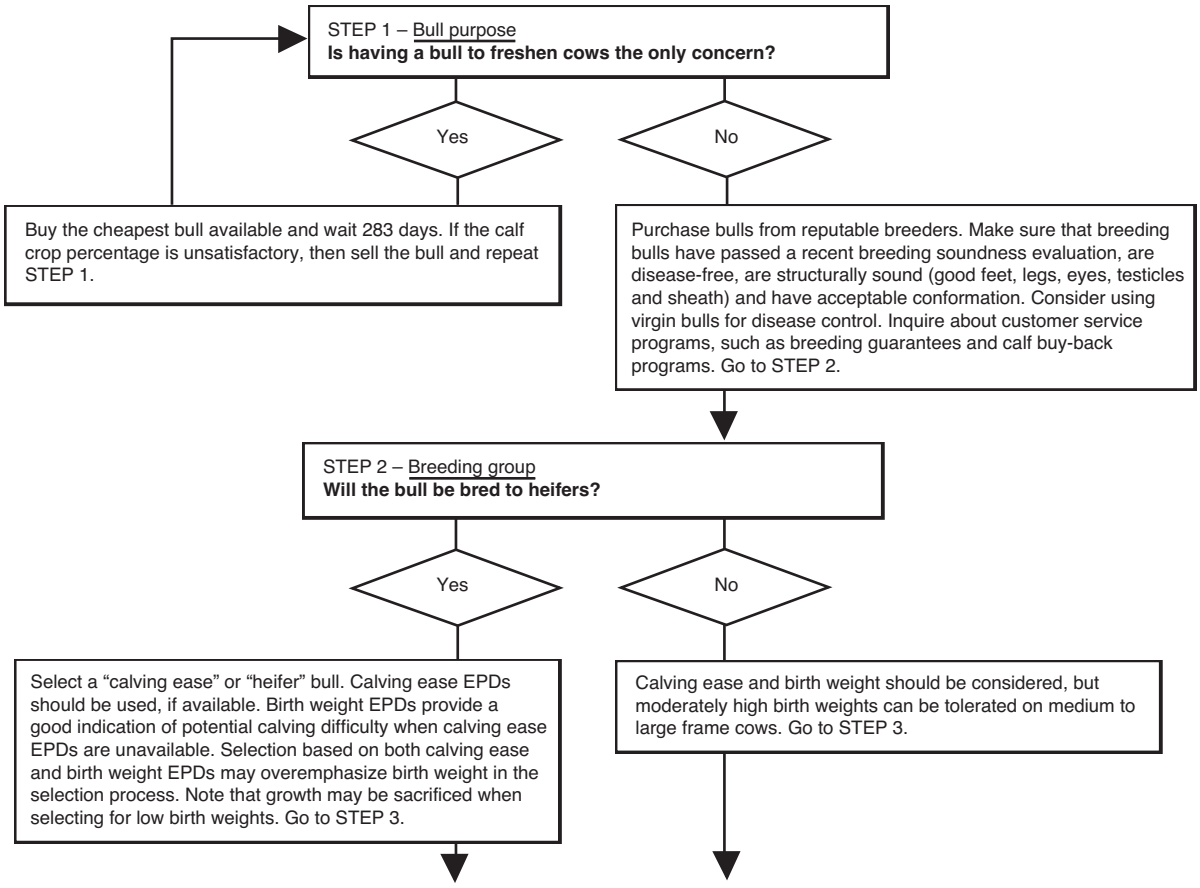
5. What about performance by the bull's sire and dam?

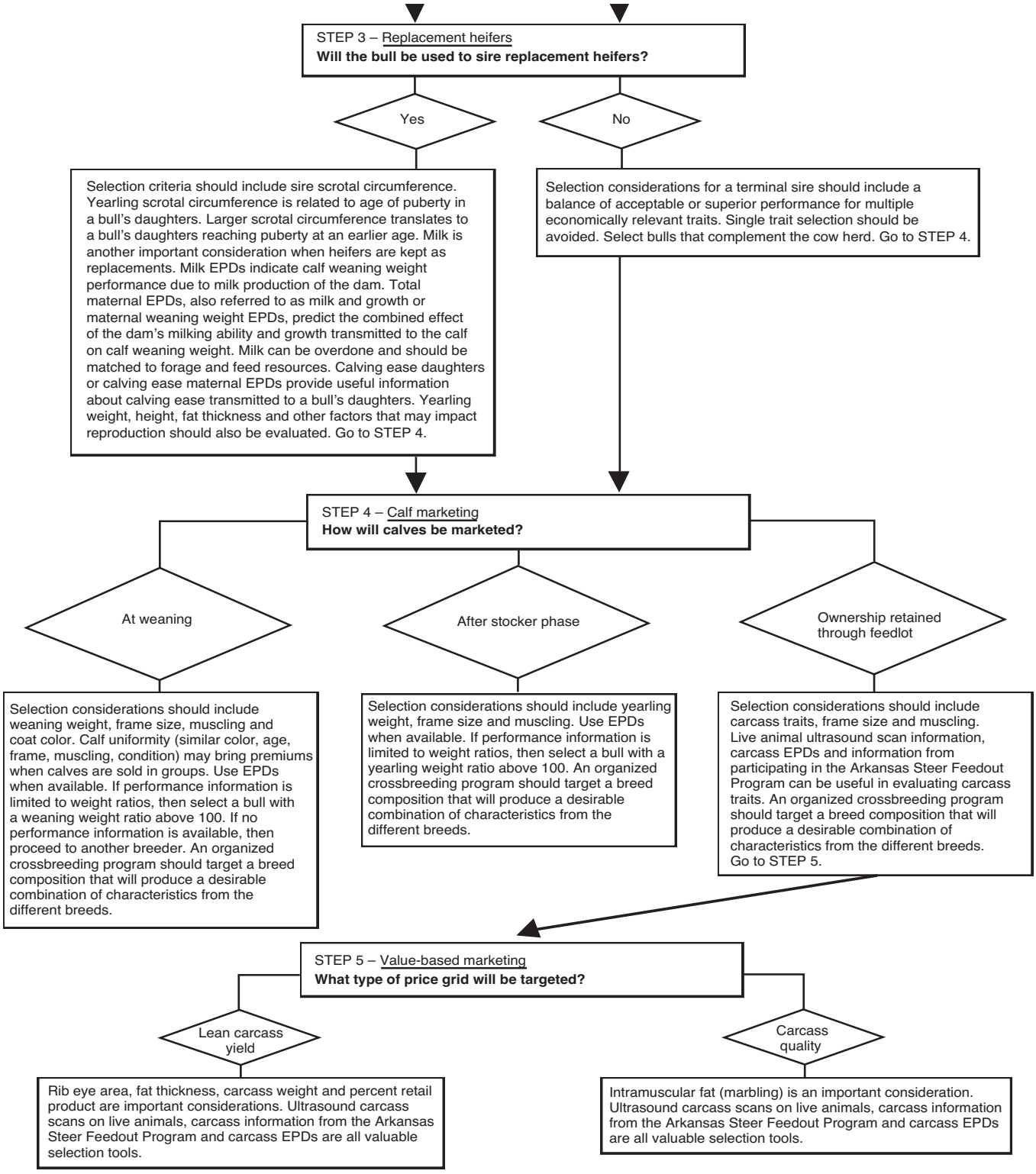
The herd sire should come from a cow that has been a regular producer, has consistently weaned calves heavier than the herd average and is strong structurally. The sire should be an outstanding individual in the desired performance traits and should have proven ability to transmit his characteristics to his offspring.

6. How much is a bull worth?

Performance information along with EPDs gives an indication of the expected performance of a bull's calves for particular traits such as growth performance relative to the performance of calves sired by

FIGURE 3-2. Bull Selection Decision Flow Chart




STEP 3 – Replacement heifers
Will the bull be used to sire replacement heifers?
Yes
No
Selection criteria should include sire scrotal circumference. Yearling scrotal circumference is related to age of puberty in a bull's daughters. Larger scrotal circumference translates to a bull's daughters reaching puberty at an earlier age. Milk is another important consideration when heifers are kept as replacements. Milk EPDs indicate calf weaning weight performance due to milk production of the dam. Total maternal EPDs, also referred to as milk and growth or maternal weaning weight EPDs, predict the combined effect of the dam's milking ability and growth transmitted to the calf on calf weaning weight. Milk can be overdone and should be matched to forage and feed resources. Calving ease daughters or calving ease maternal EPDs provide useful information about calving ease transmitted to a bull's daughters. Yearling weight, height, fat thickness and other factors that may impact reproduction should also be evaluated. Go to STEP 4.
Selection considerations for a terminal sire should include a balance of acceptable or superior performance for multiple economically relevant traits. Single trait selection should be avoided. Select bulls that complement the cow herd. Go to STEP 4.
STEP 4 – Calf marketing
How will calves be marketed?
At weaning
After stocker phase
Ownership retained through feedlot
Selection considerations should include weaning weight, frame size, muscling and coat color. Calf uniformity (similar color, age, frame, muscling, condition) may bring premiums when calves are sold in groups. Use EPDs when available. If performance information is limited to weight ratios, then select a bull with a weaning weight ratio above 100. If no performance information is available, then proceed to another breeder. An organized crossbreeding program should target a breed composition that will produce a desirable combination of characteristics from the different breeds.
Selection considerations should include yearling weight, frame size and muscling. Use EPDs when available. If performance information is limited to weight ratios, then select a bull with a yearling weight ratio above 100. An organized crossbreeding program should target a breed composition that will produce a desirable combination of characteristics from the different breeds.
Selection considerations should include carcass traits, frame size and muscling. Live animal ultrasound scan information, carcass EPDs and information from participating in the Arkansas Steer Feedout Program can be useful in evaluating carcass traits. An organized crossbreeding program should target a breed composition that will produce a desirable combination of characteristics from the different breeds. Go to STEP 5.
STEP 5 – Value-based marketing
What type of price grid will be targeted?
Lean carcass yield
Carcass quality
Rib eye area, fat thickness, carcass weight and percent retail product are important considerations. Ultrasound carcass scans on live animals, carcass information from the Arkansas Steer Feedout Program and carcass EPDs are all valuable selection tools.
Intramuscular fat (marbling) is an important consideration. Ultrasound carcass scans on live animals, carcass information from the Arkansas Steer Feedout Program and carcass EPDs are all valuable selection tools.

another bull or group of bulls. Using this information, educated purchasing decisions can be made regarding the purchase price differences that can be justified when comparing bulls. To illustrate differences in bull value, the following is an actual scenario from the Livestock and Forestry Branch Station in Batesville, Arkansas. Bull A and Bull B were exposed to cows of similar genetic merit. Bull A sired calves that weighed on average 436 pounds at weaning. Calves sired by Bull B weighed 543 pounds on average at weaning.

Weaning weight difference between Bull B and Bull A = 543 pounds - 436 pounds = 107 pounds

Lighter-weight calves typically sell at a higher price per pound than heavier-weight calves. If calves sired by Bull A could be sold for $2.20 per pound and calves sired by Bull B could be sold for $2.08 per pound, then gross returns from each bull would be as follows:

Bull A: 436 pounds x $2.20 per pound = $960 per calf sold

Bull B: 543 pounds x $2.08 per pound = $1,130 per calf sold

The difference in gross returns per calf would then be:

$1,130 (Bull B) - $960 (Bull A) = $170 per calf

If each bull can be expected to sire 25 calves per year, then the difference in gross returns per year between the two bulls would be:

$170 per calf x 25 calves per year = $4,250 per year

Over 5 years, the difference in gross returns between the two bulls would be:

$4,250 per year x 5 years = $21,250

If Bull B costs $2,000 more than Bull A, then one-half of the additional income from the first calf crop would pay for the cost difference to acquire the superior bull:

$2,000 ÷ $4,250 = 0.47

By using Bull B as a herd sire, a producer can more than justify paying the $2,000 premium for him over Bull A. This ignores interest and depreciation costs and assumes that there are only weaning weight differences in the calves sired by the two bulls. If Bull B is also superior to Bull A in his ability to transmit heavier muscling, enhanced carcass characteristics or other economically important traits to his calves, including the improvement in heifers kept for replacement, then an even higher premium may be justified over the same payback period. This illustrates the financial importance of making bull-purchasing decisions based on as much useful and reliable information as is available.

7. What is the reputation of the herd from which selection is made?

The honesty and integrity of the owner and manager, the overall performance of the herd and the management practices under which the bull has been developed are extremely important to the prospective bull buyer.

Selecting Replacement Heifers

These traits should be considered when selecting heifers from the herd for brood cow replacements: (1) reproductive performance in the heifer's dam, (2) maternal ability of the heifer's dam, (3) weaning weight and yearling weight of the heifer, (4) conformation and (5) soundness.

When the heaviest heifers are selected at weaning, the results are improved maternal ability and growthiness in the herd. Heifers which fail to grow and develop after weaning should be culled at breeding time. Conformation is best evaluated after the heifer has reached yearling age. The third selection can be made after the heifers wean their first calves. Remove heifers that either fail to calve or produce poor calves. Generally, the first calf is a good indication of a cow's production in succeeding years.

For a 100-cow herd, about 16 heifers will usually be needed for replacements each year to maintain numbers. More than 16 may be needed if considerable culling is done at breeding time and after the first calf.

Performance Records

The University of Arkansas System Division of Agriculture's Cooperative Extension Service can assist beef cattle breeders with developing a systematic set of performance records. It also can help in utilizing these records in decisions relative to individually defined objectives within their breeding programs. Defined objectives and a planned breeding program are fundamental to attaining the maximum rate of genetic improvement in economically important traits in beef cattle. An organized improvement program with selection based on differences in records is basic to any planned breeding program.

Success in breeding superior beef cattle depends on the ability of the breeder to make accurate decisions while working toward his objectives. The more a breeder knows about the individuals in his herd and the more clearly he understands his objectives, the more likely he is to make correct decisions. Records from a complete improvement program provide the basis for making accurate decisions. A breeder's objectives for improvement can be reached only through a planned breeding program based on the use of performance data in selection.

Performance records should have flexibility and be helpful to both purebred and commercial cattle producers for comparing cattle within the same herd, breed, sex, age group and management group (Figure 3-3). Performance records are not designed for estimating differences between herds or between groups managed differently within a herd because environmental differences are likely to exist.

FIGURE 3-3. Weighing calves and measuring hip height for performance testing.

Two types of performance testing programs are available to beef cattle breeders who may use them collectively to monitor each animal's performance from birth. The two types that should receive emphasis by cattle breeders are (1) cow herd performance testing and (2) on-farm bull testing.

When performance data are maintained, they can be a valuable aid in (1) measuring progress in herd improvement, (2) evaluating performance of herd sires, (3) culling poor-producing cows, (4) selecting replacement females, (5) selecting bull calves for testing, (6) selecting future herd sires and (7) determining structural soundness under standardized conditions.

Contact your county Extension office for more information about performance testing.

Expected Progeny Differences (EPDs)

Throughout history, geneticists have studied methods for use in identifying superior individuals in beef cattle populations. Sire selection has tremendous value to the beef cow-calf operation. Choices of herd sires not only have an impact on the resulting calf crops, but these choices also affect the performance of the cow herd if daughters of the sires are kept as replacement heifers. Ideally, beef producers would like to select sires of desirable genetics for genetic improvement in economically important traits. Selection of desirable genetics to match with a cow herd is a challenging task. Fortunately, the concept of breeding value provides beef producers an avenue to make useful selection decisions. The background on breeding value estimation leads to a better understanding of the merit of Expected Progeny Differences (EPDs).

Background on Breeding Value Estimation

Breeding Value

Breeding value is defined as the value of an individual as a parent. Parents transfer a random sample of their genes to their offspring. Estimated breeding value gives an estimate of the transmitting ability of the parent.

Expected Progeny Difference

One-half the estimated breeding value is equal to the Expected Progeny Difference (EPD). The word "difference" implies a comparison. Thus, EPDs let us compare or rank the superiority of individual animals. EPDs provide a prediction of future progeny performance of one individual compared to another individual within a breed for a specific trait. The EPDs are reported in plus or minus values in the units of measurement for the trait. For example, birth, weaning and yearling weight EPDs are reported in pounds. As a common rule, the EPD values may be used to compare only those animals within a breed. For example, the EPD values for a Hereford bull may not be compared against the EPDs for an Angus or Limousin bull. However, new across-breed EPD adjustment values are now available that make it possible to compare EPDs on animals of different breeds.

Genetic Evaluation

The first beef cattle national sire summary was published in 1971 by a breed association. Up until the first summary, only within-herd comparisons of breeding value could be made for a given year, season and contemporary group. The national sire summaries in the early '70s and subsequent summaries allowed cattle within a breed to be compared across herds, generations and regions of the United States. These evaluations by individual breeds were National Sire Evaluations (NSE). However, the NSE concept had some problems.

1. Bulls had to have progeny information in order to be included in the evaluation. This meant that only older bulls were published in the summaries.
2. No adjustment was made for the mating of superior cows to the bulls represented in the evaluation. The purebred breeders saw this as a big problem.
3. Progeny records were used in the evaluation, but the individual record on a bull was not included.
4. Breeding values were calculated on sires in the evaluation, but no genetic values were computed for dams.

A mathematical model, called the Animal Model, was developed in the mid-1980s to correct the problems associated with NSE. Use of the Animal Model required extensive calculations. To reduce the number of equations that needed to be solved in an evaluation, the Reduced Animal Model (RAM) was developed. This approach reduced the amount of computer memory necessary to run the genetic evaluation.

The theory behind RAM was developed much earlier, but the computer technology was needed to process large numbers of equations for many animals. With the advances in computers, major beef breed associations today conduct National Cattle Evaluations (NCE) rather than National Sire Evaluations (NSE) because of its superiority in genetically evaluating cattle within a breed. The beef industry had progressed into an era of computing EPDs for all animals within a breed, thus the terminology of cattle evaluation rather than sire evaluation was adopted.

National Cattle Evaluations conducted using RAM procedures calculate a genetic value for an individual within a breed, whether that individual is a sire, dam or nonparent animal. Any combination of pedigree, individual records and progeny information is included to derive breeding values for all animals in the evaluation. The breeding values are divided by two and reported as EPDs. The Animal Model approach adjusts for the merit of mates. Specific matings of inferior or superior animals are considered. Maternal genetic values, or Milk EPDs, may be computed for the maternally influenced trait, weaning weight. As with the previous evaluation (NSE), EPDs from the NCE are comparable across herds. Environmental and management differences are accounted for so that comparisons can be made.

Also, any genetic change within a breed for a particular trait is accounted for in the evaluation; therefore, comparisons may be made across generations of cattle. Young bulls with no progeny may be directly compared with older sires that have progeny.

Each EPD value should have an accuracy assigned to it. Accuracy is the measure of reliability associated with an EPD. It is expressed as a value between 0 and 1. A high accuracy (>.7) means a higher degree of confidence may be placed on the EPD and the EPD value is not expected to change much as further information is gathered. A low accuracy (<.4) means that the EPD may change a great deal as additional information is gathered.

Contemporary Group

In the collection of beef cattle performance information, breed associations realize that contemporary group definition is critical. A contemporary group is a group in which animals of a given sex and age, having similar treatment, are given the equal opportunity to perform (Beef Improvement Federation Guidelines, 1990). The basis of sound performance testing relies on correct identification of contemporary groups. Accuracy in estimation of genetic differences within a group of animals is dependent on accuracy of grouping.

Breeding value estimation in beef cattle has an important history. Developments in animal breeding theory and computer technology have provided beef cattle producers with a selection tool for comparison or ranking of individual animals within a breed. This selection tool is an Expected Progeny Difference (EPD). National Cattle Evaluations conducted by individual beef breed associations combine pedigree, individual records and progeny performance to compute EPDs. The use of EPDs allows producers to make selection decisions for beef cattle traits of economic importance.

Breed Average EPD and Base Year

It is frequently said that an EPD is a comparison to an average bull. This is **NOT** an accurate statement. A zero EPD represents the average genetic merit of

animals in the database at the time when there was sufficient information to calculate EPDs. Therefore, it represents a historic base point, or base year. Some breed associations now set the base year to a particular year. If the breed has made any genetic change for a trait, the average EPD for the trait will no longer be zero. Breed associations publish the average EPDs in the sire summaries made available to the public. Information printed in the summaries should be examined carefully before individual EPDs are studied.

Accuracy

Accuracy is the measure of reliability associated with an EPD. Each EPD value should have an accuracy assigned to it. It is expressed as a value between 0 and 1. A high accuracy (>.7) means a higher degree of confidence may be placed on the EPD and the EPD value is not expected to change much as further information is gathered. A low accuracy (<.4) means that the EPD may change a great deal as additional information is gathered. Nonparent animals have lower accuracy values since no progeny information contributes to their EPD. From a practical viewpoint, the EPDs are used to select bulls for use in the herd, and accuracies help determine how extensively to use the bulls in the herd. Some sale catalogs do not list accuracies with the EPDs. On young animals with no progeny data, such as yearling bulls, one would realize that accuracies would be low.

Possible Change Value

Possible Change is the measure of the potential error associated with EPD values. Many sire summaries are starting to include such values. Possible change is expressed as "+" or "-" pounds of EPD. These values quantify the amount a certain EPD may deviate from the "true" progeny difference. Accuracy and possible change values share a relationship. As more information is accumulated, accuracy increases and possible change diminished. For a given accuracy, the "true" progeny differences of two-thirds of all animals evaluated within a breed are expected to fall within the plus or minus possible change value. An example to illustrate this point follows:

Birth Weight EPD = +2.0 pounds
Accuracy = .60
Possible Change = + 1.3 pounds

Of all the animals with this EPD and accuracy, two-thirds of the animals are expected to have "true" progeny differences between +.7 and +3.3. These "true" differences have a much greater chance of falling toward the center of the range defined by the possible change value than falling close to the extremes. Also, one-third of the individuals in the evaluation may have their "true" progeny difference values fall outside the range of +.7 and +3.3. This means that one-sixth of the individuals may have "true" values less than +.7 and one-sixth of the individuals may have "true" values of more than +3.3.

Sire summaries include a sampling of the available genetic material in each breed. The summaries for breed associations that conduct National Cattle Evaluations come out at least once a year. Summaries include EPDs, accuracies, graphs of the average change in EPD for the particular breed, breed average EPDs, possible change values and other useful materials. Descriptive material written at the beginning of each summary describes the format for reporting the EPDs. An example of a sire summary is listed in Table 3-1. The example presents EPDs and accuracy values (ACC) for traits commonly found in most summaries.

At least 18 beef breed associations currently conduct National Cattle Evaluation programs. Almost all sire summaries include birth weight, weaning weight, yearling weight and milk EPDs. A few currently include some characteristics that have a role in reproduction such as calving ease, gestation length and scrotal circumference. Many of the breed associations are currently working to include some of these other characteristics into the summaries. There is a fairly large effort to incorporate more carcass information. Carcass evaluations may result in EPDs for carcass weight, rib-eye area, fat thickness and marbling score.

Many of the summaries contain two listings of bulls. The first is a listing of progeny-proven bulls. These are older bulls that have calves with performance records; therefore, the accuracies on the birth and weaning weight EPDs are generally at least .5. The second section is devoted to younger bulls that have lower accuracies (.3 to .5 on weaning and birth weight). The criteria for listing varies among the breeds.

TABLE 3-1. Example EPDs for Two Bulls

Sire	Birth Wt.		Weaning Wt.		Milk		Yearling Wt.	
	EPD	ACC	EPD	ACC	EPD	ACC	EPD	ACC
Bull 123	+4.0	.90	+24	.90	+12	.70	+50	.80
Bull 345	+2	.35	+12	.30	+5	.40	+23	.20

Growth Trait EPDs

EPDs provide a prediction of future progeny performance of one individual compared to another individual within a breed for a specific trait. The EPDs are reported in plus or minus values in the units of measurement for the trait. For example, birth, weaning and yearling weight EPDs are reported in pounds. The EPD values may be used to compare only those animals within a breed. In other words, the EPD values for a Hereford bull may not be compared against the EPDs for an Angus or Limousin bull. The EPD values are most useful when two individuals are being compared directly. For example, consider the two sires in Table 3-2 and assume that both sires are from the same breed and that the EPDs have equal accuracies.

TABLE 3-2. Example of Birth Weight EPD		
	Sire A	**Sire B**
BW EPD (LBS)	+5	-2

The expected difference in the progeny of Sire A and Sire B for birth weight is 7 pounds. Sire A has an EPD of +5 and Sire B has an EPD of -2. On the average, we should expect the calves by Sire A to be 7 pounds heavier at birth than calves of Sire B, if all the calves are managed uniformly and are from cows of similar genetic merit. The predicted performance difference is 7 pounds although it is not possible to estimate the actual birth weight average for these calves. The EPDs allow the prediction of performance differences, not actual performance.

Each individual member of a breed can have EPD values calculated for it. Purebred breeders report data to the National Herd Improvement Program for their breeds to contribute to the breed national database. Age and sex of a calf or status as a parent are not limiting factors. A newborn calf could be assigned EPDs. It is possible to compare any two members of the breed regardless of location, but comparisons cannot be made across breeds. Each individual has its own performance and the performance of progeny, sibs, parents, grandparents, etc., that can be utilized to evaluate genetic merit. New animal breeding and computer technology result in techniques whereby the performance of the animal and information on its relatives are included in the estimate of genetic merit. Thus, EPDs are available on parent and nonparent animals. This process involves extensive calculations which only the latest generation of computers is able to accomplish efficiently.

The EPD values are available for all animals, male and female. Preferential mating of certain individuals does not bias the results. A genetically superior bull can be mated only to genetically superior cows and his EPD will not be inflated. This is accomplished by adjusting for the EPDs of the cows to which he is mated. Appropriate adjustments are made for genetic trend. For example, this adjustment allows young bulls to be directly comparable to older bulls with many progeny records.

Table 3-3 is an example of Weaning Weight EPDs. It describes a weaning weight difference in the progeny of two bulls.

TABLE 3-3. Example of Weaning Weight EPD		
	Sire A	**Sire B**
WW EPD (LBS)	+25	-10

The expected difference in the progeny of Sire A and Sire B for weaning weight is 35 pounds. Sire A has an EPD of +25 and Sire B has an EPD of -10. On average, we should expect the calves by Sire A to be 35 pounds heavier at weaning than calves of Sire B, if all the calves are exposed to the same environmental conditions and are from cows with similar genetic merit. Table 3-4 is an example for Yearling Weight. It describes a yearling weight difference in the progeny of two bulls.

TABLE 3-4. Example of Yearling Weight EPD		
	Sire A	**Sire B**
YW EPD (LBS)	+50	+10

The expected difference in the progeny of Sire A and Sire B for yearling weight is 40 pounds. Sire A has an EPD of +50 and Sire B has an EPD of +10. On average, we should expect the calves by Sire A to be 40 pounds heavier at one year of age than calves of Sire B, if all the calves are managed uniformly and are from cows with similar genetic merit.

Maternal Trait EPDs

Maternal effects are an important consideration when evaluating beef cattle performance. Extensive studies have been conducted to quantify maternal effects for a variety of traits, especially those measured during the preweaning period. Phenotype is the physical expression of the genetic makeup of an animal. In beef cattle, the dam makes at least two contributions to the offspring phenotypic value. These contributions are the sample half of her genes passed

directly to the offspring and the maternal effect she provides her calf. A maternal effect is defined as any environmental influence that the dam contributes to the phenotype of her offspring. The contribution of the dam is environmental with respect to the calf (mothering ability, milk production, environment, maternal instinct). The genetics of the dam allow her to create this environment for her calf. Maternal effects are important during the nursing period with diminishing effects through post weaning.

Milk EPD

Weaning weight can be determined by the genes for growth in the calf and genes for milk (mothering ability) in the cow. There are separate EPD values for these two components. The Weaning Weight EPD evaluates genetic merit for growth, and the Milk EPD evaluates genetic merit for mothering ability. The Milk EPD that results from the separation of weaning weight into growth and milk segments is, like any other EPD, fairly simple to use. It is the expected difference in weaning weight of calves from daughters of a particular sire, due to differences in mothering ability. As an example, consider two bulls in Table 3-5.

TABLE 3-5. Example of Milk EPD

	Sire A	Sire B
EPD (LBS)	+10	-5

The expected difference in the progeny from daughters of Sire A and Sire B is 15 pounds. Sire A has a Milk EPD of +10; Sire B has a Milk EPD of -5. The expected weaning weight difference, due to mothering ability alone, in calves from daughters by the two bulls is 15 pounds. The 15 pounds are expressed in pounds of weaning weight, not pounds of milk.

Combined Maternal EPD

Combined Maternal EPD (sometimes called maternal weaning weight or total maternal) reflects both the milking ability transmitted to daughters and direct weaning growth transmitted through daughters to their calves. An example is illustrated in Table 3-6.

TABLE 3-6. Combined Maternal EPD

	Weaning Weight EPD	Milk EPD	Combined EPD
Bull A	+20	+12	+22
Bull B	+4	+6	+8
Combined (Bull A) = 1/2(20) + 12 = 22 Combined (Bull B) = 1/2(4) + 6 = 8			

Bull A has a direct Weaning Weight EPD of +20 pounds. This expresses the ability of the bull to transmit weaning growth directly to his progeny. On average, calves sired by Bull A should be 16 pounds heavier at weaning than calves sired by Bull B, assuming both bulls are mated to a comparable set of females and the calves are exposed to the same environmental conditions. The 16-pound difference in future progeny performance is due to genes for direct weaning growth. The Milk EPD for Bull A (+12) is the contribution to his daughter's calves solely through transmission of genes for mothering ability. The expected difference in the progeny from daughters of Bull A and Bull B is 6 pounds. Bull A has a Milk EPD of +12; Bull B has a Milk EPD of +6. The expected weaning weight difference, due to mothering ability alone, in calves out of daughters by the two bulls is +6 pounds. The Combined EPD for Bull A (+22) is computed by taking one-half the Weaning Weight EPD plus all the Milk EPD. The +22 pounds affect both the milking ability transmitted to daughters and the direct weaning growth transmitted through the daughters to their calves. In a similar method, the Combined EPD for Bull B is one-half times the Weaning Weight EPD plus the Milk EPD, or +8 pounds. An average difference of 14 pounds would be expected as the difference in weaning weight of calves out of daughters of the bulls based upon the genetic merit for growth (WW EPD) and milk (Milk EPD).

Calving Ease EPDs

Calving ease heritabilities have been reported to be small (.00 to .13) for beef cattle. The magnitude of the estimates indicates that little genetic progress can be made on selecting directly for calving ease. However, there are exceptions where calving ease heritabilities have been reported to be over .46 in particular studies. Some breed associations report Calving Ease EPDs along with Birth Weight EPDs while other associations' reports do not include Calving Ease EPDs. Breed associations that report Calving Ease EPDs may present them in different formats. Be sure to study the meaning of Calving Ease EPDs separately for each breed. Descriptive material written at the beginning of most sire summaries should be useful in interpreting the meaning of Calving Ease EPDs. Different breed associations may list the calving information in different formats.

Calving Ease EPDs are given in two ways: Calving Ease EPD and Maternal Calving Ease EPD. Calving Ease EPDs are expressed as deviation of percent of unassisted births.

When comparing EPDs of two animals, a larger EPD represents a higher percent of unassisted births. Calving Ease EPDs indicate the ease with which calves of a sire are born to first-calf heifers. Maternal Calving Ease EPDs are the ease with which daughters of a sire calve as first-calf heifers. These may also be given as the ease with which daughters of a sire calve as mature cows. When comparing sires, the larger EPD represents a higher percent of unassisted births for calves born from daughters of a bull.

Milk EPDs are widely available from beef cattle breeds. The values are expressed in pounds of weaning weight. Direct comparisons of Milk EPDs may be made between individuals within a breed. The Milk EPD is the expected difference in weaning weight of calves from daughters of a bull compared with calves from daughters of another bull, due to mothering ability. Beef producers may use Milk EPDs as part of their selection program when choosing bulls to sire replacement heifers for their herd.

The Combined Maternal EPD is another value available for use in sire selection. It is the sum of one-half the Weaning Weight EPD plus all the Milk EPD. The Combined Maternal EPD reflects both the mothering ability transmitted to daughters and direct weaning growth transmitted through daughters to their calves. Calving Ease EPDs are available and are correlated with BW EPD. Details about these values and their use should be studied before selection decisions are made.

$Value Indexes

These values are multi-trait selection indexes, expressed in dollars per head, to assist beef producers by adding simplicity to genetic selection decisions. A $Value has meaning only when used in comparison to the $Value of another animal. For example (Table 3-7), just as with EPDs, variation in $Values between animals indicates average expected differences in the relative value of progeny if random mating is assumed and the calves are exposed to the same environment.

TABLE 3-7. $Value EPD

$W	$F	$G	$B
+22.36	+14.26	+12.53	+26.25

Weaned Calf Value ($W) is an index expressed in dollars per head. This is the expected average difference in future progeny performance for preweaning merit. $W includes both revenue and cost adjustment associated with differences in birth weight, weaning direct growth, maternal milk and mature cow size.

Feedlot Value ($F) is an index that includes adjustments associated with postweaning performance and predicts the variation in value between sires.

GridValue ($G) is an index that includes adjustments associated with carcass grid merit and predicts the variation in value between sires

Beef Value ($B) is the expected average difference in future progeny performance for postweaning and carcass value compared to progeny of other sires. The $B value combines the contributions of $F and $G.

The values are not designed to be driven by a single trait, as an index is multi-trait by design. These selection tools are the result of the application of industry-relevant market values to genetics for preweaning, feedlot and carcass merit. These values should be used to complement the criteria that producers already use when selecting bulls. These are $ indexes reported by the American Angus Association. However, many breed associations are now reporting $ index values, and some come with different definitions than the ones that are listed here. It is very important to evaluate the sire summary to understand each value that is associated with your breed of interest.

Use of EPDs

Use of EPDs for Selection in Purebred Herds

Purebred producers need to consider EPDs in their breeding programs. Competitors are using EPDs and making genetic change in their beef herds. However, care needs to be exercised when making selection decisions. Type fads have caused some problems in the past when single traits have been emphasized. Similar, or worse, problems may arise if a single performance trait is emphasized. For example, if the members of one breed association began to emphasize yearling weight and ignored all other characteristics, several concerns might arise. Birth weight would be expected to increase, with the attendant calving difficulty. Mature size should also increase, perhaps to the point where the functionality of the cow herd would diminish. This could also lead to problems in reaching desirable quality grade at an acceptable weight. Each trait has a set of drawbacks if changes are carried to an extreme. The availability of EPDs would make such extremes easier to achieve if breeders chose to blindly emphasize a single trait.

A more balanced selection program is certainly desirable. Some producers recommend choosing herd sires that have a balanced yearling weight EPD, milk EPD and birth weight EPD. It also needs to be recognized that there are still many important traits that are not included in the sire summaries. Careful monitoring of reproductive performance, conception rates, calf mortality, regularity of calving and libido in bulls is critically important. Carcass characteristics may have increased importance in the near future; therefore, breeders are encouraged to obtain whatever carcass data is feasible and use it in making some selection decisions. Carcass EPDs should be available in several breeds soon, but more complete databases need to be established.

Most beef breed associations have EPDs. Purebred breeders should obtain EPDs on each member of their herd if their association provides the service. Although the accuracies are sometimes low on these EPDs, they should be used when choosing replacements and, where possible, when culling cows. Purebred producers are not only users of EPDs, but they also provide the data used in calculating EPDs. Producers are encouraged strongly to provide complete, accurate records on all calves born each year. Complete, accurate record keeping is the only way that useful EPDs can be calculated.

Use of EPDs for Selection in Commercial Herds

Commercial producers should be using bulls that are listed in a breed association's sire summary. What then should the commercial producer do about EPDs of their progeny? Many breed associations have a mechanism in place where individual purebred producers can obtain EPDs on each animal in their herd including the calves. Commercial producers should demand the information from their purebred breeding stock sources.

A commercial producer has a major responsibility of choosing the appropriate breed, or breeds, for his/her program. Once breeds are chosen, examination of what is needed in replacement breeding stock is in order. Some recommendations for commercial scenarios are shown in Table 3-8.

Each of these recommendations should be followed while at the same time considering the prevailing conditions. Rougher conditions probably dictate the need to avoid very high EPDs for growth or milk and even more to avoid high birth weights. Growth EPDs should be geared to the needs of the potential buyers. Also, traits for which there are no EPDs as yet can be important. Traits associated with reproduction certainly fall into this category. Commercial producers should demand that the seller's bulls should have passed a breeding soundness examination.

EPDs within a breed are directly comparable between herds. Therefore, if a commercial producer has more than one source of breeding stock, he/she can compare the genetic merit of the different sources.

Pedigree Estimated EPDs

Many sale catalogs will contain Expected Progeny Differences (EPDs) for the bulls offered for sale. Some bulls will appear in catalogs with limited or no EPD information. This may be particularly true for young bulls that have not had their performance information included in the breed genetic evaluation yet. Bull buyers may use a quick and easy procedure to compute "Pedigree EPD" values for young bulls with no EPDs.

Pedigree EPDs may be computed provided that you have access to EPDs on the animals in the pedigree of the young bull. By using the EPDs on animals in the young bull's pedigree, you are ready to compute Pedigree EPDs. Each calf receives a random

TABLE 3-8. Recommendations for EPDs for Various Commercial Scenarios

Use of Individual	Breed	Birth	Weaning	Yearling	Milk
Terminal sire on mature cows	Large carcass	Not too high	High	High	Not relevant
Bull to use with heifers	Small to medium size	Low	Moderate	Moderate	Consider, if keeping heifers
Sire replacement heifers	**Medium size maternal**	**Low to moderate**	**Moderate to high**	**Moderate to high**	**Varies**

sample half of the sire's genes and a random sample half of the dam's genes. The two halves combine to form the complete genetic makeup of the calf. Parents of the calf also receive their genetic makeup in the same way, with half of their genetic makeup contributed by each of their parents. By understanding this halving nature of inheritance, the EPDs on parents and grandparents in the pedigree of a young bull may be used to compute Pedigree EPDs.

Across-Breed EPDs

Since the inception of EPDs, it was easy to make bull comparisons within the same breed for selection decisions. Today that is still the case. However, the U.S. Meat Animal Research Center (MARC) in Clay Center, Nebraska, has made it possible to compare EPDs among different breeds. MARC has released a table of adjustment factors used to estimate across-breed expected progeny differences (AB-EPDs) for 18 breeds. Bulls of different breeds can be compared on the same EPD scale by adding the appropriate adjustment factor to the EPDs being evaluated.

Genetic Testing

Improvements in genomic technology have now made it possible to further enhance predictability of our current selection tools with the incorporation of genomic values into our genetic evaluations and thereby improving accuracy of EPD, particularly for younger animals. Hair follicles, blood card, semen or tissue notches are required for samples in the DNA test kits. DNA tests, however, do not replace the importance of collecting actual phenotypic data.

This technology can be used to help decide which bulls should be of value, as an early sorting stick of such. It will add value for commercial bull buyers because it can correct potential pedigree errors and increase the accuracy of EPDs on young animals. Use of EPDs will not change and remains the industry standard, but this technology is a means of mitigating risk by increasing the confidence of the EPD of young sires. Essentially animals will have the accuracy value that is typically associated with animals that have already had calves.

Genomic performance testing is currently available through Zoetis (GeneMax Advantage) and Neogen (Igenity and GeneSeek). Testing includes genetic markers for maternal, growth and carcass traits. Results are often represented as scores.

Genomic defect testing is now required by many breed associations for offspring of a sire or dam that is a known carrier of a genetic defect such as curly calf syndrome or calves born hairless.

Chapter 4

Animal Breeding

Improving production efficiency and product desirability through each segment of the beef cattle industry rests with purebred breeders and commercial cattle producers. They determine the matings that produce beef and replenish breeding stock. Therefore, they should have a working knowledge of genetics, or the science of heredity, an appreciation of the traits of economic importance throughout the beef cattle industry and an understanding of the procedures for measuring or evaluating differences in these traits.

Basis for Genetic Improvement

Differences among animals result from the hereditary differences transmitted by their parents and the environmental differences in which they are developed. With minor exceptions, each animal receives half its inheritance from its sire and half from its dam. Units of inheritance are known as genes which are carried on threadlike material present in all cells of the body called chromosomes. Cattle have 30 pairs of chromosomes. The chromosomes and genes are paired with each gene being located at a particular place on a specific chromosome pair. Thousands of pairs of genes exist in each animal, and one member of each pair in an animal comes from each parent.

Tissue in the ovaries and the testicles produces the reproductive cells, which contain only one member of each chromosome pair. The gene from each pair going to each reproductive cell is purely a matter of chance.

The female is born with all of her potential eggs already produced and stored in the ovaries. Once she reaches puberty, one egg, sometimes two, will be released from the ovaries during each estrous cycle throughout the remainder of her reproductive life. The male, on the other hand, does not produce sperm cells until he reaches puberty. Sperm are then produced in the testicles by a process that requires about 60 days. Because beef cattle have 30 pairs of chromosomes and only one chromosome from each pair is contained in each sperm cell, there are 1.1 billion different combinations of chromosomes that may be contained in the sperm cells.

When a reproductive cell, or sperm cell, from a male fertilizes a reproductive cell, or egg, from the female, the full complement of genes is restored. Some reproductive cells will contain more desirable genes for economically important traits than will others. The union of reproductive cells that contain a high proportion of desirable genes for economically important traits results in a superior individual and offers the opportunity for selection. However, the chance segregation in the production of reproductive cells and recombination upon fertilization results in the possibility of genetic differences among offspring of the same parents.

The genetic merit of a large number of offspring will average that of their parents. However, some individuals will be genetically superior to the average of their parents and others will be inferior. Those that are superior, if selected as parents of the next generation, contribute to improvement.

Factors Affecting Rate of Improvement From Selection

Factors that affect rate of improvement from selection include (1) heritability [h^2], (2) selection differential [SD], (3) genetic correlation or association among traits and (4) generation interval [GI]. The amount of improvement for a single trait may be calculated as Rate of Improvement = (h^2 x SD) ÷ GI. If selection is based on more than one trait, the genetic association between traits becomes important.

Heritability

Heritability is the proportion of the differences between animals that is transmitted to the offspring. Thus, the higher the heritability for any trait, the greater the possible rate of genetic improvement. When evaluating animals, every attempt should be made to subject all animals from which selections are made to as nearly the same environment as possible. This results in a large proportion of the noted differences among individuals being genetic and will increase the effectiveness of selection.

The average heritability levels for some of the economically important traits in beef cattle are presented in Table 4-1. The heritability of any trait can be expected to vary slightly in different herds depending on the genetic variability present and the uniformity of the environment. Based on heritability estimates, selection should be reasonably effective for

TABLE 4-1. Percent Heritability Levels for Various Traits	
Low (h^2 less than 20%)	
Twinning	3
Calf Survival Ability	5
Conception Rate	10
Calving Interval	10
Medium (h^2 20%-45%)	
Birth Weight	40
Gain Birth to Weaning	30
Weaning Weight	30
Feedlot Gain	45
Feed Efficiency	40
Pasture Gain	30
Conformation Score at Weaning	25
Yearling Body Length	40
Carcass Grade	40
Fat Thickness – 12th Rib	45
High (h^2 greater than 45%)	
Yearling Weight	50
Yearling Hip Height	60
Yearling Wither Height	50
Dressing Percentage	50
Ribeye Area	70
Mature Weight	60

most performance traits, but these traits vary in heritability and economic importance. Thus, the rate of expected improvement and the emphasis each trait should receive in a selection program will also vary considerably.

The heritability estimates for each trait combined with the trait's economic value to that particular cattle producer should determine the relative emphasis each trait receives in the selection program. If a trait is medium to high in heritability, the purebred producer may select animals that are superior in that trait and expect reasonable progress to be made toward the goal. If the trait is low in heritability, little progress will be made by selection; however, considerable improvement may be made in traits with low heritabilities by utilizing crossbreeding. Thus, a commercial producer benefits in traits (primarily reproductive traits) that are low in heritability by crossbreeding while improving traits that are medium to high in heritability by purchasing bulls from a purebred producer who has been selecting for improvement in those traits.

Selection Differential

Selection differential is the difference between selected individuals and the average of all animals from which they were selected. For example, if the average weaning weight of a herd is 450 pounds and those selected for breeding average 480 pounds, the selection differential is 30 pounds. The average cattle producer who produces their own replacements saves from 30 to 40 percent of the heifers each year while retaining only 2 to 5 percent of the bull calves. Because of these differences in replacement rates, the greatest selection differential will be on the bull's side. Up to 90 percent of the genetic improvement in a trait over four generations is due to the sire used. Every effort should be made to obtain the maximum selection differential possible for the trait or traits of greatest economic importance and highest heritability, ignoring traits that have little bearing on either efficiency of production or carcass merit.

Genetic Association Among Traits

A genetic relationship among traits is the result of genes favorable for the expression of one trait tending to be either favorable or unfavorable for the expression of another trait. Genetic associations may be either positive or negative. If the genetic association between two traits is positive as is the case between birth weight, pre-weaning gain, post-weaning gain and eventual mature size, then selection to increase one of these traits would also cause some increase in the other traits. When two traits are negatively correlated, such as rate of gain and carcass quality, selection to increase one will cause the other trait to decrease.

Generation Interval

The fourth major factor that influences rate of improvement from selection is the generation interval – that is, the average age of all parents when their progeny are born. Generation interval averages approximately 4½ to 6 years in most beef cattle herds. Rate of progress is increased when the generation interval is shortened. This can be accomplished by vigorous culling of the cow herd based on their production, calving heifers as two-year-olds and using yearling bulls on a limited number of females.

Mating Systems

The five fundamental types of mating systems are (1) random mating, (2) inbreeding, (3) outbreeding, (4) assortative mating and (5) disassortative mating.

Random mating is mating individuals without regard to similarity of pedigree or similarity of performance.

Inbreeding is mating individuals that are more closely related than the average of the breed or population. Linebreeding is a special form of inbreeding and refers to the mating of individuals so the relationship to a particular individual is either maintained or increased. Linebreeding results in some inbreeding because related individuals must be mated.

Outbreeding is mating of individuals that are less closely related than the average of the breed or population. The term outcrossing is also used to mean outbreeding when matings are made within a breed. Crossbreeding is a form of outbreeding.

Assortative mating is the mating of individuals that are more alike in performance traits than the average of the herd or group. This mating system is often used when establishing uniformity within a herd.

Disassortative mating is the mating of individuals that are less alike in performance traits than the average of the herd or group. This mating system is used to correct deficiencies within a herd.

Crossbreeding for Commercial Beef Production

Crossbreeding can be used in commercial beef production to realize heterosis, or hybrid vigor, and complementary combinations of breed characteristics and to match market requirements, feed and other resources available in specific herds.

The effect of heterosis on some performance traits is important. Productivity in some traits is greater in crossbred animals than the average of the two parents due to heterosis. The effect of heterosis is inversely proportional to heritability. For example, high heritability traits such as post-weaning growth rates, feed efficiency and carcass composition are affected less by heterosis than low heritability traits such as livability and fertility.

More than 50 breeds are available in significant numbers to cattle producers through either natural breeding or artificial insemination. These breeds vary greatly in performance traits. Because offspring resulting from crossbreeding tend to be a blend of both parents, crossbreeding can be used to obtain a performance goal in one or two years that would require several years to accomplish through selection for genetic change within one breed.

Also, by matching the sire breed and the dam breed in proper combination, complementary traits can be obtained in the offspring through crossbreeding. For example, a cow selected for its small size, quick maturity, high fertility and low maintenance cost can be matched with a sire breed selected for faster growth rate and a lean muscular carcass.

Crossbreeding Systems

For most livestock species, crossbreeding is an important aspect of production. Intelligent crossbreeding generates **hybrid vigor** and **breed complementarity**, which are very important to production efficiency. Cattle breeders can obtain hybrid vigor and complementarity simply by crossing appropriate breeds. However, sustaining acceptable levels of hybrid vigor and breed complementarity in a manageable way over the long term requires a well-planned crossbreeding system. Given this, finding a way to evaluate different crossbreeding systems is important. The following is a list of seven useful criteria for evaluating different crossbreeding systems:

1. Merit of component breeds
2. Hybrid vigor
3. Breed complementarity
4. Consistency of performance
5. Replacement considerations
6. Simplicity
7. Accuracy of genetic prediction

Merit of Component Breeds

For any crossbreeding system to be effective, the breeds in the system must be well chosen. Each breed included in a crossbreeding system must bring favorable attributes to the cross. Determining the appropriate breeds to use in a crossbreeding system can be challenging. Another challenge is the availability of animals of those breeds.

Hybrid Vigor

Generating hybrid vigor is one of the most important, if not the most important, reasons for crossbreeding. Any worthwhile crossbreeding system should provide adequate levels of hybrid vigor. The highest level of hybrid vigor is obtained from F1s, the first cross of unrelated populations. To sustain F1 vigor in a herd, a producer must avoid **backcrossing** – not always an easy or a practical thing to do. Most crossbreeding systems do not achieve 100 percent hybrid vigor, but they do maintain acceptable levels of hybrid vigor by limiting backcrossing in a way that is manageable and economical. Table 4-2 lists expected level of hybrid vigor or heterosis for several crossbreeding systems.

Breed Complementarity

Breed complementarity refers to the production of a more desirable offspring by crossing breeds that are genetically different from each other but have

TABLE 4-2. Expected Heterosis Levels and Breed Complementarity Attributes of Several Crossbreeding Systems			
	Expected Heterosis		
Crossbreeding System	Offspring	Dam	Breed Complementarity
Two-breed terminal cross	100	0	maximum
Three-breed terminal cross (using F1 females)	100	100	maximum
Two-breed rotation	72	56	some
Three-breed rotation	91	70	minimal

Definitions

hybrid vigor – An increase in the performance of crossbred animals over that of purebreds, also known as heterosis.

breed complementarity – An improvement in the overall performance of crossbred offspring resulting from the crossing of breeds of different but complementary biological types.

backcrossing – The mating of an individual (purebred or hybrid) to any other individual with which it has one or more ancestral breeds or lines in common.

complementary attributes. In beef cattle breeding, it is often stated as "big bull X small cow" complementarity. The big bull contributes growth and leanness to the offspring, and the small cow requires less feed to maintain herself. The result is a desirable market animal economically produced.

Consistency of Performance

A crossbreeding system should ideally produce a consistent product. It is much easier to market a uniform set of animals than a diverse one. It is also much easier to manage a female population that is essentially one type than one made up of many types, each with its own requirements. Crossbreeding systems vary in their ability to provide this kind of consistency.

Replacement Considerations

In terms of hybrid vigor, the ultimate female is an F1. Commercial producers would like to have entire herds of F1 females. How can you produce a continuous supply of F1s? One way is to maintain purebred parent populations to cross to produce F1s. A second way is to purchase all the replacements needed from a third party. Neither of these methods is optimum for most producers. A number of crossbreeding systems manage to overcome the replacement female dilemma by allowing breeders to produce replacement heifers from their own **hybrid** populations. However, this convenience comes at a price, a price typically paid in loss of hybrid vigor, breed complementarity and simplicity.

Simplicity

Crossbreeding systems should be relatively simple. Expensive systems or complex systems that require an unrealistically high level of management are unlikely to remain in place for very long. More complex breeding systems often conflict with important management practices unrelated to breeding. For example, beef cattle crossbreeding systems that require many breeding pastures make grazing management difficult. It is important that crossbreeding systems fit with other aspects of cattle production. This means that crossbreeding systems should be kept simple.

Accuracy of Genetic Prediction

The higher the accuracy of genetic prediction, the lower selection risk and more predictable the offspring. Because relatively little performance information on commercial animals is recorded and even less is reported for analysis, accuracy of prediction in a commercial operation refers to accuracy of prediction for seed stock inputs to the crossbreeding system – typically sires. In many cases, accurate **EPDs** are available for purebred sires, and crossbreeding systems using purebred sires benefit as a result.

Definitions

hybrid – An animal that is a cross of breeds within a species.

EPD – Expected progeny difference.

Example Crossbreeding Systems

Terminal Cross

The simplest form of crossbreeding is a terminal cross. In this system, all offspring are marketed, making it necessary to purchase replacement heifers. If F1 replacement heifers (females that have 100 percent hybrid vigor for maternal traits) are purchased and are bred to bulls of a different breed, both cows and calves take advantage of maximum heterosis. This system also allows the most flexibility in choosing breeds to use. Replacement heifers can be purchased that are comprised of "maternal" breeds and bred to terminal or high-growth breed bulls. This type system is optimal for many cow-calf producers. This system is illustrated in Figure 4-1.

An even simpler form of this system just uses two breeds. Bulls of breed A are bred to females of breed B to produce F1 A X B offspring. These offspring will exhibit maximum heterosis, but since the females that produced these calves were not cross-breeds, the offspring were not able to take advantage of any maternal heterosis.

Rotational Cross

Spatial Rotations – The classic form of a rotational crossbreeding system is a spatial rotation. In spatial rotations, all breeds are used at the same time but are separated specially. This system requires multiple mating pastures, one for each sire breed. In a two-breed rotation (see Figure 4-2 for an example), two breeding pastures will be needed. A three-breed rotation would need three breeding pastures. This

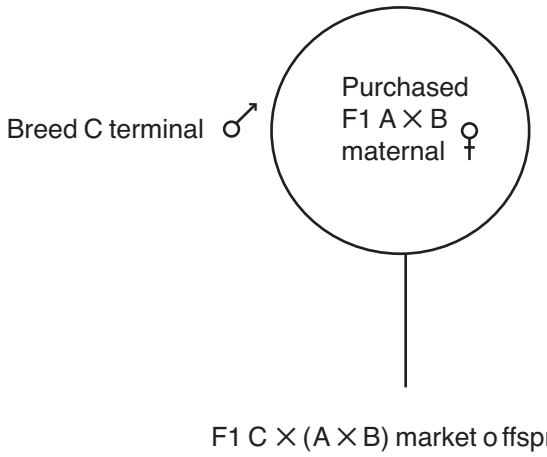


FIGURE 4-1. Example of a terminal crossbreeding system using purchased F1 females.

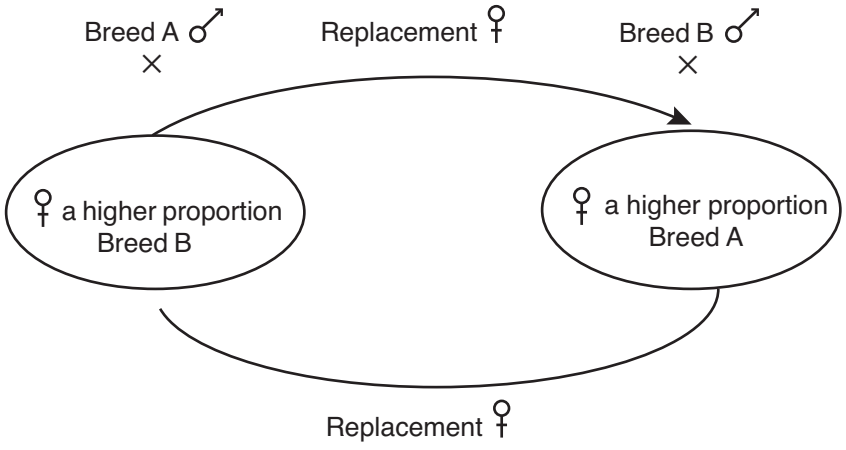


FIGURE 4-2. Example of a spatial rotation using two sire breeds.

system is designed to produce replacements. Replacements leave the group into which they were born to join the other breeding group as a replacement. As seen in Figure 4-2, replacements out of sire breed A move to the group that is to be bred to sire breed B and replacements out of sire group B move to the group to be bred to sire breed A. The more breeds that are included in the rotation, the greater amount of heterosis. Each breed added also increases the level of management needed to keep the system operational.

Rotation in Time – Another commonly used form of rotational crossbreeding is rotating sire breeds across time. In this system, only one breed of sires is used at one time. Typically, sire breeds are rotated every one or two breeding cycles. This system is simpler to manage than a spatial rotation, but the level of observed heterosis is somewhat less due to increased backcrossing. This system is illustrated in Figure 4-3. The major problem with utilizing this system is that over time the groups of breeding females become very inconsistent in their breed makeup and performance. This introduces inconsistency in their offspring. This variation in calf performance can be a hindrance during marketing of the offspring.

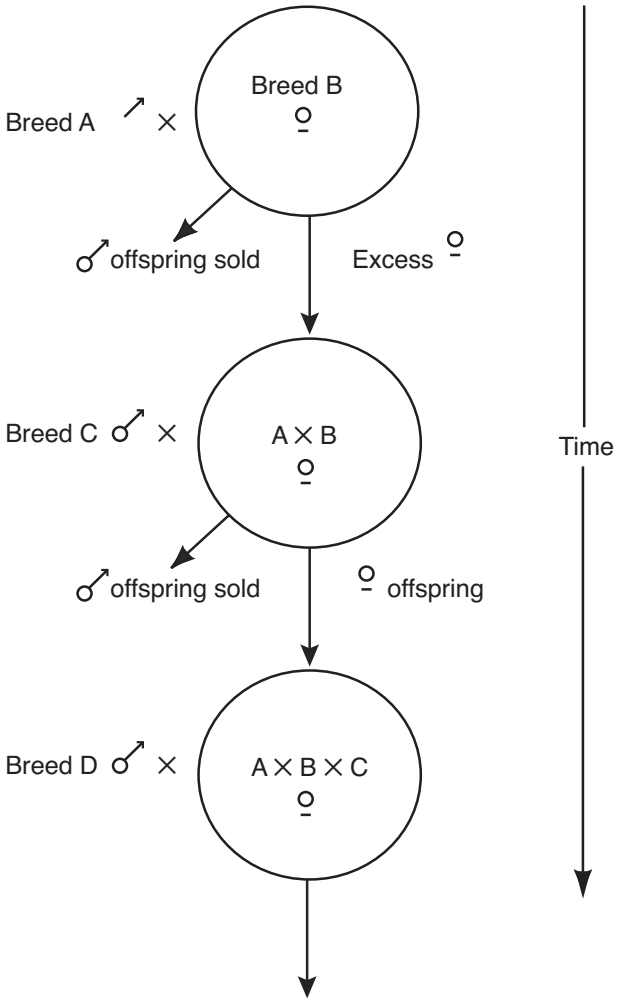


FIGURE 4-3. Example rotation in time system using three breeds.

Genetics and the Environment

In Arkansas, beef production requires compromise at intermediate levels among the traits of mature size, maturing rate and milk production in the cow herd, if best use of feed and forage resources on the farm are realized. These traits are factors that determine energy requirements. Feed and forage resources vary among farms; therefore, the optimum level of these characteristics must vary as well if the best choice of cattle is made to match the feed and forage resources. How well the cow herd matches the resources or how nearly the forage resources can meet the requirements of the cattle will be reflected in the supplementary feed that must be provided. Failure to provide needed supplementary feed for a cow herd that is mismatched with the forage resource will be reflected in increased ages at puberty, reduced reproduction and weaning rates and higher maintenance costs of cows. The size and maturing rate of the parents also influence carcass leanness and marbling at acceptable market weights.

Chapter 5

Beef Cattle Nutrition

Essential Nutrients

The nutrients utilized by beef cattle are (1) water, (2) protein, (3) carbohydrates, (4) fats, (5) minerals and (6) vitamins. Producers should understand the digestive system of the ruminant animal and the nutrient requirements of the various classes of beef cattle (see Table 6-2).

Water

Water's importance to sustainment of life results in it being classified as a nutrient, and it is the most important nutrient. Water is involved in all digestive and metabolic processes. Cattle producers often take water for granted because in most cases there is a pond or stream available for cattle to have uninterrupted access to water. Mature cows will consume 6 to 12 gallons per day during cooler times of the year and 15 to 20 gallons per day during hotter times of the year. One common concern with farm ponds is blue-green algae blooms. Nitrates can also be a concern with farm ponds that catch a lot of agricultural field drainage. Wells provide another source of water for beef cattle. Salts and other well water contaminants can affect water intake and herd performance. When using streams to water cattle, the streams should be fenced to provide limited access points, protecting streambanks from erosion. Cattle producers sometimes choose to pump water from streams instead of allowing direct access by cattle. Stagnant and slow-flowing streams present some of the same water quality concerns as ponds. Water can be tested for quality standards to determine if contents are within acceptable levels for beef cattle.

Protein

Protein is important in all tissue building and in cell functions of the body of beef cattle. Good quality grass forages grown on fertilized pastures and hay meadows will almost always supply the protein needs of dry pregnant cows and much of the time the protein needs of nursing cows. Legume forages usually have a protein level that exceeds protein needs of all classes of beef cattle.

Carbohydrates and Fats

Carbohydrates (sugars), fats and, in some instances, proteins provide the energy in all animal rations. Failure to provide energy represents the most serious feeding problem among Arkansas cattle producers. Cattle on a forage-based diet are receiving most of their energy supply from microbial digest of plant carbohydrates. Plant fiber is a structural carbohydrate. One of the greatest causes of low fertility is inadequate energy in beef cattle rations. This occurs during drought or because of poor hay digestibility throughout the winter feeding period. While there are essential fats needed in the diet, the fat content of beef cattle diets is generally low < 3 percent (diet dry matter). Fats are sometimes added to feed rations and supplements to increase the energy content because fat has 2.5 times the energy value of a carbohydrate. Too much fat (> 6 percent diet dry matter) in the total diet should also be avoided.

Minerals for Beef Cattle

Minerals are essential in beef cattle diets. Deficiencies in any of the required minerals will reduce production efficiency. The mineral content of the animal's body makes up approximately 5 percent of its weight. Minerals are classified into two general categories – macro and trace or micro minerals – based on their relative amounts present in the animal's body and secondly on the amounts needed in the ration. The macro minerals are calcium, phosphorus, magnesium, potassium, sodium, chlorine and sulfur. The trace minerals most often needed in the beef animal's diet are iron, manganese, copper, iodine, cobalt, zinc and selenium.

Macro Minerals

Calcium (Ca)

Calcium is the major element of bones; approximately 99 percent of the body's calcium supply is in bones and teeth. In addition to its role in the skeletal system, calcium is also required for many other functions in the body. A major role is in the

muscle contraction process. Calcium is usually present in adequate amounts in forage and is quite high in legume plants; however, calcium may be limited in feedlot rations as grains and most by-product feedstuffs are low in calcium.

Phosphorus (P)

Approximately 80 percent of the body's supply of phosphorus is in the skeleton and teeth. In addition to its obvious role in these areas, phosphorus has been shown to be very important in absorption and transport of various compounds within the body. It is also involved in energy transfer. Because of this, phosphorus may be viewed as the most versatile mineral element. A phosphorus deficiency is often characterized by poor reproductive performance in beef cows. Grains are considered to be moderate to high in phosphorus while forages usually contain low to moderate amounts. Supplementation of phosphorus is often needed in a grazing situation. The level of phosphorus supplementation will be dependent upon forage species and soil fertility. A forage test can help determine phosphorus supplementation needs. Certain minerals must be kept in proper ratio to one another in the ration because their roles in metabolism and body functions are interrelated. For this reason, a Ca:P ratio of 1:1 to 5:1 should normally be maintained.

Magnesium (Mg)

Magnesium is closely associated with calcium and phosphorus in its distribution and metabolism in the animal's body. Under normal conditions, Mg is not a problem; however, the condition "grass tetany" is related to Mg deficiency. This is most likely to occur with mature beef cows grazing lush spring pasture. When there is risk of tetany, cattle producers will often feed a high magnesium mineral. Feeding a high magnesium mineral should start at least one month in advance of the period tetany is most likely to occur. Mineral mixes designed to help prevent grass tetany usually contain 10 percent magnesium. In some situations, a custom feed mix may need to be formulated to provide greater levels of magnesium than that available in common mineral mixes.

Potassium (K)

Potassium is usually found in the intracellular (within the cell) fluids. It functions primarily to maintain osmotic pressure within the cell, maintain proper pH and the transfer of nutrients across the cell wall. Forages usually contain excessive amounts of this mineral, thus grazing cattle are not usually supplemented with K.

Sodium (Na) and Chlorine (Cl) (Salt)

Sodium (Na) and Chlorine (Cl), more commonly known as salt, are used in the body to regulate osmotic pressure in cells and contribute to buffering systems. Sodium is also essential in the transmission of nerve impulses. Cattle will normally consume more than their requirements if given free access to either loose salt or blocks. Since the storage of these two elements in the body is rather limited, a regular supply should be self-fed.

Salt is sometimes used as an intake limiter for a self-feeding ration. In this situation, an abundant supply of fresh water is a must to prevent salt toxicity.

Trace Minerals

The level of trace minerals in the basic diet is ignored many times in ration formulations and 100 percent of the animal's requirements are added. This is done because of the tremendous variability that exists in the trace mineral composition of feeds and the minimal cost involved in adding these elements to the ration. Iodine, copper and selenium are all deficient in many soils of the United States. Cobalt may need to be supplied because of its role in the formation of vitamin B12 by rumen microorganisms. Copper has been shown to be deficient in the coastal plains region where heavy stocking rates and high nitrogen fertilization have occurred. Arkansas forages can be marginal in copper, and there are several copper antagonist, including sulfur, molybdenum and iron, that affect copper's absorption. Supplementing copper is recommended. Selenium deficiencies have been found in fescue pastures in north Arkansas. Trace mineral supplements are categorized as two types: inorganic and organic. The common inorganics include sulfates, oxides and chlorides. The bioavailability of these are generally good with the exception of copper and iron oxide. Copper oxide should be avoided in free-choice mineral supplements. Organic forms include elements bound to simple amino acids or more complex organic structures. Organics often have a greater bioavailability than inorganics; however, in mineral supplements they are seldom used as the sole source of a trace mineral.

Vitamins for Beef Cattle

Pasture and average to excellent quality roughages usually contain sufficient quantities of

the vitamins needed by beef cattle to support body maintenance, production and reproduction. Beef cattle may need vitamins A, D and E supplementation where the forage supply consists of crop residue, over-mature or weather-damaged hay or dry winter forage.

Vitamins are classified as fat soluble or water soluble. The water soluble vitamins include vitamin C and the B vitamins. B vitamins are produced by microbes during rumen fermentation and are seldom deficient in beef cattle. Vitamin C is only needed in the diets of humans, monkeys and guinea pigs.

The fat soluble vitamins include vitamins A, D, E and K. Vitamin K is synthesized in the rumen under most feeding conditions. Thus, the animal has little need for supplemental K. Vitamins A, D and E are routinely included in mineral mixes.

Vitamin A

Vitamin A is strictly a product of animal metabolism. Its counterpart in plants is known as carotene. The beef animal transforms carotene into vitamin A. Cattle store vitamin A and carotene in the liver and body fat during periods of abundant intake. These periods occur when animals are grazing green forage. The stored reserves may be adequate to meet the animal's needs for two to four months. Vitamin A deficiencies may cause night blindness, watery eyes and, in pregnant animals, abortions. Weak calves, retained placentas and rebreeding problems may also occur. If animals are on a prolonged diet of bleached or weathered roughage, vitamin A stores may be depleted from the body. This vitamin may be provided to the cow herd by injection, added to the mineral mix or in their regular ration. Pregnant cows that are being fed low-carotene feeds should receive the equivalent of 30,000 international units (IUs) of vitamin A daily while lactating cows should receive 45,000 IUs.

Vitamin D

Beef cattle usually receive adequate amounts of this vitamin by exposure to direct sunlight or through consuming sun-cured forages. Vitamins D and E are usually included with vitamin A supplements or injection solutions administered to cattle. Only cattle kept indoors and not fed sun-cured hay are likely to show symptoms of vitamin D deficiency.

Vitamin E

Under most conditions, natural feedstuffs supply the requirements of vitamin E. Cereal grains, grain forages and good quality hay are all excellent sources of this vitamin. Vitamin E is usually added to mineral-vitamin supplements because of its antioxidant properties which facilitate the uptake and storage of Vitamin A.

Balancing Rations

Several terms used in balancing beef cattle rations are:

Diet – The feed an animal receives in a 24-hour period.

Ration – The feed an animal receives in a 24-hour period.

Balanced Ration – A ration that furnishes the nutrients needed in the proper amounts to allow the individual to perform a certain function such as maintenance, growth, gestation or lactation.

Dry Matter (DM) – The feed remaining after all water is removed. Dry matter averages about 35 percent in silages, 90 percent in No. 2 corn and 90 percent in hay.

Supplement – A concentrate feed added to a ration to provide one or more nutrients not adequately supplied by the usual feed.

Nutrient – Any feed component or group of feed components of similar chemical composition that aid in the support of animal life. Protein, carbohydrates, fat, minerals and vitamins are examples. Carbohydrate, fat and excess protein are all used in the animal body as energy.

Total Digestible Nutrients (TDN) – A term used as a measure of energy (caloric content of feedstuffs). On an as-fed basis, grains usually contain 65 to 80 percent TDN, hays usually 50 percent and less, and silages about 20 percent.

Crude Protein – The crude protein content of a feed is determined by analyzing the feed for nitrogen. Protein in a feed contains approximately 16 percent nitrogen; therefore, multiplying N by 6.25 gives the total protein content of the feed.

Since purchased feeds are usually expensive, home-raised forages should supply the major source of nutrients needed by beef cattle. Purchased supplements, whether for energy or protein, should be fed only to supply those nutrients not furnished by home-grown forages. Forage and grain diets almost always need to be supplemented with minerals for maximum production.

To formulate a balanced ration, you should know (1) the nutrient requirements of the beef cattle to be fed and (2) the nutritive value of feedstuffs available. Table 6-2 gives a partial listing of the National Research Council's (NRC) nutrient requirements of beef cattle.

Average composition values of Arkansas-produced feeds are presented in Table 6-3. While the average nutritive content of many feedstuffs is known, the nutritive content of roughages is highly variable. Therefore, it is very important to have an analysis conducted on these feeds to determine their exact nutrient content so that rations may be balanced accurately. An analysis is inexpensive and often prevents expensive mistakes in underfeeding or overfeeding. **DON'T GUESS – FORAGE TEST.**

To formulate a ration for a 1,100-pound mature, lactating beef cow (2 months since calving, 20 pounds peak milk), first list (as shown in Table 5-1) the nutrient requirements of this class of cattle from Table 6-2. Next, assume that grass hay is available for feeding with the following analysis on a dry matter basis: 10 percent protein, 58 percent TDN, 0.35 percent calcium and 0.18 percent phosphorus. Assume daily intake of grass hay will be 26.4 pounds. Calculate the daily intake of each nutrient by multiplying the daily intake by the hay analysis (for protein, 26.4 x 0.10 = 2.64 pounds).

TABLE 5-1. 1,100-Pound Lactating Cow, 2 Months Since Calving, 20 Pounds Peak Milk

	Pounds				
	DM	Protein	TDN	Calcium	Phos-phorus
Requirements	26.4	2.88	15.9	0.084	0.055
Grass hay	26.4	2.64	15.3	0.092	0.048
Deficiency (-)/Excess (+)		-0.24	-0.6	+0.008	-0.007

Grass hay alone supplies inadequate amounts of protein, TDN and phosphorus. From Table 6-3, corn and cottonseed meal are chosen as good sources of TDN and protein, respectively. Next, the net gain by feeding supplemental corn and cottonseed meal is determined.

One pound of grass hay dry matter contains 0.58 pounds of TDN, while one pound of corn dry matter contains 0.90 pound of TDN. The net effect of replacing one pound of grass hay with one pound of corn dry matter is a net gain of 0.32 pound of TDN (0.90 - 0.58 = 0.32).

A deficiency of 0.6 pound of TDN exists. Dividing the pounds of nutrient deficiency by the pounds of nutrient gain gives the pounds of dry matter to substitute. For example:

$$\frac{\text{0.6 pound TDN needed}}{\text{0.32 pound TDN net gain}} = \text{1.9 pounds of corn dry matter substituted for 1.9 pounds of grass hay dry matter}$$

The protein deficit of 0.24 pound does not change because corn and the grass hay contain the same amount of crude protein.

Next, determine how much cottonseed meal is needed to meet the protein deficit. One pound of cottonseed meal substituted for one pound of grass hay gives a net gain of 0.36 pound (0.46 - 0.10 = 0.36) of protein when 1 pound of cottonseed meal is substituted for 1 pound of hay.

$$\frac{\text{0.24 pound protein needed}}{\text{0.36 pound protein net gain}} = \text{0.67 pound of cottonseed meal}$$

The amount of grass hay in the ration is reduced to 23.8 pounds due to the substitution of 1.9 pounds of corn and 0.7 pound of cottonseed meal. The balanced ration is as follows in Figure 5-2:

TABLE 5-2. 1,100-Pound Lactating Cow, 2 Months Since Calving, 20 Pounds Peak Milk

	Pounds					
	DM (lbs)	Total Feed (as-fed)	Protein (lbs)	TDN (lbs)	Ca (lbs)	P (lbs)
Requirements	26.4	---	2.88	15.9	0.084	0.055
Ration:						
Grass hay	23.8	26.4	2.38	13.8	0.083	0.043
Corn	1.9	2.1	0.19	1.7	---	0.006
Cottonseed Meal	0.7	0.8	0.32	0.5	0.001	0.008
Total	26.4	29.3	2.89	16.0	0.084	0.057

The total feed (as-fed) is determined by dividing the pounds of feed (dry matter basis) by the percent dry matter in the feed (for grass hay with 90 percent dry matter, 23.8 divided by 0.90 = 26.4).

Grass hay fed alone was deficient in phosphorus, but supplemental corn and cottonseed meal eliminated the phosphorus deficiency. If phosphorus deficiency was a problem, dicalcium phosphate or another feed with a high phosphorus level could be used to meet the animal's requirement. If only calcium was deficient, limestone could be used. The same procedure used to determine protein and TDN needs would be used to determine calcium or phosphorus needs.

A mineral-vitamin supplement should be provided with the ration above to supply adequate amounts of all required minerals, including salt, trace minerals and also vitamin A.

When purchasing nutrients to balance a ration, always purchase the feed that provides the least cost per pound of nutrient needed. For example, if energy is a limiting factor in your ration, then supplement the ration with a high-energy feed. Refer to Table 6-3 (Composition of Feeds) for the TDN level of various feeds and calculate what each unit of TDN costs by using the following formula:

$$\text{Cost/cwt of TDN} = \frac{\text{Cost of feed/cwt}}{\text{Lbs of TDN/cwt (as-fed basis)}} \times 100$$

To convert TDN value of corn on a dry matter basis to an as-fed basis, multiply the TDN value of corn on a dry matter basis (90 percent) by percent dry matter for corn (90 percent).

$$\underset{\text{(TDN)}}{90\%} \times \underset{\text{(DM)}}{0.90} = \underset{\text{As-fed}}{81\%\ \text{TDN}}$$

$$\text{Corn} \quad \frac{\$6/\text{cwt}}{81\ \text{lbs of TDN/cwt}} \times 100 = \$7.40/\text{cwt TDN}$$

To calculate the cost of a protein supplement:

$$\text{Cost/cwt of total protein} = \frac{\text{Cost of feed/cwt}}{\text{Lbs of protein/cwt}} \times 100$$

A computer is often used to calculate beef cattle rations. Several ration formulation programs are available for public use. Contact the county Extension office to help plan feeding programs for individual farms.

Chapter 6

Beef Cattle Feeding

The greatest single cost in beef cattle production is feed. It represents from 65 to 75 percent of the total cost of keeping cows and represents an even greater cost item in finishing cattle.

It is very important that feeding practices be both adequate and economical. Feed has a tremendous effect on breeding efficiency and weaning weight of calves and, thus, influences both cow productivity and profit.

In feeding cattle there are two main goals: (1) determine the amount of each nutrient the animal needs (Table 6-2) and (2) determine how much and what kind of feed should be fed to cattle to supply their nutrient needs. For optimal performance, feeding a balanced ration which furnishes necessary nutrients in the amounts and proportions needed for proper nourishment is necessary.

Underfeeding and overfeeding are both costly problems for many Arkansas cattle producers. Underfeeding may result in lower calf crop percentage, lighter weaning weights, slower growth rates and increased parasite load depending upon the severity of undernourishment. Overfeeding is too expensive and cuts into profits.

Emphasis should be given to the amount and kind of feed needed each day. For example, thin-growing animals may consume up to 3 percent of their body weight as air-dry feed, while mature animals in fleshy condition may consume as little as 1.5 percent of their body weight.

The quality of the feedstuff has an effect on the amount an animal can consume as a percentage of its body weight. Physical fill and digestibility limit the intake of low-quality forage; whereas, metabolic control over satiety limits intake of high-quality feeds.

Feeding the Cow Herd

Most Arkansas cow-calf producers should strive to meet the nutritional needs of the cow herd with a year-round forage production program. During certain periods of the production year, supplementing the available forage with other feeds (Table 6-3) may be necessary, but the easiest and most economical feeding program for the cow herd is based on forages the cow harvests by grazing. The Arkansas climate is fairly well suited to grow cool-season grasses and small grains that enable year-round grazing for the cow herd with good pasture management.

The beef cow's nutritional requirements vary depending upon the (1) stage of production, (2) level of production, (3) age, (4) weight, (5) condition, (6) weather and (7) specific nutrient deficiencies in the area.

Stage of Production

The nutrient requirements of a beef cow change with her stage of production. The beef cow's production year begins at calving and ends with calving the next year. This period can be divided into four major stages of production: (1) the 82-day post-calving period, (2) a 123-day period during which the cow is lactating and attempting to breed or is in the early stages of pregnancy, (3) a 110-day mid-gestation period and (4) the 50 days just prior to calving.

TABLE 6-1. Calving

Period 1 (82 Days)	Period 2 (123 Days)	Period 3 (110 Days)	Period 4 (50 Days)
Early Lactation (1 to 3 months after calving)	Pregnant and Lactating (4 to 7 months after calving)	Mid-Gestation (8 to 10 months after calving)	Immediately Precalving (11 to 12 months after calving)

Period One – This 82-day period is the most critical of the cow year. During this time, the cow has just undergone the stress of giving birth, is lactating at a peak level and must gain strength and condition to start the reproductive cycle and rebreed. Most Arkansas cattle calve in the late winter or early spring; therefore, this period usually starts in February or March. The cow is often being fed hay or some other form of stored feeds at this time.

As spring pasture arrives, the green grass may appear to solve many nutritional requirements for the cow. Because of the high moisture content in spring grass, the average lactating cow may not be able to consume enough to provide necessary energy and dry matter requirements. Continued feeding of dry hay or even grain may be economically feasible during this time if the cows are not milking well or slow in rebreeding.

TABLE 6-2. Nutrient Requirements of Beef Cattle

Growing Steer and Heifer Calves – 1,100 Pounds @ Finishing or Maturity (Replacement Heifers)

Body Wt. (lb)	ADG (lb)	DMI (lb/day)	TDN (lb)	CP (lb)	Ca (lb)	P (lb)	Vitamin A (1,000s IU)
400	1.5	10.7	6.8	1.30	0.053	0.026	11
	2.0	10.7	7.4	1.51	0.066	0.031	11
500	1.5	12.6	8.1	1.41	0.054	0.027	13
	2.0	12.7	8.8	1.63	0.066	0.032	13
600	1.5	14.4	9.2	1.53	0.054	0.028	14
	2.0	14.6	10.1	1.74	0.065	0.033	15
700	1.5	16.2	10.4	1.64	0.054	0.030	16
	2.0	16.3	11.2	1.85	0.064	0.034	16

Pregnant Replacement Heifers – 1,100 Pounds Mature Weight

	Months Pregnant	DMI (lb/day)	TDN (lb)	CP (lb)	Ca (lb)	P (lb)	Vitamin A (1,000s IU)
	1	18.0	9.1	1.30	0.041	0.032	23
	2	18.5	9.3	1.33	0.041	0.032	23
	3	19.0	9.6	1.36	0.042	0.032	24
	4	19.5	9.9	1.41	0.043	0.033	25
	5	20.1	10.3	1.47	0.043	0.034	26
	6	20.8	10.9	1.57	0.044	0.035	26
	7	21.5	11.6	1.70	0.069	0.049	27
	8	22.3	12.6	1.92	0.069	0.049	28
	9	22.9	13.9	2.24	0.069	0.050	29

Two-Year-Old Heifers (20 Pounds Peak Milk) – 1,100 Pounds Mature Weight

	Months Since Calving	DMI (lb/day)	TDN (lb)	CP (lb)	Ca (lb)	P (lb)	Vitamin A (1,000s IU)
	2	22.5	13.9	2.45	0.072	0.045	40
	7	20.2	9.9	1.39	0.036	0.026	26
	11	21.4	11.9	1.79	0.060	0.036	27

Mature Beef Cows (20 Pounds Peak Milk) – 1,100 Pounds Mature Weight

	Months Since Calving	DMI (lb/day)	TDN (lb)	CP (lb)	Ca (lb)	P (lb)	Vitamin A (1,000s IU)
	1	25.4	15.0	2.62	0.075	0.051	45
	2	26.4	15.9	2.88	0.084	0.055	47
	3	26.9	15.6	2.73	0.077	0.051	48
	4	26.0	14.7	2.45	0.068	0.046	46
	5	25.0	13.8	2.17	0.060	0.042	44
	6	24.2	13.0	1.95	0.053	0.037	43
	7	20.9	9.8	1.36	0.033	0.026	27
	8	21.2	10.0	1.40	0.033	0.026	27
	9	21.8	10.4	1.45	0.033	0.026	28
	10	22.6	11.1	1.56	0.057	0.036	29
	11	22.5	11.7	1.73	0.057	0.036	29
	12	23.0	12.9	2.00	0.057	0.036	29

Yearling and Breeding Bulls – 2,000 Pounds Mature Weight[a,b]

Body Wt. (lb)	ADG (lb)	DMI (lb/day)	TDN (lb)	CP (lb)	Ca (lb)	P (lb)
1,000	1.73	25.2	15.1	1.89	0.062	0.036
	2.75	24.6	17.2	2.23	0.078	0.043
1,200	1.73	28.9	17.3	1.96	0.063	0.039
	2.75	28.2	19.7	2.22	0.075	0.044
1,400	0.49	30.7	15.4	1.74	0.051	0.036
	1.73	32.4	19.4	2.03	0.064	0.041
1,600	0.49	33.9	17.0	1.88	0.056	0.040
	1.73	35.8	21.5	2.09	0.066	0.044
1,800	0.49	37.0	18.5	2.02	0.061	0.044
	1.73	39.1	23.5	2.16	0.067	0.047
2,000	0.00	37.2	17.1	2.07	0.062	0.047
	0.49	40.1	20.1	2.15	0.065	0.049

[a]For bulls that are at least 12 months of age and weigh more than 50 percent of their mature weight.
[b]Vitamin A requirements per pound of dry feed are 1,000 IUs for growing bulls and 1,770 IUs for breeding bulls.

TABLE 6-3. Composition of Feeds

(All values except dry matter are shown on a dry-matter basis.)

	Feedstuffs	Dry Matter %	Crude Protein %	TDN %	Calcium %	Phosphorus %
	Dry Forages					
1.	Alfalfa hay, early bloom	90	18.0	60	1.41	0.22
2.	Alfalfa hay, mid bloom	90	17.0	58	1.41	0.24
3.	Bermudagrass hay	87	12.3	59	0.51	0.27
4.	Bromegrass hay	88	11.0	56	0.63	0.10
5.	Corncobs	90	2.8	50	0.12	0.04
6.	Corn stover	85	6.6	50	0.57	0.10
7.	Cottonseed hulls	90	4.2	42	0.15	0.09
8.	Fescue hay	87	11.2	54	0.50	0.31
9.	Grass-clover hay, 65%-35%	88	12.2	55	0.83	0.27
10.	Ladino clover hay	89	22.4	60	1.45	0.33
11.	Lespedeza hay, mid bloom	93	14.5	50	1.04	0.23
12.	Oat hay	91	9.5	53	0.32	0.25
13.	Orchardgrass hay, early bloom	89	12.8	65	0.27	0.34
14.	Red clover hay	89	15.0	55	1.38	0.24
15.	Rice straw	91	4.3	41	0.21	0.08
16.	Sorghum stover	88	5.2	54	0.52	0.13
17.	Soybean hay, mid bloom	94	17.8	53	1.26	0.27
18.	Wheat straw	91	3.5	40	0.17	0.05
	Silages					
19.	Alfalfa, wilted, early bloom	35	17.0	60	1.00	0.22
20.	Corn, well eared	35	8.7	72	0.25	0.22
21.	Grass-legume	28	12.1	57	0.86	0.29
22.	Sorghum	33	10.1	56	1.03	0.40
23.	Sorghum-sudangrass	30	9.0	62	0.49	0.28
	Concentrates					
24.	Barley	88	13.2	84	0.05	0.35
25.	Brewers grains, dehydrated	90	29.2	66	0.29	0.70
26.	Brewers grains, wet	21	26.0	70	0.29	0.70
27.	Corn, dent, grade 2	90	9.8	90	0.03	0.32
28.	Corn gluten feed	90	23.8	80	0.07	0.95
29.	Cows milk	12	25.8	130	0.92	0.67
30.	Cottonseed meal, 41%	90	46.1	75	0.20	1.16
31.	Cottonseed, whole	89	24.4	95	0.17	0.62
32.	Dehydrated alfalfa, 17%	92	18.9	61	1.51	0.25
33.	Ground ear corn	87	9.0	82	0.07	0.27
34.	Molasses, sugarcane, dehydrated	94	10.3	70	1.10	0.15
35.	Molasses, sugarcane (black strap)	74	5.8	72	1.00	0.10
36.	Oats	89	13.6	77	0.01	0.41
37.	Rice, rough	89	8.9	79	0.07	0.32
38.	Sorghum grain	90	11.6	82	0.04	0.34
39.	Soybean hulls	90	12.2	77	0.53	0.18
40.	Soybean meal, 44%	89	49.9	84	0.40	0.71
41.	Soybeans, whole	90	40.3	94	0.27	0.65
42.	Wheat	90	14.2	88	0.05	0.44
43.	Wheat middlings	89	18.4	83	0.15	1.00
	Mineral Sources					
44.	Dicalcium phosphate	97	---	---	22.0	19.3
45.	Deflorinated phosphate	100	---	---	32.0	18.0
46.	Limestone, calcium carbonate	100	---	---	34.0	---
47.	Magnesium oxide (55% magnesium)	98	---	---	3.1	---
48.	Sodium tripolyphosphate	96	---	---	---	25.0
49.	Steamed bone meal	97	13.2	---	27.0	12.7

Period Two – For the next 123 days, the cow is in the early stages of pregnancy and is also nursing a calf. Milk production declines during this period, and the calf increases its grass consumption to meet its own needs. Drought and the accompanying shortage of total feed supply are often the main concern during this time. Short grass growth usually results in decreased milk production and lighter calf weights but should not affect the reproductive capability of the cow during this period as long as she stays healthy. Supplemental feeding of the cow for greater milk production is rarely economical. Creep feeding the calf 30 to 45 days prior to weaning will usually improve weight gain and reduce weaning stress; however, the economic return to creep feeding is affected by the quality and quantity of pasture forage as well as the cost of the creep feed supplement.

Period Three – This mid-gestation period of around 110 days is the time when the cow's needs are at her lowest level. If the cow is on stored forage, the worst hay in the barn should usually be fed.

Period Four – This 50-day period is the second most important in the cow's year. This is in midwinter for most Arkansas cattle operations. During this time, 70 to 80 percent of fetal growth occurs. At the time of calving, the cow should be in a moderate body condition (body condition score of 5 on a 1 to 9 scale) and gaining weight to withstand the stress of calving, beginning of lactation and rebreeding on time.

Level of Production

Heavy weaning weights are usually accompanied by high milk production in the cow herd and often by larger cows. Both milk production and cow size influence nutrient requirements. Failure to supply the adequate nutritional level reduces the milk supply and prevents the calf from growing to its full genetic potential and, more importantly, affects the cow's ability to cycle and rebreed on time. Table 6-4 shows differences in nutritional requirements that may exist.

TABLE 6-4. Nutritional Requirements as Influenced by Weight and Milk Production

Mature Cow Weight	Peak Milk Production			
	10 lbs/day		20 lbs/day	
	900 lbs	1,200 lbs	900 lbs	1,200 lbs
	Requirements daily, lbs			
Dry matter	20.6	24.9	23.5	27.8
Crude protein	1.92	2.19	2.70	2.97
TDN	11.7	13.9	14.5	16.7
Calcium	0.053	0.062	0.077	0.086
Phosphorus	0.035	0.042	0.051	0.057

Age

The nutrient requirements of females vary greatly between the young, growing heifer or first-calf cow and the mature cow. Replacement heifers and first-calf cows must perform all the reproductive functions of the mature cow plus maintain an adequate level of growth. Requirements for mature cows are primarily related to size and the stage of production. Separating replacement heifers from mature cows is necessary to provide the most adequate and economical feeding system.

Weight

Nutrient requirements vary with cow size. Large cows have greater nutrient requirements than small cows and must be fed accordingly if adequate reproduction levels are to be maintained.

Condition

Condition, or the amount of flesh on the cow, is important. In a spring calving program, cows that are in above-average condition in the fall can be fed less and lose weight over the winter but still maintain an adequate reproduction level. (See information on body condition scores in the section on "Beef Cattle Management Practices.") Thin cows will have to be fed more and gain weight prior to calving or reproductive efficiency will be adversely affected. Table 6-5 shows reproductive performance of cows in different body conditions at calving.

TABLE 6-5. Reproduction of Cows in Different Body Conditions

Body Condition at Calving	Percent Pregnant after Breeding for	
	20 Days	80 Days
Thin	33	76
Moderate	47	93
Fleshy	58	96

Source: Dr. J. N. Wiltbank, Texas A & M University

Weather Stress

The cow's energy requirements will increase 20 percent or more in extremely cold or cold and wet weather.

Some of the guesswork while feeding during severe winter months is eliminated by using a cattle feed index as a guideline to adjust the quantity of feed fed. The National Weather Service issues the index so that cattle producers can schedule extra feed deliveries or determine labor requirements.

Cattle producers can associate the feed index with the percent of additional feed energy an exposed animal needs during the next 24 hours to maintain body heat without weight loss. If, for example, an animal normally consumes 20 pounds of hay, but the index is 30, then 6 more pounds of hay would be required for that day (20 × 30% = 6). The new ration would be 26 pounds. If the animal would not consume this

amount, then supplemental grain or higher quality forage should be fed so that daily feed energy (TDN) could be increased by 30 percent.

Special Nutrient Deficiencies

Some specific nutrients, primarily minerals, may be deficient on a farm depending on the forage production system and the intensity of grazing. Copper, selenium, zinc and magnesium all have been shown to be deficient under some Arkansas conditions.

Feeds Produced in Arkansas

Arkansas has an abundance of forage and a surplus of protein supplements, but grain production is limited. Most cropland suitable for grain production is used for soybeans, cotton or rice.

Energy Feeds

Milo and some **other grain sorghums** are produced in relatively large quantities in some sections of Arkansas. Much of the sorghum grain produced is used in poultry and swine rations. One limitation to using grain sorghum as a cattle feed is grain sorghum should be processed for feeding.

Wheat is relatively abundant in some areas, but most wheat grain is sold for milling rather than use in cattle rations. As a feed grain, wheat is often more costly than other grains. Similar to milo, wheat grain requires processing for cattle to digest the wheat at its fullest potential. Wheat that is ground into a flour should not be used without seeking advice from a nutritionist.

Corn acreage in Arkansas increased with demand for fuel ethanol. Despite Arkansas not being a major corn production state, its abundant supply makes it a competitive energy supplement for beef cattle. The energy value of many feedstuffs is tied to corn price. Unlike the smaller grains, corn can be fed whole to beef cattle.

Rice bran often serve as both energy and protein sources. Rice bran (unless de-oiled) is quite high in fat content which limits its inclusion rate in some rations.

Soybean hulls (seed coats) often serve as a good source of both energy and protein, especially for cattle on forage diets. They are usually used in rations for cows and growing animals. Although the hulls are relatively high in fiber content, the fiber is highly digestible.

Protein Feeds

Soybean meal and **cottonseed meal** are produced in large quantities in Arkansas. They are commonly used to supplement low-protein feeds. Both are very satisfactory feeds used for beef cattle.

Brewers grain is moderately high in both protein and energy. It is available to some producers in Arkansas from sources within the state or in close proximity to the state. It is usually fed as a high-moisture feed; therefore, spoilage and the additional expense of hauling water are two issues to consider with brewers grains.

Corn gluten feed and **corn distillers grains** are by-products of corn syrup and corn ethanol production. These feeds are routinely used as both protein and energy supplements in Arkansas.

Roughages

Cottonseed hulls, a by-product of the cotton industry, are used as a roughage substitute for beef cattle. Hulls are easily mixed with other ingredients and are eaten quite readily by cattle. The nutritional value of cottonseed hulls is low; therefore, cottonseed hulls do not work well as a sole feed source for beef cattle.

Bermudagrass, fescue, johnsongrass, orchardgrass and **other grass hays** furnish a large portion of the harvested forages fed to beef cattle in Arkansas. They tend to be moderately low in protein (8 to 10 percent) unless heavily fertilized and cut in early stages of growth. Energy supplementation is often necessary for lactating cows, and protein supplementation is sometimes needed when these forages are fed to lactating cows.

Legume hays, such as clover, alfalfa or lespedeza, are good sources of protein, calcium and energy. No protein supplement is needed for beef cattle if at least half of their feed supply is good-quality legume hay. Nutritional requirements of the animal and stage of harvest for the legume hay will dictate how much supplemental energy is needed.

Haylages and **silages.** Both corn silage and grass hay silage continue to grow in popularity. Corn silage harvested at the right stage of maturity will only require protein supplementation. Many cattle producers inaccurately assume grass silage is of greater quality than grass hay. Grass silage can often be of lesser quality if not ensiled properly. One common mistake made on ranches using round bale silage for the first time is not feeding enough. Round bale silage is 50 to 60 percent moisture, whereas hay is 10 percent moisture. Cow intake is generally attributed to the amount of diet dry matter; therefore cows need to be fed a lot more silage round bales compared to dry hay bales for them to be able to meet their daily dry matter fill.

Chapter 7

Forages for Beef Cattle

Forages are required for beef production and provide the majority of nutrients for cattle. In many cow-calf operations, forages provide all the nutrients needed for maintaining the cow and producing the growing calf except for mineral supplementation. A forage system may include pasture, hay, silage, crop residues or any combination of these. Grazing is the most economical method for harvesting forages, so well-managed pasture is a very important feed source. When sufficient forage is not available for grazing, cattle are fed stored forages such as hay or silage. Machine harvesting of forages for hay or silage adds expense, but also adds flexibility because harvested forages can be stored for later use or transported for feeding in other locations.

Matching Pastures With Seasonal Forage Requirements of Cattle

Different livestock operations require different seasonal pasture strategies for optimum animal production. Spring-calving herds have different seasonal forage requirements than fall-calving herds. Stocker calf operations have different forage needs than cow-calf operations. A good pasture program matches forage quantity and quality with the animal nutritional requirements during each season.

The peak seasonal nutritional requirement for a cow-calf operation occurs between calving and rebreeding. The cow will reach peak lactation at about 60 days after calving and should be on schedule to rebreed 60 to 90 days after calving. These performance demands require that pastures be at an optimum level of growth and quality during that period. For spring-calving herds, calving in February/March, the best quality forage should be available April 1 through July. For fall-calving herds, calving in September/October, the best quality forage should be available November 1 through February. Dry, non-lactating cows have lower nutrient requirements and can maintain adequate body condition on lower quality forage after the calf is weaned.

In cow-calf operations, most calves are weaned at approximately 400 to 500 pounds. Preferred weights for calves going to a finishing feedlot are 600 to 800 pounds. So in stocker calf operations, about 200 to 300 pounds of weight can be added to weaned calves before they are ready for the feedlot. High forage quality is required at all times to support good calf weight gains. Weight gains will be low for calves grazing low quality pastures without supplementation. Some producers prefer to utilize existing low or moderate quality pasture and provide supplemental feed, and others prefer to manage for very high quality forages with less feed supplementation. Cost of feed supplements or establishing high quality pastures must be considered for profitability of stocker operations.

Forages for spring and fall pastures include cool-season grasses and legumes such as clover. Cool-season grasses produce most of the annual growth during spring and fall but are usually dormant or unproductive during hot summer months. About two-thirds of the annual growth of perennial cool-season grasses occurs in the spring, and about one-third of the annual growth occurs during the fall. Perennial cool-season grasses commonly grown in Arkansas include tall fescue, Kentucky bluegrass, matua bromegrass and orchardgrass. Winter annual cool-season grasses include annual ryegrass and small grains such as wheat, cereal rye and oats. These grasses can be grown in pure stands or in mixtures with other cool-season grasses or legumes. Forage quality of cool-season grasses is very high when new growth begins in spring but declines as the plants become mature and produce seed. Forage quality of fall regrowth of cool-season grasses is also very good, but it does not decline as quickly during the fall growth phase as in spring because plants remain vegetative during that time of year.

Tall fescue is the major perennial cool-season grass in Arkansas and is adapted statewide. Many tall fescue pastures are infected with an endophyte fungus which causes fescue toxicosis in grazing animals. Animals grazing fescue pastures that are infected with the endophytic fungus can show symptoms of lameness, heat stress, lower weight gains, low milk production and lower conception rates. These symptoms are often more severe when cattle are grazing infected fescue during hot weather. The negative effects of the fescue endophyte can often be reduced by reducing nitrogen fertilizer rates, by planting new pastures of nontoxic endophyte fescue varieties, by

incorporating legumes into existing infected pastures and by grazing other forages during the hot summer months.

Legumes are highly palatable and nutritious to livestock and generally have higher nutritive quality at any given growth stage than grasses. Legumes can be grazed in spring, summer or fall but require careful management to maintain adequate stands. Perennial legumes include alfalfa, white clover and red clover. Annual legumes include annual lespedeza (Kobe or Korean), arrowleaf clover, crimson clover and hairy vetch. Red and white clovers grow in spring, early summer and fall. Alfalfa grows from spring through fall. Annual lespedeza is a summer annual legume that germinates in spring, grows in summer and dies at frost. Arrowleaf and crimson clover and hairy vetch are winter annual legumes that germinate in fall, produce most of their forage yield in spring, then die before summer.

Forages for summer pastures include warm-season grasses and legumes such as lespedeza. Warm-season grasses grow rapidly during the summer months but grow very little in spring or fall. Warm-season grasses provide good quality, actively growing forage during the hot summer when cool-season grasses and many legumes are dormant or unproductive. A forage program that includes both warm-season and cool-season grass pastures will provide a more constant forage supply over the growing season. Typical perennial warm-season grasses grown in Arkansas include bermudagrass, bahiagrass, dallisgrass and johnsongrass. Some annual warm-season grasses include crabgrass, millet (several species) and sorghum-sudan. These grasses usually have a very rapid growth rate and very high production potential. Close attention to grazing or hay harvest management is required to prevent them from becoming too mature for good forage quality, especially in stocker calf operations.

Where wildlife is important on the farm, native warm-season grasses can be grown. Native grasses provide nesting cover for wildlife but also can be grazed or harvested for hay. Native warm-season grasses include big bluestem, indiangrass, little bluestem, eastern gamagrass and switchgrass. These grasses can be grown in pure stands or in mixtures with other native warm-season grasses. The native grasses should not be grazed shorter than 8 inches to maintain stands.

Forages for winter, other than small grain forage or stockpiled fescue, include stored hay and silage and also crop residues. Stored forages are mainly fed during winter but can be used anytime to supplement low pasture availability. Good quality hay can be made from almost all forage species grown in Arkansas. But every species including alfalfa can be very poor quality if allowed to become too mature. Forage quality is influenced mainly by maturity of the forage at harvesttime and, to a lesser extent, by soil fertility. Fiber content of the forage increases as the forage matures and is the primary factor that controls the animal's intake. Mature forages have high fiber content and pass through the digestive tract slowly, reducing animal performance. Leafy, immature, vegetative forages have low fiber content and high nutritive quality. Low fiber forages are digested rapidly and pass through the digestive tract faster, promoting good animal performance.

Visual evaluation of hay may indicate good or poor forage condition, but a lab analysis is the only way to determine nutrient content. Hay samples can be tested for nutrient content by the University of Arkansas Forage Lab and by private laboratories. If there is considerable variation in hay quality, more efficient feeding will result by grouping the hay according to quality, grouping the cattle according to nutrient requirements and matching hay quality with animal nutrient needs.

The amount of hay needed per cow depends upon the hay quality, length of the hay feeding period, storage and feeding methods and conditions, and the production cycle and size of the cow. For a 65-day feeding period, approximately one ton of hay is required per cow, but that nearly doubles for a 120-day feeding period (Table 7-1). Hay can be fed by spreading it on the ground or feeding in bunks or hay feeder rings. The major task in properly feeding hay is to limit waste. Storage and feeding losses of hay can range from as low as 5 percent to as much as 30 percent depending on conditions and hay type. Typical storage losses are chemical and physical deterioration that occur due to rain or water damage, and feeding losses include trampling, leaf shatter, fecal contamination and refusal. The best feeding method is influenced by the type of bale, amount to be fed and weather conditions.

TABLE 7-1. Amounts of Hay Needed Per Cow* (1,100 Lb Average Weight) for 65- to 120-Day Feeding Periods Assuming 25% Feeding and Storage Loss From Large Round Bales

	Hay Feeding Period		
	65 days	90 days	120 days
	---------- lbs of hay ----------		
Non-lactating dry cow – 1,100 lbs	1,787	2,475	3,300
Lactating cow – 1,100 lbs	2,234	3,093	4,125

*Assuming the hay quality meets animal nutritional requirements

Silage for feeding beef cattle in Arkansas is limited mainly to backgrounding or finishing programs. Silage made from corn, sorghum or small grains is relatively high-energy, high-cost feed that can be used more economically when fed to high-producing animals. It is not widely used for feeding beef cows in Arkansas because their feed requirements can be furnished with pasture or hay at less cost. Plastic-wrapped baled silage is becoming popular and is lower cost to produce than chopped silage. Most forages typically cut for hay can be used for making baled silage, but higher quality forages such as small grains, ryegrass, clover and alfalfa are good choices. An advantage of baled silage is that the forage can be cut, baled and wrapped at higher moisture levels during weather that is too wet for drying hay. This helps producers capture the forage quality that would have been lost due to rain damage on partially dried hay or from excessive forage maturity due to delayed hay harvest.

Crop residue is that part of crop plants that remains in the field after grain is harvested. The residue left after harvesting grain sorghum, corn, wheat, soybeans, rice or cotton should not be overlooked as a feed to fill some of the seasonal voids in pasture availability. It is usually low quality and fibrous but may be used for grazing or hay. Before using any crop residue for forage, check the grazing and hay restrictions for all herbicides and insecticides used on the crop. Some crop chemicals cannot be used on any forage fed to livestock. If there is any question about residue from herbicides or insecticides used on the crop, check the pesticide label and contact your county Extension agent.

Planning the Grazing Season

Pasture management involves more than just grazing grass, so good cattle farmers must also be good grass farmers. Optimum pasture growth seldom occurs naturally over an entire growing season, so advanced planning and management are required. ***A good pasture manager must always plan at least one season ahead*** to increase the chances of producing adequate forage for his/her herd. The climate and forage species options in Arkansas are adequate to make long grazing seasons possible. By combining different forage species and pasture management practices, grazing seasons can extend to nearly year-round. A reasonable forage management goal for a cow-calf operation is to plan for a 300-day grazing season and to feed hay for 65 days or less. There are five basic steps for developing a 300-day grazing season. These are:

Five Steps for a 300-Day Grazing Season

1. Inventory the forage base to find what forages are available for grazing during each season.
2. Improve forage management practices to extend the grazing season with the existing forages.
3. Add complementary forages to fill in seasonal gaps if needed.
4. Plan forage and grazing practices ahead for the year and get the schedule on the calendar.
5. Monitor and adjust forages and livestock as needed by keeping records of each practice.

1. Pasture composition and forage inventories

Some of the most common Arkansas forages and the major season of growth or grazing for each are shown in Table 7-2. A very simplistic example using two forage species to fill a grazing season would be fescue for spring, bermudagrass for summer, fescue and stockpiled bermudagrass for fall, and stockpiled fescue for winter. Adding additional forages improves the reliability and nutritive quality of the grazing system.

For sustained forage production over the growing season, a good balance of forage types is needed. In north Arkansas a mix of ⅔ of the pasture acres as cool-season forages and ⅓ of the acres as warm-season forages is desirable, and in south Arkansas the mix may

TABLE 7-2. Common Forage Species* and Major Grazing Periods for a 300-Day Grazing Season in Arkansas

Cool-Season Forages	Warm-Season Forages	Cool- and Warm-Season Forages	Cool-Season Forages
Spring – 100 days *March 1 – June 8*	**Summer – 100 days** *June 9 – Sept. 16*	**Fall – 100 days** *Sept. 17 – Dec. 25*	**Winter – 65 days** *Dec. 26 – Feb. 28*
• Fescue • Clovers/legumes • Orchardgrass • Annual ryegrass • Small grains	• Millet • Sudangrass • Lespedeza • Bahiagrass • Bermudagrass • Crabgrass • Dallisgrass	• Fescue • Clovers/legumes • Orchardgrass • Annual ryegrass • Small grains • Stockpiled bermudagrass	• Stockpiled fescue • Small grains • Annual ryegrass • Hay/stored forages

*Forages listed are the most common, but many other forage species are grown in Arkansas.

be ⅔ warm-season and ⅓ cool-season forages. However, the proportion can vary for each farm due to the needs of the specific livestock operation.

To determine the proportion of different forage species on the farm, you should make a forage inventory. Forage inventories give a snapshot assessment of the forage species composition in each pasture. Inventories show what is currently growing in a pasture, pasture condition due to the effects of past management and provide information to help plan the forage transition from one season to the next. Some pastures may have mostly warm-season grasses, some may have cool-season grasses, others may have significant amounts of clover or weeds. Making inventories for spring, summer and fall reveals the seasonal profile of forage and weed species and indicates whether sufficient forage species diversity exists on the farm for a season-long grazing system. This information is useful for pasture planning, especially in mixed species pastures, because grazing or fertilizer management can be adjusted to ensure growth of different forages for each season or to reduce competition from weeds.

Making a forage inventory is simple. Walk across a pasture and identify what is found at the end of your toe at every fifth step. Record the information as tally marks on a forage inventory sheet. Inventory sheets, such as the one shown at the end of this chapter, can be obtained through the county Extension office, from the Extension web site, or a simple one can be made by listing categories of grass, weeds, clover and bare ground. That list can be expanded to include as many grasses, weeds or legumes as can be readily identified. Try to get at least 50 tally points in a small pasture or 100 tally points in large pastures.

The proportion of each forage or weed type on your farm is calculated from the inventory results. To calculate the area occupied by each forage, multiply the percentage of each forage in the field based on the inventory by the acres of that field. Do this for each field across the entire farm. For example, if field #1 is 20 acres and has 60 percent bermudagrass, 20 percent white clover and 20 percent fescue, then it contains 12 acres of bermudagrass, 4 acres of clover and 4 acres of fescue. Since bermudagrass is a warm-season forage and clover and fescue are cool-season forages, the seasonal profile would be 60 percent warm-season forage and 40 percent cool-season forage for the field.

2. Improve forage management practices to extend the grazing season with the existing forages

Stocking Rate – A key to an efficient pasture program is having the proper animal stocking rate to match the forage productivity in the pasture. The stocking rate varies across farms due to productivity differences, but a typical stocking rate is 2 to 3 acres of pasture per animal unit (AU) for a year (⅓ to ½ AU per acre). Stock density refers to the number of animals per acre grazing a field at any specific time and can be much higher than the stocking rate. For example, 50 AU on a 100-acre farm is a stocking rate of 2 acres per AU for the year (½ AU per acre), but if all 50 cows were put in a 5-acre pasture for one day, then the stock density would be 10 AU per acre for one day. Using high or low stock density on a pasture for short duration is useful for controlling excess forage growth or to reduce overgrazing. It is important to not maximize stocking rate on the farm based on very good growing conditions because poor weather can cause severe forage shortages quickly. Overstocking the grazing system leads to overgrazing and lower forage and livestock production.

Fertilizer Application and Timing – Fertilizer can be applied in split applications over the year to maintain growth of cool- and warm-season forages, but knowledge of the forages and livestock operation is required to make the best use of the fertilizer recommendations. If the pastures are heavily stocked, then fertilizer rates and forage yield must be high to maintain the livestock. If stocking rate is low, then lower forage yields and fertilizer rates are needed. It is not efficient to apply fertilizer and not utilize the forage. Soil tests are the best tools for determining fertilizer recommendations. The University of Arkansas System Division of Agriculture - Cooperative Extension Service provides fertilizer recommendations for hay production, grazing, forage establishment and wildlife food plots. When submitting soil samples, the correct fertilizer crop code must be selected to get the correct fertilizer recommendation for the specific forage and yield level. Consult your county Extension agent for soil sampling recommendations and to select the correct fertilizer recommendations for your forages.

Selecting a grazing system to manage grazing pressure allows you to plan for the seasonal forage transitions as the grazing season progresses. Growth of cool-season forage species declines as summer approaches while growth rate of warm-season forages increases. The opposite occurs as summer transitions to fall. In mixed pastures, managing the seasonal transition to utilize forages as they grow is important. If spring forages are allowed to become too mature, livestock will refuse them and the resulting mature heavy overgrowth creates excessive shading of underlying summer forages. This shading reduces summer forage growth and grazing for the next season in that pasture. Subdividing the pasture with temporary electric fence or changing the stocking rate allows more control of the forage utilization rate by increasing or

decreasing stock density. Increasing stock density in late spring to remove the spring forage canopy allows more sunlight to reach emerging summer forages such as bermudagrass, crabgrass or lespedeza. This sets up a desirable forage transition from spring grazing to summer grazing in the same pasture. Information gained from forage inventories shows which forages will be potentially available before, during and after each seasonal transition. There are several types of grazing systems, and each system has advantages and disadvantages. Some grazing system options include rotational grazing, continuous grazing, set-stocking, leader-follower, creep grazing and strip-grazing.

Rotational grazing allows increased utilization of the forage, thus helping extend the grazing season. Research has shown that increasing the pasture rotation frequency from twice a month to twice a week increased the number of grazing days by 40 percent. No harvest system is 100 percent efficient, especially grazing animals. In a pasture system, estimated animal consumption of the forage is between 30 and 65 percent of what is actually grown. In continuous grazing systems cattle are allowed to continually graze a pasture with no restrictions on rotation. Much of what is produced is wasted, or in overgrazing situations pasture growth rate becomes severely reduced. It is estimated that only 30 to 35 percent of the total forage produced is actually eaten by the livestock. The other 65 to 70 percent is trampled, soiled by mud, manure and urine or used as bedding areas. Closing pasture gates or using electric fence to change pasture or paddock size restricts the grazing habits of the cattle, forcing them to consume a higher percentage of the forage. When well-managed rotational grazing is used, forage utilization can be as high as 65 to 70 percent of the forage produced. This level of utilization can be achieved by rotationally grazing animals among several pastures or paddocks. Rotational grazing systems require more fencing and time for the initial setup but less time to manage afterward. Cattle become trained quickly to electric fence and can be moved quickly between pastures or to working facilities.

Continuous grazing and set-stocking are lower input systems than rotational grazing. In continuous grazing, livestock are allowed full access to all the pasture on a continuous basis. Stocking rate and forage utilization are lower and forages with low tolerance of grazing are harder to maintain in the pasture than in rotational systems. However, continuous grazing requires less time for setup and lower management input than rotational grazing. Set-stocking is a variation of continuous grazing in which a set number of animals are placed in a pasture until the available forage is grazed during a specific season. This is often done with stocker calves on small grain pasture where calves are allowed to graze out the forage before moving to a different pasture.

Leader-follower grazing systems are commonly used when herds with different nutritional needs are being grazed. An example would be grazing weaned calves and dry non-lactating cows. The weaned calves are grazed in a paddock or pasture first and allowed to only graze the high quality top portion of the forage before being rotated to a new paddock. The cows are then moved in to graze the remaining lower quality forage after the calves are moved out. The two groups are rotated across the farm with the cows grazing each paddock after the calves. This gives an opportunity for higher weight gains on the calves while maintaining nutritional status for the cows.

Creep-grazing is a variation of leader-follower grazing in which young calves are allowed to graze high quality pastures before the cows. A simple version is to subdivide paddocks with a single electric wire placed at a height to keep cows in the paddock but high enough for the young calves to go under. The calves can then roam to adjacent paddocks to graze. In more permanent systems, creep gates with openings small enough to allow only calves to pass through are placed in the fence between pastures.

Strip-grazing is used for grazing dormant forages, especially during fall and winter. A single electric wire is used to allow cattle to have access to only a strip or portion of the pasture and is moved as the forage is grazed. Most producers prefer to move the electric fence wire twice a week, but the interval can be as long or short as needed for the operation. It is best to start grazing in a strip nearest the cattle water source then advance the wire across the field. Since the forage is dormant and not growing, a back wire is not needed. The concept is similar to feeding hay but using an electric wire to control access to the forage. The fence protects the ungrazed forage and can double the grazing days per acre.

Stockpiling forages to reduce hay feeding may be one of the most cost-effective pasture management practices available. Demonstrations on farms across Arkansas have shown average savings of $20 per AU or more by grazing stockpiled forages compared to feeding hay. In well-managed systems, over 100 animal grazing days per acre are possible on stockpiled forages. Bermudagrass and bahiagrass can be stockpiled in late summer for fall grazing, and tall fescue can be stockpiled during fall for winter grazing. For stockpiling bermudagrass or bahiagrass, clip or graze the pasture short in early August, apply 50-60 lbs N per acre and allow the forage to grow until mid-

October before grazing. Early fertilization is important because warm night temperatures are required for good warm-season grass growth rates. Waiting until September to fertilize can reduce potential forage yields by 60 to 80 percent. Forage quality of stockpiled bermudagrass and bahiagrass remains good even after frost occurs. However, continued cold weather will cause deterioration of the forage over time and will cause forage quality to decline. These grasses are best grazed during fall up to mid-December. For stockpiled fescue, clip or graze the pasture to about a 3-inch stubble and fertilize with 50-60 lbs N per acre in early September. Early September application is important. Studies have shown little yield response to fertilizer applied in mid-October. The stockpiled fescue grows during the fall with maximum forage accumulation by December. The grazing period can be from late November through February. Fescue tolerates freezing weather and can remain green with good forage quality late into the winter. Forage quality of stockpiled forage is very good when managed as described. Cattle can be continuously grazed (given full access to the stockpiled pasture) or strip-grazed. In many demonstrations, producers that strip-grazed the stockpiled pastures got twice as many grazing days per acre as those that continuously grazed the stockpiled pasture.

3. Plant complementary forages where needed to extend the grazing period

Complementary forages increase the amount of grazing days in a pasture or farm instead of substituting for another forage. An example would be growing ryegrass in a bermudagrass pasture. The ryegrass grows in spring when the bermudagrass is dormant, thus providing more grazing days per acre. Other complementary forages include annual lespedeza or crabgrass on a fescue pasture to fill in summer gaps when the fescue is dormant. Small grains such as wheat, cereal rye, ryegrass and winter annual legumes are high quality forages that work well in winter and spring stocker calf programs. Mixing ryegrass with wheat or cereal rye provides maximum fall and spring grazing. Cereal rye and wheat are more productive in the fall and early spring while ryegrass will extend spring grazing another 3 to 6 weeks in late spring. When annual forages are grown in perennial grass sod, the transition of forages from one season to the next is important to allow optimum growth of each species. Allowing forage to become too tall and mature in one season reduces growth of the forage in the following season.

Legumes are commonly overseeded into grass pastures to improve nutritional quality of the pasture. Grass/legume pastures containing at least 25 percent legumes usually don't need nitrogen fertilization because legumes have symbiotic rhizobia bacteria in the roots that fix N from the air. Good stands of legumes in pastures can fix 50 to 150 lbs of N/acre per year.

Legumes can be planted in fall or late winter. Planting legumes in bermudagrass or bahiagrass pastures should be done in fall when growth of the warm-season grasses is slowing before cold weather. Legumes established in the fall will have a good root system and can begin growth in spring before the competitive growth of the grass occurs. Interseeding legumes into fescue can be done in the fall if the fescue is grazed short or can be planted during February after the fall fescue growth is grazed down. The key for planting small-seeded clovers is to graze the grass very short and to plant the seed very shallow. Seed planted deeper than ¼ inch may not emerge. More successful establishment occurs from planting right at the soil surface than from planting too deep. Legumes need higher soil pH levels than grasses for optimum persistence and growth. Soil tests should always be obtained for fields where legumes will be planted. To get the proper fertilizer recommendation, ask for Crop Code 116, "Legumes Over-Seeded Into Grass Sod," when submitting soil samples.

4. Plan forage and grazing practices ahead for the year and get the schedule on the calendar

When planning a seasonal grazing system, the schedule for most forage practices can be put on a calendar to help keep management done on a timely basis. Some practices to schedule for the fescue-based example is shown in the forage planning calendar below. These include grazing practices, planting periods for complementary forages, stockpiling, and other forage management practices

5. Monitor and adjust forages and livestock as needed by keeping records of each practice

Record keeping of the success and challenges associated with different forage management practices are important. Records provide a good basis for fine-tuning the system and for maintaining the most effective practices. Records can be simple notations on a calendar or can be more detailed analysis kept in a logbook or computer. Severe droughts or flooding conditions may not occur every year, but good records will provide a reference of the practices that worked best in those conditions.

Grazing System Planning Calendar

Grazing 300 days per year requires advance planning. Those plans need to be made at least one season ahead of the season when the forage begins growing. The following tips outline a 300-day grazing season with forage practices for each season and for the seasonal transitions starting in the spring and going through winter.

Grazing Management for Spring Through Summer:

Key Points:

1. Begin rotational grazing as early in spring as possible. Keeping the gates on pastures closed will actually let more grass grow than letting the cows chase new grass over the whole farm.
2. Don't fertilize more area than can be utilized. It's better to fertilize some pasture for early grazing and wait to fertilize for the next season rather than promoting too much grass that is not utilized.
3. To favor legumes, control the grass canopy by rotational grazing management.

The Transition from Spring to Summer:

1. In mixed cool- and warm-season forage pastures, graze more closely in late spring to release the summer forage. This means removing ryegrass or fescue growth to promote growth of the lespedeza, crabgrass or bermuda underneath.
2. Rotationally graze spring legumes to let the cattle spread the N in the legumes across the pasture to boost forage growth in late spring and summer.

Grazing Management for Summer Through Fall:

Key Points:

1. Rotational grazing will maintain forage availability longer into dry weather periods.
2. Don't fertilize more acres than needed.
3. Don't graze lespedeza or crabgrass too early or too short. Grazing lespedeza before the plants are 8 inches tall causes the plants to grow prostrate forming low-growing plants that cattle can't graze effectively.
4. Keep bermuda rotationally grazed to maintain it in a growing vegetative stage.

The Transition from Summer to Fall:

1. In early August graze bermuda short and fertilize for stockpiling for fall grazing. Stockpiled bermuda is grazed from October through December. Stockpiled forage can save $20 per cow compared to feeding hay.
2. In early September graze fescue short and fertilize for stockpiling. Stockpiled fescue can be grazed from December through February.
3. In September graze other bermuda pastures short to prepare for interseeding winter annuals in late September or early October.
4. Graze crabgrass, johnsongrass and lespedeza before frost.

Grazing Management for Fall through Winter:

Key Points:

1. Managing for stockpiled pasture is cheaper than feeding hay, but feeding hay for a short period in fall may allow better stockpiled forage growth if other pasture runs short.
2 Use temporary electric fence to strip-graze stockpiled pastures. Strip-grazing stockpiled pasture doubles the number of grazing days per acre.
3 Use lower quality forage for dry cows and high quality pasture or hay for weaned calves or lactating cows.

The Transition from Fall to Winter:

1. Graze bermuda and fescue short where annuals or clover will be planted in fall then go to stockpiled pasture.
2. Don't graze winter annuals too early. Small grains or ryegrass should be 8 inches tall before grazing.

Grazing Management for Winter through Spring:

Key Points:

1. Strip-graze any remaining stockpiled pasture.
2. Allow winter annual forages to reach 8 inches before grazing.
3. Limit grazing cows 2 days per week on small grain/ryegrass pasture during late winter with hay feeding utilizes the high pasture quality as a feed supplement.
4. Winter annuals can be grazed earlier if strip-grazing or using paddocks.

The Transition from Winter to Spring:

1. Some early fertilization on only a couple of pastures can jump-start spring grazing.
2. Overseed legumes during February in closely grazed pastures.
3. Graze off winter weeds in bermuda in February/March.
4. Set up spring paddocks for early grazing.

DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

Pasture and Hay Forage Inventory Sheet

Field ID:		**Number acres:**	**Date:**

Plant species	**Species count**	**Total**	**Percent**
Fescue			
Orchardgrass			
Kentucky bluegrass			
Small grain			
Annual ryegrass			
Other cool-season grasses			
	Percent cool-season grasses		
Bermudagrass			
Bahiagrass			
Dallisgrass			
Crabgrass			
Other warm-season grasses			
	Percent warm-season grasses		
White clover			
Red clover			
Annual lespedeza			
Hairy vetch			
Annual clovers			
Other legumes			
	Percent legumes		
Perennial broadleaf weeds			
Annual broadleaf weeds			
Perennial grassy weeds			
Annual grassy weeds			
Sedge/rush			
Woody or thorny brush			
	Percent weeds		
Bare ground			

Chapter 8

Beef Cattle Management Practices

Generally success or failure in the cattle business depends to a large extent upon doing the right things at the right time. Whether this is the result of good training and knowledge, good judgment or intuition, the diligence with which some producers carry out certain management practices skillfully makes them more successful than others. This is often referred to as the MAN in MANagement.

Management of Breeding Animals

Calving Season

For efficient beef production, every cow should produce a calf each year. It is best if all calves are born within a 60- to 90-day period. A controlled, seasonal calving program is necessary to carry out good management practices.

- It facilitates the keeping of good production records, thus making comparisons between cows and calves more meaningful for culling and selection purposes.
- Better care can be provided to cows during calving. It is very difficult to properly check cows that are calving year-round.
- Seasonal calving helps manage a good herd health program. If cattle producers perform such practices as identification, castration, dehorning, vaccination, worming and weaning within a short time span or all at one working, the labor requirement is greatly reduced.
- Pregnancy testing can be done more conveniently on a seasonal calving program.
- The nutritional requirements vary greatly between animals at the various stages of reproduction and production. When all cows are in a similar stage of production, brood cow nutrition can be properly managed.
- Finally, seasonal calving improves the opportunity for successful marketing.

Some producers may prefer a split calving season. For example, the cattle may be divided into two herds with one calving in October, November and December and the other in February, March and April. A split calving season enables each bull to breed more cows each year. It can also allow more efficient use of feed supplies and extend the marketing season. A controlled calving season is still possible in a split calving system, but additional labor and pasture facilities are required.

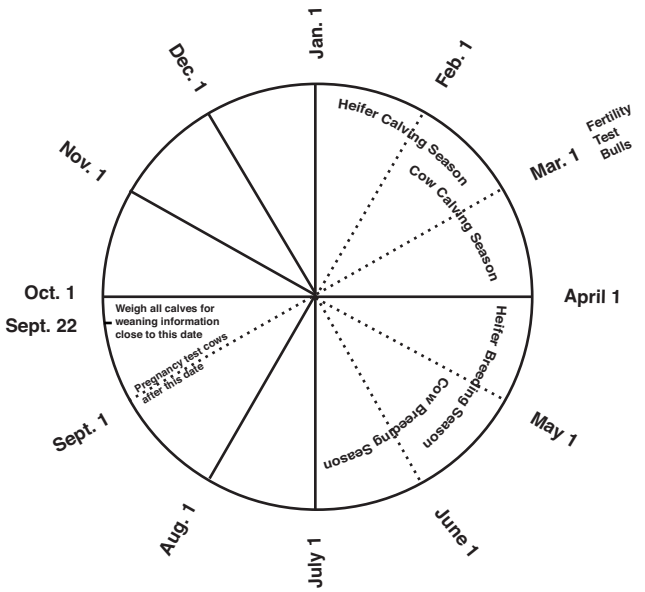


FIGURE 8-1. Calendar for 60-day calving breeding season.

Breeding Management

Good breeding management starts several months before the bulls are turned in with the cows. Proper development of young bulls and replacement heifers and proper nutrition of cows from six weeks prior to calving and continuing through the breeding season are necessary to ensure early estrus and high conception rate.

Other breeding management techniques during the season that will be advantageous are:

- Expose heifers approximately 30 days before the breeding season selected for the mature cow herd. This allows 30 extra days for young cows to recover from calving and be ready to breed within the calving season their second year of production.

- Breeding heifers to bulls known to produce calves with small birth weights or with calving ease EPDs can greatly reduce calving difficulties.
- Separate heifers with their first calf from the mature cow herd and feed separately. First-calf heifers need feed to continue growth and development in addition to the feed required for milk production and regular reproduction.
- Provide adequate "bull power" during the breeding season. The number of bulls required depends on the age and condition of the bulls, general herd health and the system of matings. A bull can service more cows when hand mated than when pasture mated. More bull power is necessary for a confined calving season than if the calving season is split or the cows are calving year-round. The general recommendation is one mature bull to 25 cows.

Fertility Testing Bulls

Checking the bulls for fertility and breeding ability is insurance. The test should include a thorough physical examination by a veterinarian to determine if the reproductive organs are normal and functional. A semen evaluation should be made to determine motility of sperm and sperm abnormalities. A test service on one or two cull cows or heifers that are "in heat" provides some assurance of the bull's ability to mate. The bulls should be in good breeding condition, not too fat and sound in feet and legs. If bulls are to be worked hard, additional grain or other high-quality feed may be required. Alternating use of bulls during the breeding season can extend their usefulness and help prevent calf crop losses due to reduced bull fertility from overwork or injuries.

Evaluation of a bull should include a measurement of scrotal circumference. This ranks as one of the most useful and valid measurements of a bull's breeding ability. Scrotal circumference is highly correlated with semen production capacity in young bulls. Research also has shown that bulls with larger testicles tend to sire heifers that reach puberty at a younger age. The diagram in Figure 8-2 indicates how this measurement is taken.

Semen quality should be determined by an experienced veterinarian. Semen is scored for **motility** and **morphology**. Bulls are said to have satisfactory semen if the sperm morphology is ≥ 70 percent normal sperm, sperm motility ≥ 30 percent individual motility and/or "fair" gross motility and a scrotal circumference that is equal to or larger than the preset standard for bulls of their age. Table 8-1 gives the scoring system recommended by the Society of Theriogenology.

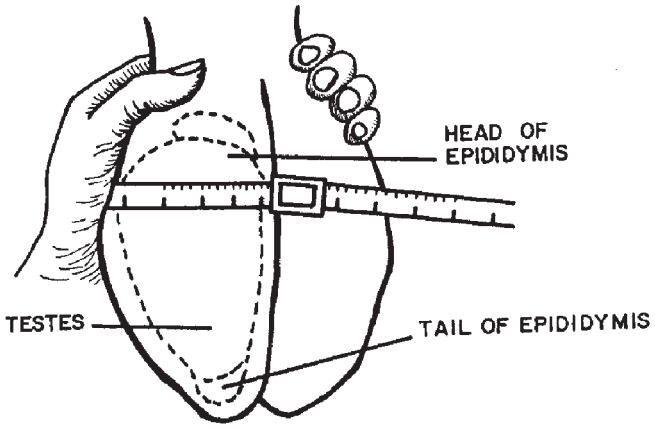


FIGURE 8-2. The proper way to measure scrotal circumference.

TABLE 8-1. Standards for Scrotal Circumference and Sperm Morphology and Motility

Category	Threshold
Scrotal Circumference _____ (cm)	30 cm at ≤ 15 mo. 31 cm at > 15 mo. ≥ 18 mo. 32 cm at > 18 mo. ≥ 21 mo. 33 cm at > 21 mo. ≥ 24 mo. 34 cm at > 24 mo.
Sperm Morphology	≥ 70% normal sperm
Sperm Motility	≥ 30% individual motility and/or "fair" gross motility

Artificial Insemination of Beef Cows

The use of artificial insemination for beef cattle has increased tremendously in recent years, especially in purebred and large commercial herds. A major problem in artificially inseminating beef cows is heat detection under range conditions. Development of fairly successful heat detecting devices has lessened the problem. Still, much of the success or failure in artificially inseminating beef cows depends on the training, skill, carefulness and thoroughness of the ranch manager and the inseminator.

Estrous Synchronization in Cattle

Estrous synchronization is the manipulation of the reproductive processes so that all females can be bred during a short, predefined interval with normal fertility. This control facilitates breeding in two important ways: it reduces, and in some cases eliminates, the labor of estrous detection, and it allows the producer to schedule the breeding. For example, if a herd can be induced to exhibit estrus at about the same time,

the producer can arrange for a few days of intensive artificial or natural insemination. Estrous synchronization early in the breeding season should result in a large percentage of a herd calving earlier in the prescribed calving season, thereby producing heavier weaning weights. It enables the producer to breed more cows to a selected bull, and it concentrates labor into shorter periods of time for breeding, calving and calf management procedures.

Advanced procedures related to estrous synchronization, superovulation, embryo transfer and artificial insemination continue to be researched and developed. Reproductive efficiency is one of the important economic considerations in beef cattle production.

Embryo Transplantation

Embryo transplantation in beef cattle production has gained popularity in the last decade and will likely increase. Embryo transplantation involves the removal of an embryo from a donor cow and implanting the embryo into a recipient cow. The donor cow usually is superovulated in order to increase the number of viable embryos. Embryo transplantation likely will have greatest impact on the purebred cattle industry by increasing the number of progeny from an individual female. Only cows with proven production records should be used as embryo donors. Heifers and young cows should not be chosen as donors. Embryo transplantation is an expensive procedure. The expected value of a calf from embryo transplantation must be sufficiently great to offset the cost associated with the transfer. Calves produced by embryo transplantation pose special problems when their records are considered in selection programs, because their records contain variation associated with differences in maternal environment. Records of calves produced by surrogate mothers should not be compared to records of calves from natural mothers. Embryo transplantation has no practical application in the commercial cattle industry.

Pregnancy Testing

Pregnancy testing by palpation is done by inserting the arm into the rectum and feeling the reproductive tract for pregnancy status. Short-term pregnancies are difficult to detect, so it is best to wait at least 45 days after bulls are removed to pregnancy test. Palpation is an art and skill. Most veterinarians, artificial insemination technicians and experienced cattle producers can make accurate pregnancy determinations.

Another option for pregnancy testing is utilizing a blood sample that is sent to a commercial lab for testing. This procedure requires obtaining a blood sample from either the neck or tail of a cow. The sample needs to be collected no sooner than 30 days after the breeding season ends. This option may be a good method of pregnancy testing for producers who have limited access to veterinary services or have small herds.

Ultrasound is another option for pregnancy determination. Equipment cost makes this option prohibitive for small- and medium-size operations; however, veterinarians may offer ultrasound pregnancy detection as a service.

The cost for pregnancy checking is minimal when the expense of carrying an open cow for a year is considered. Pregnancy testing can aid in obtaining an acceptable percentage calf crop if low calving rate is a herd problem.

Body Condition Scoring

Proper body condition of cows prior to calving plays an important role in continued successful reproduction in a herd. Scoring cows for body condition, at time calves are weighed for weaning, provides a basis of determining nutritional needs prior to the upcoming calving.

The plane of nutrition provided during lactation is the most important of several factors affecting the condition of brood cows. Differences observed in body condition within the herd may be due to age, soundness of teeth, milk production, general health or genetic variability. Extremely thin or fat cows may need to be fed separately or culled from the herd. The score cards in Tables 8-2 and 8-3 will provide some guidelines for cow management.

FIGURE 8-3. BCS 3.

FIGURE 8-4. BCS 5.

TABLE 8-2. Body Condition Score (BCS) for Beef Cattle	
Too Thin	1 — **Emaciated** – cow extremely emaciated, no detectable fat, prominent tailhead and bare ribs.
	2 — **Poor** – cow somewhat emaciated, little fat, spine, ribs, and tailhead somewhat prominent.
	3 — **Thin** – back and tailhead lightly covered, ribs individually identifiable, somewhat bare.
Borderline	4 — **Borderline** – ribs not visually obvious, some fat cover over ribs and pins.
Optimum	5 — **Moderate** – generally good overall condition, spongy fat cover over ribs and pins.
	6 — **High Moderate** – firm pressure required to feel spine, considerable fat cover over ribs.
	7 — **Fleshy** – cow appears fleshy, considerable fat cover, pones somewhat obvious.
Too Fat	8 — **Fat** – cow very fat, overconditoned, large fat deposits over ribs, around tailhead.
	9 — **Extremely Fat** – extremely wasty and patchy, extreme "pones," impaired mobility.

TABLE 8-3. Weight Changes Needed by Calving Time and General Feed Recommendations for Beef Cows	
Too Thin	1 — Needs to gain 350 lbs (cull)
	2 — Needs to gain 300-350 lbs (cull)
	3 — Needs to gain 200-300 lbs, improved ration, grain needed
Borderline	4 — Needs to gain 150-200 lbs, improved ration, excellent forage
Optimum	5 — Needs to gain weight of fetus (100 lbs), good forage
	6 — Needs to gain weight of fetus (100 lbs), good forage
	7 — No weight gain needed, fair forage
Too Fat	8 — Needs to lose 50-100 lbs, limit ration, too fat to calve
	9 — Needs to lose 100-200 lbs, may need to be culled, usually low in fertility

FIGURE 8-5. BCS 7.

Management at Calving

Most calf losses at birth are due to abnormal or difficult deliveries. At least half of the losses at calving time can be prevented by proper observation and assistance when needed. First- and second-calf heifers should be given special attention because most calving losses occur with this age group.

Location of a calving site is important for ease of observation. Observation of cows every 4-6 hours is generally adequate to detect difficulties. As the cow approaches parturition she becomes nervous and restless. Labor pains begin a few hours before birth and increase in both frequency and intensity until delivery. Most cows will attempt to calve in seclusion away from both man and other animals if given a choice.

The cow will normally calve within a 1- to 3-hour period from the first signs of attempted delivery. She should be left alone if calving proceeds normally. If the calf has not been delivered within 3 hours, examination and assistance are in order. A normal presentation is both front feet first with the head on the knees. An inexperienced producer should obtain the prompt services of a veterinarian when difficulties in delivery are encountered.

A strong, healthy cow will usually care for her newborn calf, especially if delivery has been normal. Determine if the calf is breathing when born. If the nostrils are covered with fetal membranes or filled with mucous fluid, they should be cleared.

A normal calf should stand and nurse within 30 to 45 minutes after birth. Weak or chilled calves may require assistance to obtain a first feeding of colostrum (first milk). This milk provides highly concentrated food nutrients and antibodies helpful in preventing calf diseases and digestive disorders. It is essential.

The cow should expel the placenta, or afterbirth, from her reproductive tract. If the cow does not clean out normally within 24 hours, contact your

veterinarian. A retained placenta putrefies rapidly and may cause toxemia (blood poisoning).

For the first few days after birth, watch for scouring in the calf and see that the calf is nursing all quarters of the cow's udder. Sometimes heavy milkers or cows with large teats need to be "milked out" a few times to prevent the udder from spoiling.

Managing the Calf Crop

A calf management program should begin with individual animal identification. Calves are identified to (1) provide positive identity for recording performance and family relationships and (2) serve as a means to establishing legal title. A number of methods provide good permanent identification for a record program. These methods include (1) ear tattoo, (2) hot iron brand, (3) freeze brands, (4) chemical brands and (5) ear notching. Temporary identification, such as chains, nylon cords or eartags, may also be used for easy identification. Some horned cattle breeders use horn brands. Paint brands and stick-on tags are often used for very temporary identification, usually associated with marketing.

The ear tattoo is widely used by breed registry associations and cowherd performance testing programs as a method of permanent identification.

A number brand is second in use to the ear tattoo as a permanent means of individual animal identification. Number brands are usually applied with a hot iron. The hot iron brand has been an integral part of the heritage of the beef cattle industry in the western range states. Originally brands were used only as a means of ownership identification, and ownership brands are still important in many areas of the country. There are rigid brand registration laws in many states. In Arkansas, state registration of your brand is not required by law, but brands of record take precedence over unrecorded brands of like and kind when there is question of ownership. Brands should be registered with the Division of Brand Registry, Livestock and Poultry Commission, Little Rock, Arkansas.

Permanent number brands may also be applied by freeze branding. This method is popular with some producers. Branding technique determines the success or failure of freeze branding.

Soft-type plastic ear tags are probably the most widely used method of temporary identification. Often the ear tattoo and ear tags are both used simultaneously on an animal. Tags are easy to read, and the ear tattoo provides identification should a tag be lost.

Castration

Steer calves are preferred over bull calves in the feeder market. Bull calves should be castrated if not intended to be retained for breeding purposes. Castration can best be done when the calf is quite young. Older calves are more difficult to restrain and suffer a greater set back. Many cattlemen castrate newborn calves at the same time they tattoo them for permanent identification.

Surgical castration is the most positive method of castration and is preferred by many stockmen. The young calf is restrained, the lower third of the scrotum is opened with a scalpel or Newberry knife, the testicles are then pushed one-at-a-time through the incision where it is separated from the membranes. The spermatic cord is severed usually by scraping with a knife blade. An antiseptic should be applied to the wound, and if castration is performed during fly season, an insect repellent should be applied.

Emasculating, or clamping, is a bloodless method of castration. Each cord should be carefully crushed separately. Make certain to leave the median unclamped for free circulation of blood to the scrotum. Improper clamping will result in a large number of stags.

Elastration is another bloodless method of castration. This method runs a rather high risk of tetanus or other clostridial infections. Also, the rubber rings sometimes fail to hold until the operation is complete.

Dehorning

Cattle without horns attract some preference over horned cattle in the market. Hornless cattle require less space in transit, in the feedlot and at the feed bunk. They fight less and inflict fewer injuries to each other. There are several effective methods of dehorning, depending on operator preference and age of the animals.

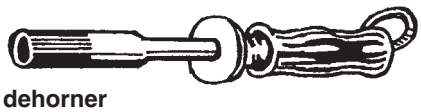
Genetic – Crossing cows with a bull that is homozygous for the polled trait is an often overlooked solution to dehorning. All calves from such a mating will have no horns. Likewise, if your cowherd is comprised of a polled breed, you can breed to a horned bull and all calves will be polled without the expense incurred with other dehorning procedures.

Chemical Dehorning – A caustic paste or stick can be used on very young calves (up to two or three weeks of age) where only a button can be felt. Clip the hair from over the horn button and apply petroleum jelly below the area to protect the calf's eyes. After applying caustic, keep the calf in the dry and away from its dam until the treated area is hardened or dried. Be careful to avoid contact of the chemical with your skin or eyes.

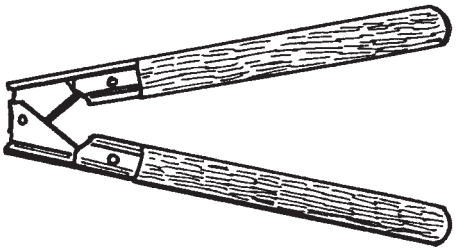
Spoon or Tube Dehorners – Horn buttons or small horns just emerging can be readily removed with spoon or tube dehorners. The tube must be large enough to fit over the base of the horn and include about one-eighth of an inch of hair around the horn.

– Tube dehorner

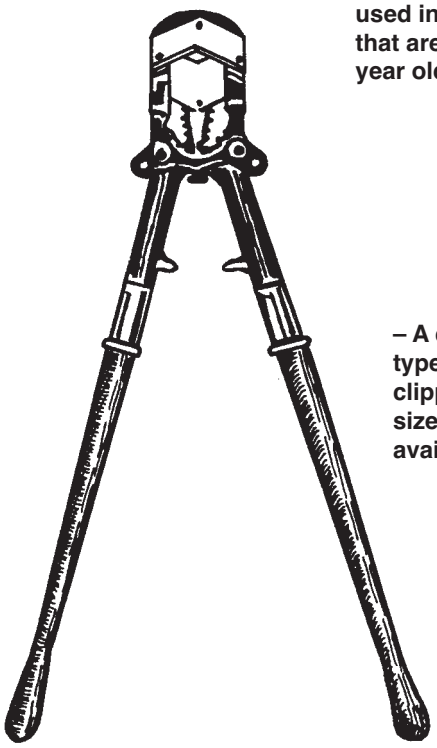
– Hot iron dehorner



– Electric dehorner



– Mechanical dehorner (Barnes type) especially adapted to dehorning calves. This type is available in two sizes, the larger of which can be used in dehorning animals that are up to about a year old.



– A commonly used type of dehorning clipper. At least two sizes usually are available.

FIGURE 8-6. Types of dehorners.

Push and twist until the skin has been "cut through" and then, using the cutting edge of the tube, cut or scoop under the horn and remove it. Apply an antiseptic and an insect repellent if needed.

Hot Irons – A hot iron may be used to dehorn calves with buttons or small horns. Fire-heated irons usually come in sets so the proper size can be selected to fit over the base of the horn. Heat the iron to a dull red. Electrically heated irons are designed to maintain the proper temperature. Success depends on holding the hot iron in place long enough to destroy the ring of growth cells around the base of the horn. This method of dehorning is practically bloodless and one of the most satisfactory methods available when properly used on the right age calf.

Barnes Type Dehorners – Barnes type dehorners can be used on horns too large for tube or hot irons but small enough for the instrument to fit properly and permit cutting a ring of skin and hair. Barnes type dehorners are available in calf and yearling sizes. Close the handles to fit the blades around the base of the horn. Spread the handles and twist while applying considerable pressure against the skull to remove the horn. Hemorrhage may need to be controlled by pulling major exposed arteries with forceps. Apply a non-irritating antiseptic and fly repellent if needed.

Removing Large Horns – Cattle with horns too large to remove with the above methods can be dehorned with a saw, clippers or obstetrical wire. Removal of a ring of skin and hair around the horn is essential in all cutting methods of dehorning, not only to prevent regrowth but also to expose the arteries so hemorrhage can be controlled. Dehorning wounds in large cattle heal slowly and care must be taken to prevent sinus infection and flyblow. Cost and risk should be carefully weighed against expected benefits.

Creep Feeding Nursing Beef Calves

Creep feeding is the practice of providing supplemental feed, usually grain, to nursing calves in a facility that prohibits the brood cow from having access to the feed. Even though creep feeding will almost always yield a response of increased growth rate in calves, it is not always economically profitable.

Creep feeding of beef calves is certainly not a practice that is routinely recommended in commercial beef herds. Creep feeding may be worthwhile in the following situations:

- periods of drought
- poor milking cows
- calves from first-calf heifers and old cows
- cows on poor pasture or toxic fescue
- just before weaning to teach calves to eat
- calves being fed for slaughter at weaning

Situations under which creep feeding is probably not profitable are:

- cows with good milking ability
- pastures high in quality and abundant, such as clover-grasses
- calves to be grazed or backgrounded at relatively low rates of gain after weaning
- heifer calves being raised for replacements

Generally, creep feeding is not profitable when calves are receiving sufficient feed from other sources to grow at their genetic potential, although sometimes purebred beef cattle producers find it advantageous to creep-feed calves to be sold for breeding stock. The better conditioning and bloom of hair coat is attractive to buyers.

Weaning

Weaning is a distress period for both calf and cow. Calves are made to break the nursing habit and rely on feedstuffs other than milk for their growth and subsistence by separation from their mothers. Both cow and calf bawl and go off-feed for two or three days. The calf is particularly susceptible to various disease organisms at this time.

Weaning should be done early enough to allow cows sufficient rest prior to their next calf. A two- to four-month rest between calves will allow the cow to regain condition lost during lactation and improve her mothering ability with the next calf.

Fenceline Weaning

Fenceline weaning is a weaning process in which the calves are removed from their dams but are allowed to see, hear and smell their dams. It has the potential to reduce stress related to transport, changes in environment and diet adaptation. Fenceline weaning may also reduce labor demands and costs associated with drylot facilities and weaning.

Fencing should be substantial enough to prevent the calves from nursing and keep the cows and calves separated. Various fencing combinations have been used such as electric and non-electric, and high-tensile, barbed and woven wire fencing. For cattle that have not been exposed to electric fencing, either woven wire or at least five strands of electric fencing will likely be necessary. If the cattle are familiar with electric fencing, three strands will likely be sufficient. Yet another option is to utilize four to five strands of barbed wire combined with a single strand of electric fence offset from the main fence.

This system of weaning is generally less stressful on the cow and calf resulting in lower morbidity.

Growth-Stimulating Implants

A growth implant is implanted into the ear. Research data strongly indicate a positive and economical response to implants in all segments of the beef industry.

Livestock producers should always read the label for use and restrictions. Implant products differ for recommended age at first implanting and implanting heifers intended for breeding. Never implant bull calves. Ralgro, Synovex C and Compudose are common implants used in pre-weaned calves. Ralgro, Synovex, Component and Revalor brand implants are commonly used in pasture stocker and backgrounding calves.

FIGURE 8-7. Implanting for increased weight and profit.

Feed Additives

The purpose of this section is to give a brief introduction to the types and general purposes of feed additives. A feed additive can be generally described as a component of the diet that does not fall within the basic nutrient categories: protein, fat, carbohydrates, mineral or vitamin. Most feed additives are medicative and are approved and regulated by the Food and Drug Administration. There are other forms of feed additives that are non-medicated and may or may not be regulated by a governmental administration. For example, chemicals used as a feed through for horn fly control are regulated by the government, whereas a direct fed microbial to date is not.

Feed additives may include antibiotics, anthelmentics (dewormers), larvacides (fly control), beta-agonists, surfactants, estrus suppressors, coccidostats, yeast cultures and direct fed microbials. These products come in various concentrations and types. Some concentrated medicated feed additives are restricted to licensed feed mills for making less concentrated supplements, whereas others are available in concentrated forms for on-farm mixing.

Antibiotic feed additives are often used on cow-calf operations. Of these, chlortetracycline is most prevalent. Chlortetracycline is approved for treatment of bovine respiratory disease complex and prevention of anaplasmosis. Chlortetracycline is also approved for inclusion in free choice minerals, and this method of delivery is common; however, for the antibiotic to be effective, the mineral must be palatable and consumed on a regular basis. There are other forms of antibiotics approved to increase animal performance, increase feed efficiency, treat bovine respiratory disease complex or reduce incidences of liver abscessing, which is associated with high concentrate, low roughage diets.

Certain feed additive antibiotics are considered medically important to both animals and humans. Use of feed additives requires establishing with your veterinarian a veterinary-client-patient relationship. Through this relationship, your veterinarian can write a veterinary feed directive which outlines the legal feed use of protected antibiotics for disease prevention/treatment.

Monensin (Rumensin) and lasalocid (Bovatec) are special types of medicated feed additives called ionophores. These improve feed efficiency and rate of gain in beef cattle. The mode of action of these two products differs from that of common antibiotics. While antibiotics generally have a systemic action within the animal, the mode of action of ionophores is through changes in the microbial population of the rumen. Ionophores are selective against certain bacteria and protozoans. As a result, these products also help prevent coccidiosis. Of the two, monensin is more commonly found in feedlots and lasalosid is commonly used in cow-calf and stocker operations. The main reason for this occurrence is toxicity in horses. While both are toxic to horses, monensin toxicity occurs and at a much lower dose. Because of toxicity concerns, many commercial feed mills will not carry monensin if they manufacture horse feed. Monensin is the only ionophore approved for mature beef cows. Neither of the ionophores are labeled for developing bulls. In addition to monensin and lasalosid, there are other coccidiostats available for mixing in feed, water or for drenching.

Anthelmintics (dewormers) delivered through feed have been around for years. These products are available as a topdress; however, block and tub formulations are more popular. To be effective, these products should only be used in the spring and fall when the brown stomach worm (Ostertagia) is not in hibernation. These formulations should also be rotated with newer injectable or pour-on formulations to help prevent the buildup of drug resistance.

Larvacides may be included as feed additives to suppress horn flies. These have no systemic influence on the animal but work by interrupting the life cycle of insects that lay eggs in fecal pats. The products are often available in free choice mineral formulations which establish convenience; however, to be effective, all animals must be consuming the feed at the labeled rate. Adjacent herds where horn fly populations are not controlled can also reduce the overall effectiveness of fly suppression.

MGA® (melengestrol acetate) when added to feedlot heifer rations stops the normal hormone production sequence that produces estrus. Because feeding the exact recommended level of MGA prevents estrus but allows the optimum level of estrogen production, feedlot heifers gain at an increased rate. MGA can also be used in estrus synchronization protocols.

Beta-agonists (Zilmax, zilpaterol and Optaflexx, ractopamine) are relatively new to feedlot cattle. These are utilized toward the final days on feed and increase lean deposition and weight gain.

Direct-fed microbials, yeast cultures and yeast cell wall are specialized feed additives. Direct-fed microbials are being studied to improve health such as sustaining a higher ruminal pH under concentrate feeding to prevent sub-acute acidosis, yeast cultures are being studied as specialized nutrients for the rumen microbes, and yeast cell wall is being studied for binding properties to toxins. Animal responses to these products have varied in research. This area of feed additive development gained rapid interest in countries where feeding antibiotics has been banned.

In conclusion, feed additives vary in their form and purpose, and the cost, purpose and expected response of any feed additive should be well studied and thought out before including them in the diet. Medicated feed additives require strict adherence to the label including mixing and feeding rates, legal drug combinations, approved animal type and following withdrawal times before slaughter or marketing.

Chapter 9

Keys to Success in Stocker Programs

There are several economic advantages to retaining raised calves or purchasing calves and selling them later in groups at heavier weights. These stocker (growing calves on pasture) or backgrounding (growing calves using mixed feeds or stored forages) programs add value to cattle for feedlots because they desire cattle that are weaned, are from a minimum of suppliers, are familiar with feed bunks and water sources and have minimal health issues. The aforementioned desires expressed by feedlot cattle buyers explain the considerable discounts the lightweight bull calves weaned the day of the sale and sold in one-head lots receive at livestock auctions. Short-term (35- to 45-day) preconditioning programs add value to calves because these programs provide evidence the calves being marketed (1) are weaned, (2) have been processed (dehorned, castrated, dewormed and vaccinated) and (3) are familiar with feed sources. By adding additional weight on calves with longer term ownership, value is added to the calves because heavier cattle require fewer days to finish and typically finish at more acceptable body weight. Regardless of the type of program, marketing decisions must be well thought out so that the greatest benefit can be gained from the time and money committed to this enterprise.

Stocker and backgrounding programs are management intensive, so it is recommended that producers have experience before starting. Producers with experience managing a cow herd should start by retaining calves from their calf crop. Health problems and other management issues are minimized because the cattle are from a known background and past management history is assured. One advantage of growing retained calves to heavier weights to be sold directly to feedyards is the reputation of the cattle, bull purchasing decisions, breed makeup and carcass performance, all can be bid into the price of the cattle; but poor choices in breed makeup and bull selection, a bad reputation for performance and carcass quality can also be bid into the price of the cattle. Purchase of additional calves can increase profitability of the operation, but care should be taken to purchase the types of cattle that will gain quickly, have minimal health problems and have breed makeup and color pattern that minimize discounts at sale. It is also essential to have adequate facilities to sort, catch, load and process retained and purchased stocker calves. One common problem that occurs is receiving purchased cattle in the same facilities as the retained calves. Calves retained from the home ranch should have virtually no health problems, but to bring in and commingle purchased cattle with ranch calves exposes the ranch calves to every disease that the purchased calves were exposed to, practically ensuring health problems in ranch calves as well as purchased calves.

Economics of Stocker Enterprises

Normally, as calves become heavier, the market price per pound decreases, as shown in Figure 9-1. This price slide changes relative to the value the market places on calves of different size classification. As the cost of gain in the feedlot increases, the price paid for lighter cattle becomes lower relative to the price of heavier calves. The narrowing of this price relationship can be a powerful signal for alternative marketing programs because of something called "value of gain."

Value of gain is what added weight gain is worth after price slide has been considered. This is determined by:

$$\text{Value of Gain} = \frac{\text{Projected sales value (\$/head)} - \text{Purchase cost (\$/head)}}{\text{Total Body Weight Gain}}$$

If the cost of gain is less than the value of gain, the enterprise will be profitable, but if the cost of gain is greater than the value of gain, the enterprise will not be profitable. For example, 450-lb steers could be purchased for $165/cwt at Arkansas livestock markets in May 2013. When these calves were removed from grass in September, they weighed 650 and were worth $149/cwt, for a value of gain of $113/cwt. From 1994 to 2004 the average annual value of gain was $67/cwt; Because feedlots were faced with increased costs for feed resources and shorter supplies of feeder cattle, the value of weight added to calves increased to $96 for the period between 2004 and 2014. Even though the value of cattle was at record levels in recent years,

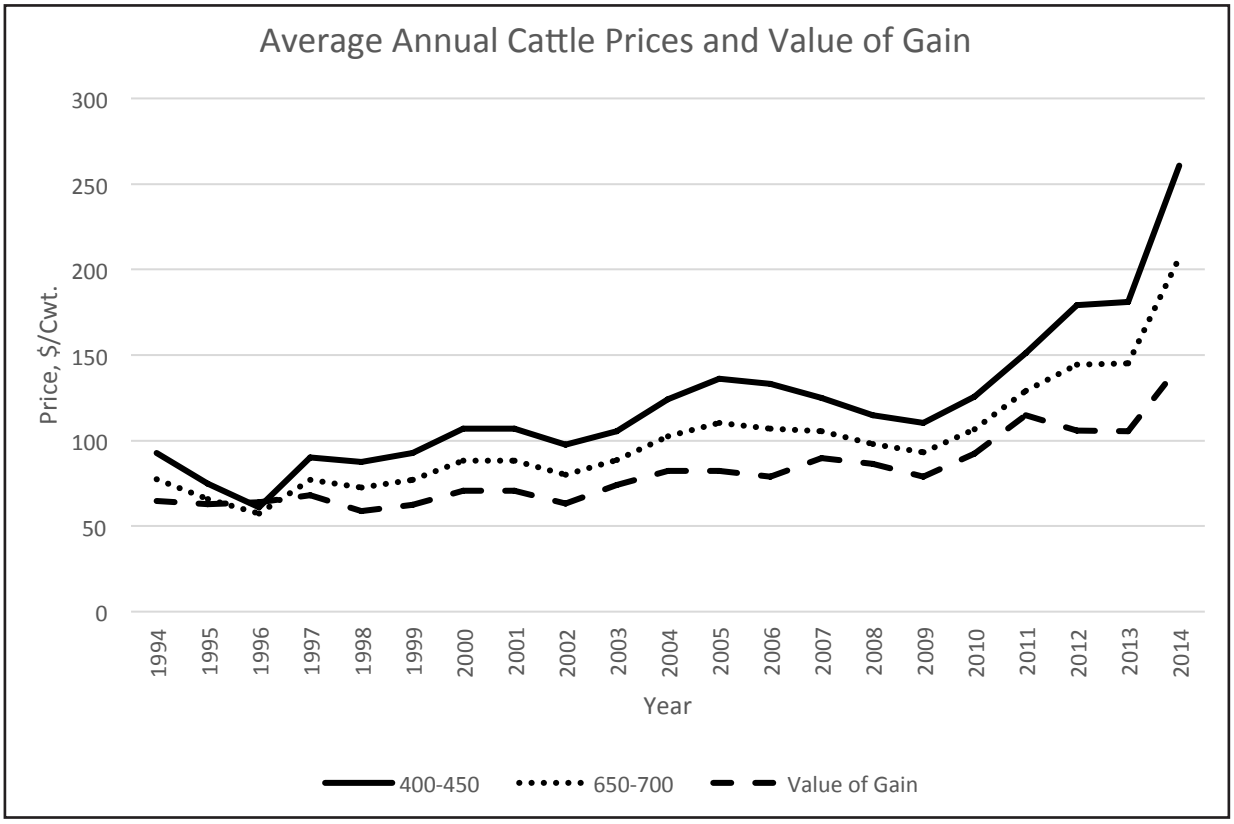


FIGURE 9-1. Arkansas annual average cattle value for 400- to 450-pound steer calves and 650- to 700-pound feeder steers and the resulting value of gain.

the value of retaining calves to grow to heavier weights on grass was over $143/cwt in 2014, an indicator of the highly profitable economics of stocker enterprises during periods of increasing prices.

Effects of Health on Performance and Profitability

Health is one of the primary issues defining performance and profitability. If the initial cost of a set of stocker calves is $500/calf, for every 1 percent death loss there is a $5/head cost incurred by the cattle that are sold. An even larger problem may stem from the number of cattle that are chronic with respiratory disease. Chronics will not perform as well as healthy cattle, they are not worth as much as healthy cattle and they use the same amount of resources as healthy cattle, but also have the additional medicine cost used to "save" the animal. Because death loss and chronic morbidity is such an expensive problem, fresh or incoming cattle must be watched carefully and treated as soon as clinical signs are identified.

Feedlot research has demonstrated cattle that get sick do not gain as well, have a greater cost of gain and do not grade as well as healthy cattle. The immune status of calves leaving the farm at weaning appears to be easily compromised by stress and disease exposure through marketing channels and commingling. Development of immunity before calves leave the farm begins with nutrition – trace minerals copper, zinc and selenium play a role in immune function and are commonly deficient in forages. Over a 9-year period at the University of Arkansas Livestock and Forestry Branch Station, bull calves castrated on arrival at the station gained 0.26 pound less per day and morbidity rates were 17 percent greater than calves received as steers. Additionally, bull calves received at the University of Arkansas Savoy Research Unit gained 0.5 pound less per day and morbidity was 58 percent greater than steer calves, costing 72 percent more for treatment of respiratory disease.

Research conducted by Bill Pinchak at the Texas AgriLife Research and Extension Center - Vernon found that gains of calves grazing summer grass pastures were reduced by an average of 10 percent when treated for respiratory disease during receiving for < 8 days and were reduced by 22 percent when treated for respiratory disease for > 8 days. In this study it was also estimated that, compared to healthy steers, gross returns were reduced by 10 percent for steers that were treated for respiratory disease,

9.7 percent for bulls castrated on arrival that remained healthy and 21.3 percent for bulls castrated on arrival that were treated for respiratory disease.

Types of Stocker/ Backgrounding Programs

Using Hay or Stored Forages for Growing Calves

Feeding hay and supplement may not be the most cost effective choice for putting additional weight on calves. Hay is an expensive source of digestible energy; if an 800-lb bale costs $30, the cost of forage delivered to the animal can approach $100/ton when storage and feeding losses are considered. Research indicates that when feeding average quality hay (10 percent crude protein and 55 percent TDN), it requires 7 lbs of dried distillers grains to get calves to gain 1.8 lbs/day. If the cost of distillers grains is $180/ton and hay intake is 9 lbs/day, the cost per pound of gain would be close to 60¢/lb. The combination of relatively low gains (< 2 pounds per day) and expensive feed sources makes growing cattle on average-quality hay unprofitable in many cases.

Feeding Mixed Diets to Growing Cattle

Calves can successfully be fed mixed diets based on digestible fiber by-product feeds (such as corn gluten feed, soybean hulls and dried distillers grains). These diets normally contain low to modest amounts (20 to 40 percent of dry matter) of roughage (hay, silage or cottonseed hulls) and are fed to promote gains of 2 to 3 pounds per day with feed efficiency ranging from 5 to 7 pounds of feed per pound of gain. These programs can be very profitable, but they are dependent on feed costs and gain in animal value. Management is intensive and these programs require excellent animal husbandry. Feed delivery must be at the same time each day, and feeding rates must be adequate to meet nutrient requirements for desired gain. When feed delivery or mixing is inconsistent, metabolic diseases are more likely (founder and acidosis), animal performance will be lower, cost of gain will be higher and profitability will be reduced.

Grass-Based Growing Programs

The performance of stocker calves is much more sensitive to forage quality and stocking rate than other classes of livestock. Leafy wheat forage commonly contains 25 to 30 percent crude protein and 75 to 85 percent digestibility; this level of protein and energy is adequate to meet the nutritional requirements of a stocker calf gaining over 3 pounds per day. In order for a calf to gain 2 pounds per day, diet digestibility should be 67 percent or greater. Summer grasses often lack the digestibility to provide adequate energy for high levels of gain.

Arkansas' climate is conducive to near year-round forage production with proper management. Tall fescue is a cool-season grass that is predominant in northern Arkansas, and it persists in many areas of southern Arkansas. Cool-season annuals are extremely productive and will grow even during cold months of the year. Warm-season forages are productive during summer.

There are several challenges to Arkansas stocker production. Although the climate is favorable to year-round forage production, it can also have its extremes including being too dry or too wet. Seasonal droughts are often a problem limiting forage production and quality during the summer and complicating establishment of cool-season annuals in the fall. In addition, extremely wet conditions during winter and spring months can impact animal performance because of increased nutrient requirements, destruction of pastures by hoof action and delaying pasture management practices.

Forage maturity, fiber levels and digestibility decline of warm-season grasses in mid-summer lead to low body weight gains. Often calves grazing summer grasses gain only 1.5 pounds per day or less without supplementation. Optimization of production requires use of inputs – fertilizer, weed control, supplemental feeds, to name a few. Fertilization of warm-season grass pastures increases the crude protein content and increases forage growth by 30 pounds of forage for every pound of actual N applied. The additional forage growth must be utilized to maintain forage quality and avoid waste.

Stocker calves grazing toxic endophyte tall fescue usually have poor weight gains. But performance during the fall and winter of weaned calves grazing this forage can be around 1.4 lbs per day when stocked at 1 calf per acre (Table 9-1). During the spring, calves were only able to gain 1 lb per day because of the increased effect of toxicity during that time. Calves lost an average of $17 when grazing toxic endophyte tall fescue in the fall and the spring. An advantage to toxic endophyte tall fescue is that it's inexpensive to produce and calves can graze it during the fall and winter until higher quality forage is available in the spring. Over eight years at the Livestock and Forestry Branch Station near Batesville, cost of gain of calves grazing toxic endophyte tall fescue was 33¢ per pound compared to 38¢ per pound for winter annual forages.

TABLE 9-1. Animal Performance and Estimated Cost of Gain Based on Stocker Cattle Research at the University of Arkansas Livestock and Forestry Branch Station and Southwest Research and Extension Center From 1997 to 2007.

	Toxic Tall Fescue	Novel Endophyte Tall Fescue	Crop-Field Winter Annuals	Interseeded Winter Annuals
Fall ADG, lb/d	1.4	2.0	2.5	2.5
Spring ADG, lb/d	1.0	1.9	2.4	2.6
Stocking Rate, calves/acre				
Fall	1	0.75 to 1	0.75 to 1	0.75 to 1
Spring	2 to 3	2 to 3	2 to 4	2 to 4
Cost of gain, ¢/lb[1]	33¢	27¢[2]	40¢	38¢

[1]Pasture only cost of gain: includes establishment cost of annuals, fertilizer etc.
[2]Cost of gain includes $250/acre establishment cost pro-rated over 8 years.

FIGURE 9-2. Calves grazing toxic endophyte tall fescue at the University of Arkansas Livestock and Forestry Branch Station near Batesville. The effects of the toxic endophyte cause problems with heat tolerance of calves even in mild temperatures of the spring grazing season, decreasing grazing time and reducing forage intake with large negative effects on animal performance.

Nontoxic or novel endophyte tall fescue is productive in stocker cattle production systems and doesn't require yearly re-establishment that annual grasses require. With this grass, stocker calves perform similarly to calves grazing annual pastures. The major disadvantage to novel endophyte tall fescue is the cost of establishment and the one-year establishment period. Research at the University of Arkansas Livestock and Forestry Branch Station near Batesville and the Southwest Research and Extension Center near Hope indicate that calves grazing nontoxic endophyte tall fescue will gain 1.9 to 2 pounds per day during the fall and the spring. Calves need to be stocked at 1 to 1.5 acres per calf during the fall but can be stocked at 2 to 3 calves per acre during the spring. Gain per acre was found to range from 400 to 900 pounds and profits averaged $88/acre.

FIGURE 9-3. Calf grazing nontoxic endophyte tall fescue at the University of Arkansas Southwest Research and Extension Center near Hope. Cattle grazing this high-quality forage can gain in excess of 2 pounds/day through the fall and spring.

Small grains (wheat, rye and oats) or annual ryegrass can be used for grazing calves in any area of the state. In many situations, producers in Arkansas have unrealistic expectations of stocking rates. Fall production of cool-season annuals is much lower than production in the spring. If stocking rates are too high in the fall, gains will be limited and forage regrowth may be impacted in the early spring. No-till production is gaining popularity in many farming areas because of increased fuel costs and reductions in the

FIGURE 9-4. Calves grazing lush wheat pasture at the University of Arkansas Livestock and Forestry Branch Station. Cattle can gain over 2.5 pounds/day when forage allowance is well managed through moderate stocking rates.

availability of labor. Production budgets based on research conducted by the University of Arkansas Livestock and Forestry Branch Station show that profitability is increased by $90/acre when using no-till establishment compared with conventional tillage establishment practices, with no reductions in forage production or animal performance.

Small grains and ryegrass are more productive when planted in crop fields but can be effectively interseeded into bermudagrass pastures. When interseeded, the risk of not getting the grass established is greater and there's less fall forage production. This delays grazing and reduces stocking rate of calves grazing interseeded cool-season pastures during the fall and winter. Calves grazing interseeded small grains during the fall gained an average of 2.5 pounds/day when stocked at 1.5 to 2 acres per steer, but decreased to 1.2 pounds/day when stocked at 0.7 acre/steer during the fall because of low forage availability. When planted into dedicated crop fields, calves stocked at 1 acre per steer have gained 2.5 pounds per day; as stocking rate increases, gains decreased to 1.8 pounds per day at stocking rates of 0.7 acre/steer. Gain has been increased at increased stocking rates by providing concentrate supplementation at rates of ¾ to 1 percent of body weight. During the spring, animal performance increases dramatically and stocking rates should be increased to 0.5 acre/steer on these pastures.

Summary and Conclusions

Well-managed stocker and backgrounding programs can be profitable and add to the net farm income of many beef cattle operations in the Southeast. The risks associated with health and marketing of these cattle can also create large economic losses if these factors are not controlled through good management. Forage programs should be designed to economically produce long periods of high quality forage that will add gain to calves cheaply. If cattle are grown on mixed diets, feed costs must be controlled and feeding management must be excellent for the program to be profitable.

Chapter 10

Herd Health

Sound herd health is vital for competitive beef production. In order to create an effective herd health plan, the producer collaborates with a veterinarian to develop strategic vaccination and parasite control protocols. The veterinarian oversees the health of the herd via vaccinations, diagnostic tests, therapeutic treatments and necropsies. The veterinarian also trains the producer to properly perform procedures that do not require the services of a veterinarian.

Cattle producers should be equipped with the proper facilities to handle and restrain cattle for treatment. Proper working chutes and headgates can save a producer much time and labor as well as prevent injury to the cattle.

The Beginning Herd

Maintaining a closed herd is the best way to keep diseases at a minimum. Unfortunately, it is not feasible to start a beginning herd in this fashion. If possible, producers should purchase animals from a single source and obtain a history of the herd before purchasing including the vaccination program and past diseases.

Purchasing virgin breeding stock and bringing them to the farm at least one month prior to breeding time is the best practice. The new animals should be isolated from other cattle on the farm and routine tests conducted to identify any incubating disease. Breeding cattle should only be purchased after a thorough physical examination by a veterinarian including specific tests for brucellosis, tuberculosis, leptospirosis, neosporosis and any other diseases known to be prevalent in the area. Breeding bulls should also have a thorough breeding soundness exam.

Herd Health Program

An appropriate health program varies from herd to herd and from region to region in Arkansas. One single program will not fit all herds throughout the state. Some herds may have very few health problems and may only need a minimal program. Other herds may need a very extensive herd health plan. A disease may be prevalent in one herd or area and be absent in another. The herd health program should be tailored to fit the individual herd.

Suggested Herd Health Practices

Breeding Herd (Cows, Bulls, Replacement Heifers)

- Fertility test bulls prior to the breeding season.
- Vaccinate for IBR-BVD-PI_3, Leptospirosis and Campylobacter (Vibriosis) 30 days prior to breeding season and while females are open (not pregnant). Follow your veterinarian's recommendation.
- Treat for internal parasites on a routine basis. Timely administration of dewormers will result in better control of internal parasites.
- Practice good external parasite control procedures; treat for flies and lice by following the veterinarian's recommendation on effective products available. Manage pastures to keep external parasites to a minimum.
- Examine all females for pregnancy after the conclusion of the breeding season and cull open cows.
- Isolate all new additions to the herd.

Calving Time

- Observe cows closely at calving time.
- Remember, a clean pasture is probably the best calving area.
- Keep animals due to calve soon in an area where handling facilities are available.
- Have your veterinarian instruct you on how to handle maternity cases. Know what equipment and medication is needed and when you should seek professional help.

- First-calf heifers usually have more trouble calving than older animals and will need closer observation and assistance.

Calves

- Dip the navel cords on all newborn calves with a disinfectant such as iodine or chlorhexidine.
- Make sure calves nurse and get colostrum (cow's first milk) within one hour after birth. Keep frozen colostrum or commercial powdered colostrum on hand for emergencies. Have an esophageal tube available for use on weak calves.
- Identify calves with a uniquely numbered ear tag soon after birth.
- Castrate and dehorn calves at an early age. It is easier, causes less pain and allows fewer problems when done early.
- Vaccinate all calves with Blackleg 7-way and IBR BVD-PI_3 at 60-90 days of age.
- Have an accredited veterinarian vaccinate all replacement heifers between 4-12 months of age for brucellosis.
- Treat for internal parasites on a routine basis.
- For eye problems, after the veterinarian gives a diagnosis, follow the veterinarian's advice as to treatment and preventative measures. Provide good fly control and observe closely to reduce losses. Vaccines are also available to aid in the prevention of pinkeye.

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Other Herd Health Practices

- Provide good basic nutrition. Have forage tested for nutritional value.
- Provide adequate salt and a balanced mineral supplement.
- Supply vitamins A and D through the feed.
- Keep feet trimmed and corns removed from animals, especially bulls. Get this work done several weeks before breeding season.
- When administering injections, be sure to follow Arkansas Beef Quality Assurance guidelines. Give vaccines subcutaneously using the "tenting" method instead of intramuscularly whenever possible, and only give vaccines in the neck region in front of the shoulder.

FIGURE 10-1. A method of deworming.
Photo Credit: Sgt. Elisebet Freeburg, 143d Sustainment Command (Expeditionary), U.S. Army Reserve

Treatment of Stocker Calves

Death of livestock is the difference between profit and loss in a stocker or backgrounding operation. Respiratory infection is a major problem in newly purchased feeder calves. Isolate new calves from other cattle on the farm and follow these procedures to minimize loss.

For calves that have been purchased:

- Rest for 12 to 24 hours after arrival on the farm.
- Provide nutritious, easily digestible feed, adequate bedding, and clean, fresh water.
- Provide windbreaks to protect from cold, wet weather. Provide shade in hot weather. Avoid close confinement in poorly ventilated structures.
- After 12 to 24 hours, administer vaccines if the cattle appear to have recovered from the stress of shipping.
- Castrate bull calves at this time.

For calves that were not purchased but came from your own herd:

- Vaccinate for Blackleg 7-way and IBR-BVD-PI_3 at 60-90 days of age.
- Administer growth implants (e.g., Ralgro; Synovex-C, -S or -H; or Compudose).
- Give optional vaccines (on advice of veterinarian): BRSV, pinkeye, *E. coli, Haemophilus, Pasteurella*, etc.
- Treat for internal and external parasites as indicated. All calves should be treated for worms and some may need treatment for lice infestation.

- Closely observe cattle for the first month.
- Visibly sick cattle should be isolated and treated. Hospital pens should be maintained separately and at a distance from cattle on pasture.
- Provide (free choice) trace mineral salt and a balanced mineral.
- Provide easy access to clean water.

Common Diseases

Diseases that affect reproduction are prevalent throughout the state. The effects may be sterility, low pregnancy rates, abortion or weak calves. The most common reproductive diseases in Arkansas are brucellosis, leptospirosis, vibriosis and neosporosis.

Brucellosis, also known as Bang's Disease, is a disease caused by the bacteria *Brucella abortus*. It is a contagious disease of cattle and other ruminant animals that can also affect humans (zoonotic). Infection spreads rapidly by ingestion of the organism and causes many abortions in unvaccinated cattle. The bacteria may enter the body through mucous membranes, conjunctivae, wounds or intact skin in both people and animals. In an effort to control the spread of disease, federal and state programs have been implemented and require vaccinations, testing and strict quarantine. Producers should have all heifer calves between 4 and 12 months of age vaccinated by an accredited veterinarian in order to be compliant with federal regulations.

Leptospirosis is caused by the bacteria of the genus *Leptospira* and is also a zoonotic disease. The bacteria are known to exist in all parts of the state. It is spread from a carrier animal through infected urine which contaminates feed and water supplies. Abortion outbreaks can occur 10 to 14 days after exposure to the organism. Blood tests can identify carrier animals, but it is difficult to pinpoint the individual strain that causes leptospirosis. There are vaccines that are specific against five strains known to cause infections in cattle. An annual vaccination is highly recommended. Cattle may need vaccination every 6 months if they are in an endemic area.

Vibriosis is caused by the bacteria *Campylobacter fetus*. This venereal disease is transmitted between animals during natural breeding and is characterized by early embryonic death, infertility and a protracted calving season. Testing bulls prior to breeding is recommended as well as annual vaccination in known infected areas of the state.

Neosporosis is caused by the protozoal organism *Neospora caninum*. Cattle become infected by ingesting feed that has been contaminated by dog feces. This disease is more prevalent in herds being fed mixed rations. When ingested in large quantities by pregnant cows or heifers, the fetus may become compromised resulting in abortion. If the fetus does not abort, the calf will become a persistent carrier when born due to transmission of the organism through the placenta. The heifer calves are then susceptible to abortions as well. As a control measure, fencing should be in place to keep out stray dogs and coyotes. New breeding stock should be tested for Neospora in endemic areas and culled if found positive. There are currently no effective vaccines or treatments available.

Other diseases causing reproductive problems include Infectious Bovine Rhinotracheitis (IBR), anaplasmosis, nitrate toxicity, molds on grass or in feed and nutritional deficiencies.

Other general infectious diseases of importance in Arkansas are anaplasmosis, blackleg, bovine respiratory disease and pinkeye.

Anaplasmosis is caused by the rickettsial parasites *Anaplasma marginale* and *Anaplasma centrale*. These parasites infect red blood cells, which causes subsequent anemia and possibly death. The organism can be found in all areas of Arkansas but is most prevalent in the southern half and rice-producing areas. The disease is spread by blood-sucking insects (mainly ticks and biting flies) or contaminated instruments. There is no cure for the disease, but antibiotics in feed can suppress the organism. There is also a vaccine available that keeps the organism in a suppressed state. Persistently infected cattle, although not sick, serve as a source for the disease. Furthermore, pregnant vaccinated cattle may abort if additional parasites are introduced via an insect bite. The disease can be controlled by vaccination, sound husbandry practices and rigid external parasite control.

Blackleg is an acute and highly fatal disease of cattle caused by the bacteria *Clostridium chauvoei*. The disease produces a gas gangrene in the muscle tissues. Death losses can be prevented by proper vaccination. A vaccine containing Blackleg 7-way should be used on all calves at 60 to 90 days of age. Repeat the vaccination at 3 to 4 weeks after the first vaccine to provide adequate protection. In some areas of the state, vaccinating all adult cattle annually is necessary to prevent death due to blackleg.

Bovine respiratory disease can be caused by several viruses coupled with the bacteria *Pasteurella multocida, Mannheimia haemolytica, Histophilus somni* or *Mycoplasma bovis*. Viruses that have been implicated include Infectious Bovine Rhinotracheitis (IBR),

Bovine Viral Diarrhea (BVD), Bovine Parainfluenza-3 Virus (PI_3) and Bovine Respiratory Syncytial Virus (BRSV). These pathogens interact with one another and the animal's immune system to produce disease. The bacteria cause the acute syndrome by invading the bovine respiratory tract that has already been compromised by viral infections, environmental conditions and/or other stress factors. The disease can affect the upper respiratory tract (sinuses and trachea) or lower respiratory tract (lungs). Various combinations of vaccines may be used and should be given at least 3 weeks prior to stressful events such as breeding, weaning or transport.

Pinkeye is a contagious bacterial disease caused primarily by the bacteria *Moraxella bovis*. Calves are more likely to develop the disease than adult cattle. Pinkeye causes painful inflammation of the cornea (the clear outer layer) and conjunctiva (the pink membrane lining the eyelids) of the eye. The inflammation leads to ulceration of the cornea, which looks like a hole or depression. There are many factors that predispose and contribute to the progression of the disease. Eye irritation is necessary for the development of the disease. Face flies, dust, UV light and tall grass can all cause a mechanical irritation to the eye. Face flies in particular can spread the disease from one animal to another. Vaccines are available and should be used in endemic areas to aid in the prevention of pinkeye. Early detection and treatment along with stringent vector control are important to reduce losses. For prevention or treatment, follow the advice of a veterinarian.

Several **forage-related problems** plague Arkansas beef producers as well. Cattle are at risk for grass tetany, nitrate poisoning, fescue toxicosis, acorn poisoning and ergotism. The three most common toxic plants in Arkansas are perilla mint, water hemlock and johnsongrass. Producers should have forage tested and inspect the pasture for potential problems prior to turnout.

Miscellaneous disease conditions of importance are cancers of the eye, warts, ringworm, bloat and foot rot. Each condition must be diagnosed and treated by a veterinarian.

Internal parasites such as roundworms (nematodes), tapeworms (cestodes), flukes (trematodes) and coccidia affect Arkansas beef cattle. Producers should have a strategic surveillance and treatment program in place that has been developed in cooperation with a veterinarian. Scheduled deworming and pasture management will reduce loss.

External parasites such as horn flies, face flies, ticks, grubs, mosquitos and lice are all problems in Arkansas. Losses can be minimized by planning a treatment program with strategic timing. Pasture treatment and management is also important to keep external parasites at a minimum. Pastures should be dragged as much as possible to break up and dry out manure. Parasiticides should be rotated to decrease insect resistance. Consultation with a veterinarian is strongly recommended.

FIGURE 10-2. Dust bag for insect control.
(Photo courtesy of Bayer)

Cattle Vaccinations

- Vaccination programs will vary with the location of the farm and the type of production and should be planned with the guidance of a veterinarian.
- Vaccines are not a substitute for good management and prevention practices which include selective purchases, isolation and testing prior to the introduction of new animals into the herd.
- Try to give only subcutaneous vaccines and administer by the skin tent method.
- Store vaccines in accordance with labeling.
- Protect vaccines and filled syringes from sunlight and heat.
- Discard bent or broken needles. Change needles often (about every ten animals).
- Clean syringes with hot distilled water (at least 212°F). Do not use soap or disinfectant.

FIGURE 10-3. Vaccinating cattle using the "tenting" method.

TABLE 10-1. Vaccination Schedule: Heifers	
Vaccine	
Brucellosis	Calfhood (4-12 months)
IBR	Before Breeding
BVD-PI_3	Before Breeding
BRSV	Before Breeding
Vibriosis	Before Breeding
Leptospirosis	Before Breeding
Blackleg 7-Way	Before Breeding
Anthrax	Optional as Directed

TABLE 10-2. Vaccination Schedule: Cows and Bulls		
Vaccine		
IBR	Recommended	Annual (Killed or Intranasal)
BVD	Recommended	Annual
PI_3	Recommended	Annual
BRSV	Recommended	Annual
Leptospirosis (5-Way)	Recommended	Annual (every 3 to 6 months in some areas)
Vibriosis	Optional	Annual (30-60 days before breeding)
Trichomoniasis	Optional	Annual (30-60 days before breeding)
Pinkeye	Optional	As Needed
Anthrax	Optional	Annual
Blackleg 7-Way	Optional	Annual

TABLE 10-3. Vaccination Schedule: Calves*		
Vaccine		
Blackleg 7-Way	Recommended	Preweaning
IBR-BVD-PI_3	Recommended	Preweaning
Leptospirosis	Recommended	Preweaning
Brucellosis	Recommended	Heifers (4-12 months)
BRSV	Optional	As Needed
Pasteurella	Optional	Preweaning
Haemophilus somnus	Optional	Preweaning
Pinkeye	Optional	As Needed
E. coli	Optional	Vaccinate Cows (prior to breeding)
Anthrax	Optional	As Directed
*Do not use modified-live products on calves that are still nursing cows.		

Health Calendar and Cattle Vaccinations

For Spring-Calving Beef Herds

JANUARY

1. Vaccinate yearlings for IBR-BVD-PI_3.
    a. They will be free of maternal antibodies.
    b. They will have recovered from weaning stress.
    c. Conception will not be affected.
    d. Pregnant cows won't be exposed to shed virus.
    e. They will be mature enough for maximum response.
2. Vaccinate yearlings for leptospirosis (5-strain).
3. Weigh replacement heifers and adjust ration to reach target breeding weight.
4. Assess cow body condition and adjust ration to assure good condition at calving.
5. Feed magnesium oxide (MgO) to cows on cool-season grass pasture through mid-April to prevent grass tetany.

JANUARY THROUGH MARCH

1. Calving Season
    a. Heifers bred to calve January 2 to March 1.
    b. Cows bred to calve February 1 to April 1.
    c. Observe cattle due to calve often: know about when labor begins; be present when help is needed; know when to call for veterinary assistance.
    d. See that calves get colostrum within 6 hours (preferably within one hour) after birth.
    e. If calved in confinement, soak calf's navel in iodine preparation immediately.
    f. If delivery assisted, inject cow with antibiotic.
    g. Separate young and thin cows from mature and well-fleshed cows.
2. Evaluate bulls for breeding soundness.
    a. Complete physical examination.
    b. Rectal examination.
    c. Semen collection and evaluation.
    d. Mating behavior observed, if possible.
3. Vaccinate the breeding herd for *Campylobacter fetus* (vibriosis), leptospirosis, IBR and BVD.
    a. For cows and heifers, after calving and 30 days before breeding.
    b. For bulls, at least 30 days before breeding to allow sperm count to recover.

MARCH 26 THROUGH MAY 25

1. Breed heifers (have them to target weight).
2. Vaccinate calves with Blackleg 7-way.
3. Castrate and implant bull calves.
4. Remove horns from calves.

APRIL THROUGH OCTOBER

1. Constantly control flies.
    a. Sprays, backrubbers, dusters, ear tags or VetGun.
    b. Use approved products according to label instructions.
    c. Rotate class of parasiticide.
2. Minimize pinkeye.
    a. Clip pastures, provide shade and control flies.
    b. Treat clinical cases immediately.
    c. Vaccinate for *Moraxella bovis*.
3. Consider an anaplasmosis control program.
    a. Establish a relationship with a veterinarian.
    b. Give medicated feed to suppress illness.
    c. Vaccinate for anaplasmosis (experimental drug is only available).
    d. Control vectors.
    e. Avoid transmission with needles, palpation gloves.

APRIL 25 THROUGH JUNE 23

Breed all cows.

AUGUST

1. Pregnancy exam all heifers (near August 1).
    a. Estimate calving date by early examination.
    b. Cull open heifers.
    c. Sell surplus pregnant heifers.
2. Plan for brucellosis vaccination of heifer calves.
    a. Must be done by a veterinarian accredited by the USDA.
    b. Vaccinate at 4 to 12 months of age.
3. Castrate bull calves if not done earlier.
4. Implant steer calves with growth implants.
    a. First time at castration regardless of age.
    b. Every 90-120 days thereafter until sold.
5. Deworm all calves.
6. Plan to vaccinate calves for leptospirosis at 60-90 days of age.

SEPTEMBER

1. Examine cows for pregnancy (near September 1).
2. After examination, mark cows for culling.
3. Vaccinate cows for leptospirosis.
4. Treat all cattle for lice with a veterinarian-recommended product. Follow directions on label.
5. Vaccinate calves.
    a. IBR-PI_3 (intranasal vaccine)
    b. Blackleg 7-way

NOVEMBER

1. Wean and weigh calves.
2. Deworm and implant steer calves to be held over.
3. Select replacement heifers (50 to 75 percent extra).
    a. Calculate feeding program to reach breeding weight by March 26.
    b. Feed in groups to achieve projected gain.

Chapter 11

Working and Feeding Facilities

Facilities and equipment for working and feeding cattle are required for the proper management and care of cattle on the farm. No one should enter into a cattle operation without the proper facilities and equipment to care for and manage the herd.

Working Facilities

Well-planned working facilities and well-designed equipment will immediately start to pay for itself in the following ways: (1) fewer injuries to cattle and people, (2) less stress on cattle and people, (3) an ease of working that will prevent cattle working from becoming a dreaded job and (4) a total cattle management program can be easily carried out on the herd. Points to consider for working facilities are location and design of pens, gates, chutes, alleys and restraint equipment.

Location

Working facilities should be located in an area that is near to the cattle and where several pastures meet. If the cattle operation is on several different farms or on a very large farm and spread out, then additional working areas should be considered. The working area should be located along fencelines so cattle can be more easily driven into the pens. The working area should be located where trucks can reach the pens to deliver cattle and haul cattle out. The working area should be well drained and designed for expansion if needed.

Pens

Pens are needed to hold cattle for working. The main points to consider with pens are the number of pens, the size of the pens, the height of pen fences and the arrangement of pens for sorting and holding cattle. The number and size of pens should be related to herd size. Several small pens to hold the herd in groups are more desirable than one big pen for the whole herd. Cattle are more easily driven out of a small rectangular pen than a large pen or pasture lot. Also, when the herd is sorted for various reasons, several small pens will be more workable than one or two large pens.

Pens need to hold cattle. Gentle or docile cattle can be held with 4½- to 5-foot high fences. Hard-to-work or excitable cattle may need fences 6 feet high to hold them.

Pens should be arranged along a central alley or in a cluster so the herd can be sorted off into groups and held as groups. One or more pens should have a water trough to serve as a holding pen, a hospital pen or quarantine pen.

Gates

Gates in the working facilities should be designed and installed with some of the following points in mind. Gates should be of sturdy construction with anchor post set well into the ground to prevent sagging and to handle heavy use. Gates should be located in pen corners and along fencelines leading into the working facilities for ease of cattle movement. Gates should be hung so that they close behind cattle as they are moved into and through the working facilities. Gates should be the same height as pen fences (4½ to 5 feet for docile cattle, 6 feet for hard-to-work cattle). Alleys should be sized to the gates. If 12-foot gates are used, then alleys should be 12 feet wide. With this arrangement, gates can be used to cross off alleys, or they can be swung completely around to let cattle pass the gate and go up the alley or down the alley. Gates and gate hinges should be designed and hung so that the gate will swing in the proper direction and swing far enough into the pen or alley so that cattle can pass. Some extra gates can be built into the facilities. These gates can go between pens to move cattle from pen to pen without using the alley. Some man gates (3- to 4-foot wide) can be added for people to enter the working area – especially near the squeeze chute.

Crowding Pen

The crowding pen is set at the end of the alley and is used to crowd cattle into the working chute and onto the squeeze chute. Older designs use a square or funnel-shaped pen with a swing gate or several swing gates to crowd cattle into the working chute. Newer designs use a circular-shaped pen with

a swing gate to crowd the cattle. Circular pens take advantage of cattle's tendency to move in circles when crowded, and there are no corners for them to jam up in. The swing gate in the crowding pen should be solid (not open planks) and be designed to latch at several positions as it is closed down and cattle are moved into the working chute. Besides the swing gate being solid, the crowding pen should have solid sides. Solid sides will prevent cattle from seeing out and balking because of activities or movement around the working area. Several companies manufacture crowding pens and refer to then as sweep tubs.

Bud Box

A Bud Box is a facility design that allows the handler to be positioned correctly to facilitate cattle flow out of the box into either the crowd alley leading to a chute or to a trailer load out. Always keep in mind that the box is a flow-through part of the facility. Cattle should never be stored in the box waiting to be sent into the crowd alley or to a trailer. Bring them in and let them flow back out immediately.

Dimensions are important to the successful use of a box but not as critical as handler position in relation to the stock leaving the box (Table 11-1). Without proper position and attention to detail, a box will only confuse the stock and frustrate the handler.

The box should be large enough to accommodate a volume of cattle to fill the crowd alley or fill a trailer compartment. A crowd alley to a squeeze chute should hold a minimum of 4 cows and might need to hold 20 head depending on the speed of processing. Crowd alleys on cow-calf operations will typically hold 5 to 6 cows. Facilities working calves or yearlings routinely need crowd alleys for 12 to 20 head of cattle.

TABLE 11-1. Bud Box Dimensions.

Handler	Width	Depth*
Always on foot	12 feet	Minimum 20 feet
Afoot and horseback	14 feet	20 to 30 feet
Always horseback	16 feet	Maximum 30 feet

*Dictated by size of groups handled

Working Chute

The working chute is used to move cattle to the squeeze chute in single file and in an orderly manner. Working chutes should be at least 18 to 20 feet long to hold several head of cattle in line for working. Several blocking gates or back stops should be placed in the working chute to control movement of cattle in the chute. Newer designs use a circular shape for the same reasons as circular crowding pens are being used. Solid walls in working chutes provide for easier movement of cattle. The major problem with many working chutes is they are too wide. This allows some cattle to turn around which stops the orderly flow through the chute. Working chutes should be 18 to 28 inches wide. The narrower widths (18 to 22 inches) are suitable for operations that basically handle calves (weaners to 1,200 pounds). The wider widths (26 to 28 inches) are for cow-calf operations. Herds with very large cows and bulls may want to add another 2 or 4 inches to their chute width. Smaller calves will turn around in the wider chutes. In these wider chutes, placing plywood panels mounted on 2x4's or 2x6's into the chute when working calves will make it narrower and prevent turnarounds. Newer designs use sloped or V-shaped sides. With sloped sides (16 inches at ground level, 28 inches at 4 foot height), the problem of smaller animals turning around in the working chute is eliminated. Some working chutes have been built with removable sections. These can be removed to get at downed animals in the working chute.

As with crowding pens, several companies manufacture working chutes. These are available in straight and curved designs and can be purchased with solid sides or open pipe sides. Most working chutes can be adjusted for width to suit the size cattle being worked.

Squeeze Chute and Headgates

The squeeze chute and headgate are vital to the working facilities because essentially all work done on cattle is done in the squeeze chute and headgate. The sole purpose of the squeeze chute and headgate is to restrain the animal so that any desired management practice can be safely conducted on the animal. Safety is essential for both cattle and operator.

In designing working facilities, the squeeze chute and headgate should not open into a pasture. The squeeze chute and headgate should be enclosed in a pen. With this setup, a group of worked cattle can be turned out together or they can be moved back to a holding pen. More importantly, with an enclosed working area, an animal that gets out of the squeeze chute without being worked is not loose in the pasture and can easily be maneuvered back to the chute.

There are a number of manufactures that build outstanding squeeze chutes (Power River, Pearson Livestock Equipment, Priefert Manufacturing, W-W Livestock Systems, etc.). Squeeze chutes (headgate) come with many options and features (manual, hydraulic, sizes, portable vs. stationary, etc.),

and the best one depends upon personal preference. Money spent on a good squeeze chute and headgate is often one of the best investments made in the cattle operation.

Before purchasing a squeeze chute and headgate, check with different manufacturers to determine design features, construction and any special features. In addition to checking with manufacturers, check with people in the area that have commercial equipment. Find out what they like and dislike about their equipment. Major design features to consider when purchasing a squeeze chute and headgate are the latching system, protruding handles and levers, squeeze system, side exit, general or overall construction, options and headgate style. Many of today's squeeze chutes have convenient doors and latches to administer animal health products according to Beef Quality Assurance Guidelines.

When looking at a squeeze chute, check for protruding handles and levers. All squeeze chutes and headgates have one or more handles or levers that are needed to operate the equipment. Handles and levers should be placed and operated in a manner that will not hit and possibly injure the operator or bystanders. Handles and levers that are most likely to cause problems are those that are located at head and shoulder height and those subject to sudden movement. As with all equipment, learn how to properly operate the squeeze chute and headgate. Some chutes place the headgate controls on the front for a one-man operation (Figure 11-1).

Side exits are available on many squeeze chute models and can be quite useful. With proper arrangement of fences and pens, a side exit can be used to sort or cut out cattle when they reach the squeeze chute. In addition, the side exit can be used as an emergency exit or release on downed cattle in the squeeze chute.

There are options available with squeeze chutes. One option is a brisket bar that keeps cows from kneeling and keeps cows standing (Figure 11-2). Almost all chutes have side panels that drop down (Figure 11-3) so feet and legs can be examined or bulls can be BSE tested. Some chutes even have blinders to prevent visual distraction allowing cattle to enter the chute without baulking (Figure 11-4).

Oftentimes a palpation cage can be purchased with the squeeze chute. The palpation cage allows someone to step in behind the animal in the squeeze chute. The palpation cage is basically designed for pregnancy testing and artificial insemination work, but will serve well any time access to the rear end of the animal is needed.

FIGURE 11-1. All controls are on the front of the chute for one-man operation.

FIGURE 11-2. Brisket bar keeps cows from kneeling and keeps cows standing.

FIGURE 11-3. Lower panels can be removed to access the cattle's feet and legs.

FIGURE 11-4. Flexible poly blinders to help funnel cattle into the headgate by reducing visual distractions from outside the chute.

For additional information on working facilities, contact your local county Extension office.

Other Facility Design Considerations

1. Enclose the squeeze chute and headgate area in a pen. If an animal is missed or accidentally gets out of the headgate, it is still confined to the working area and can be put back through the chute. If the headgate opens out into a pasture, then the animal is missed.
2. Provide solid footing in the squeeze chute and headgate area. The next most important area for solid footing is the crowding pen.
3. A shed built over the squeeze chute and extending back over the working chute enables the cattleman to work cattle under adverse weather conditions. The shed should be high enough for slide-up gates to clear and for people to clear rafters if they are on a catwalk or climbing over the chutes.
4. Consider running an electric line and possibly water lines into the facilities. This provides power for lights and other equipment that may be needed while working cattle.
5. A catwalk built alongside the working chute helps move cattle through that chute.
6. A set of scales built into the working chute can be useful for performance work or monitoring calf gains in stocker operations.
7. Loading chutes for many operations have gone by the wayside since bumper and gooseneck-type trailers have become common farm equipment. With these trailers, cattle can be loaded through the working chute. Unloading involves backing into a pen and opening the back gate. For some large operators, plans are available for loading chutes.

TABLE 11-2. Size and Space Requirements for Cattle Working Facilities

	Calves to 600 lbs	Calves 600-1,200 lbs	Cow-Calf and Cattle Over 1,200 lbs
Holding area, sq ft/hd	14	18	20
Crowding pen, sq ft/hd	6	10	12
Working chute, straight sides			
Width	18”	22”	26”
Length (min)	20’	20’	20’
Working chute, sloped sides			
Width, inside bottom	15”	15”	16”
Width, inside at 4’ height	20”	24”	28”
Length (min)	20’	20’	20’
Working chute fence			
Posts			
Depth in ground[1]	36”-48”	36”-48”	36”-48”
Clearance above ground for cross-beams	7’	7’	7’
Fence			
Height, solid wall	54”-60”	54”-60”	60”
Top rail, gentle cattle	54”-60”	60”	60”
Top rail, hard-to-work and wild cattle	60”-72”	60”-72”	72”
Corral fence			
Posts			
Depth in ground[1]	36”-48”	36”-48”	36”-48”
Height above ground			
Gentle cattle	60”	60”	60”
Large cattle, wild cattle	60”-72”	60”-72”	72”
Loading chute			
Width	26”	26”	26”-30”
Length	12’	12’	12’
Rise in/ft (max)	3 1/2”	3 1/2”	3 1/2”
Ramp height			
Trailer	15”		
Pickup	28”		
Large truck	40”		
Tractor-trailer	48”		

[1] Chute and corral post depth will depend on the soil’s ability to hold posts. Posts need to hold tight under heavy use. Posts set in concrete will be more stable.

Feeding Equipment

Feeding equipment for cow-calf and stocker operators will be fairly simple. For feeding hay, many producers have gone to round bales which should be fed in a bale feeder to minimize hay losses. Bale feeders and hay rings are fairly inexpensive, and some very good ones are homemade. Some companies have hay feeding systems that involve bale unrollers, hay wagons, tub grinders, etc., that may be suitable for some farm management programs.

With most farms using round bales, some consideration must be given to hay storage. Round bales and stacks stored outside should be in a well-drained area and placed so they do not touch each other. Hay quality can be better maintained if round bales are stored under cover. A pole barn provides excellent protection for round bales. Pole barns should be built high enough so round bales can be stacked several high and be easily moved about. Be careful not to exceed the ability of your equipment to stack round bales in a barn. The cost of the pole barn can probably be justified over the long run by limiting the amount of hay that is wasted or lost to weathering.

Feed troughs should be part of the feed equipment on most cattle operations. The main use of feed troughs is feeding grain and protein supplements to cattle. Certain times of the year stocker operators have to feed supplemental rations. Growing heifers and bulls need some supplemental feed, and this is best fed in a trough. Troughs can be homemade or purchased. Some self-feeders are on the market that handle several tons of bulk feed and a large number of cattle at one time.

Mineral feeders are needed. There are good manufactured and homemade mineral feeders on farms. Mineral feeders can be portable or stationary. These feeders should be sturdy and covered to protect mineral supplements from the elements. Plan on having enough mineral feeders so that all pastures with cattle have a feeder.

Feed bins are an item not often seen on many cattle operations. The use of feed bins and purchasing some feeds or supplements in bulk (not sacked) should be investigated by many cattlemen. Purchasing in bulk or in larger quantities (1 ton, 3 tons, truckload, etc.) can yield big savings on the feed bill.

Chapter 12

Marketing

Beef production in Arkansas is primarily the cow-calf enterprise. The principle products sold are stocker and feeder calves, slaughter cows and slaughter bulls. A growing number of yearling feeder cattle are produced by cow-calf operators. Some operators retain ownership after weaning through a grazing or backgrounding program, whereas others purchase stocker calves and graze them to yearling weights. Also, a growing number of Arkansas cattle producers are shipping yearling feeder cattle to custom feedlots in the major cattle-feeding areas of the United States and retaining ownership until they are finished for slaughter.

Most stocker and feeder cattle produced in Arkansas are shipped to pastures and feedlots outside the state. Heavier feeder calves quite commonly move northward to be grown on silage or corn stalks before going to Corn-Belt feedlots for finishing. Lighter stocker calves often move westward to wheat or native pasture to be grown prior to entering feedlots in the High Plains.

Slaughter cows and bulls are slaughtered primarily by packers in close proximity to the state. Only a small number of steers and heifers are finished for slaughter in Arkansas.

Marketing Alternatives

A good cattle marketing system should be efficient in operation and effective in pricing. The operational efficiency may be judged on how well the system performs the functions of assembling, processing, packaging and distributing cattle to the new owners. Pricing efficiency may be determined by how well the system reflects supply conditions and buyer demand.

Several marketing methods are available to cattle producers in Arkansas. They are (1) the weekly auction markets, (2) direct selling at private treaty and (3) retaining ownership while finishing cattle in a commercial feedlot. Identifiable differences in the marketing costs and prices exist between these market outlets. Each method tends to serve certain types of producers best. Other methods of marketing feeder cattle, such as electronic systems of marketing, could be effective in the state but have not developed.

Weekly Auction Markets

The local weekly livestock auction is the primary method of marketing feeder cattle in Arkansas. There are 32 livestock auctions in the state located in every major cattle-producing area. The weekly auction is a convenient source of cattle for a backgrounding operation and a convenient way to sell cattle at the end of the backgrounding period. Weekly auctions are best suited to the small producer with limited time to spend on marketing. Auctions sell all classes of cattle, and a market price on sale day is virtually assured. However, commission rates to market through weekly auctions are relatively high, and the indirect marketing costs associated with assembly are reflected in prices that may be lower than other marketing methods. This may be especially true at smaller auctions.

Direct Selling at Private Treaty

This method of marketing is best suited to producers who have uniform load-lots of cattle to sell at one time. A small producer may sell direct to an order buyer or dealer who, in turn, sorts and assembles the cattle with others of similar kind for shipment to their destination. Selling direct is usually less convenient than selling through a weekly auction since the backgrounder must stay abreast of market conditions and prices and serve as his/her own marketing agent, locating buyers, negotiating the sale and arranging for shipment. Compared to public markets, such as weekly auctions, selling direct is more efficient, does not place as much physical stress on the cattle and can return a higher price with less marketing cost.

Retaining Ownership

Retaining ownership of backgrounded cattle and finishing them in a commercial feedlot eliminates many marketing costs such as commission charges, hauling, shrink and death loss incurred with other marketing methods. However, substantially more capital investment is necessary.

Other Livestock Auctions

Other livestock auctions are available such as regional auctions, satellite auctions, video auctions, internet auctions, special calf/feeder sales, age and source verification sales, commingled sales, etc. Each of these auction types has advantages, disadvantages, costs and restrictions.

Future Price Outlook

Prices for cattle are determined jointly by supply and demand. Demand for beef is relatively constant, although changes do occur over a long time. Supply is much more apt to change, particularly in the short run, and cause rapid movements in market prices for cattle.

The cattle inventory usually increases when prices are at a profitable level. During a buildup phase in the inventory, females are retained in the herd which reduces the available supply of market cattle and forces prices higher. This, in turn, encourages additional hold-back of breeding stock and growth in inventory. Eventually, however, production increases and prices begin to fall. The declining prices cause producers to liquidate some of their inventory and drive prices even further down.

These cycles are fairly regular in length because of biological factors involved in cattle production, but the extent of buildup and liquidation and subsequent price change may vary greatly as other economic factors influence market conditions.

Seasonal cycles in production and prices exist as feed supplies vary during the year. Prices for both feeder cattle and cows are usually highest during the spring months when smaller supplies are being offered for market and the upcoming summer grazing is near. In contrast, prices are normally lowest in the fall as greater supplies are marketed and the higher cost of winter feeding is coming on.

Valuable data are readily available for producers to use in following changes in supply, demand and prices and in projecting future market conditions. Knowledge of these trends should enable cattlemen to make more profitable decisions in production and marketing.

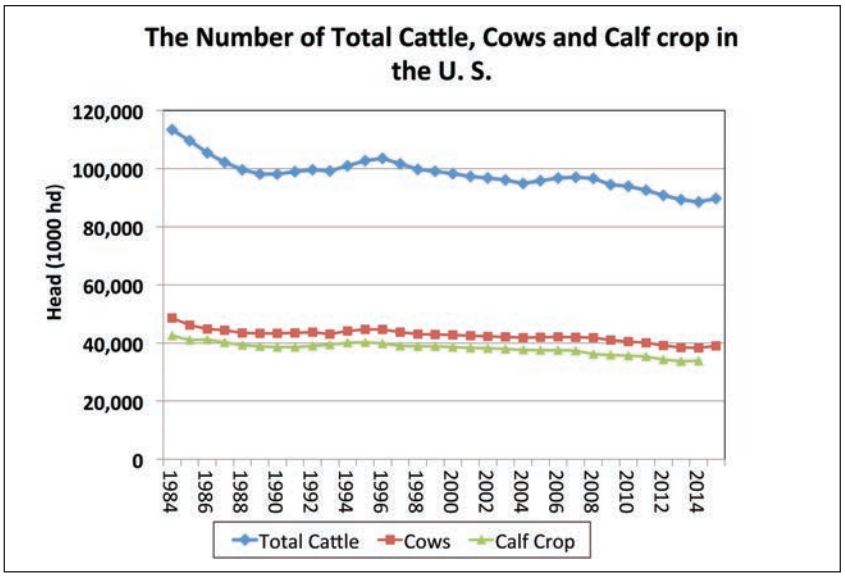


FIGURE 12-1. Number of total cattle, cows and calf crop in the U.S.

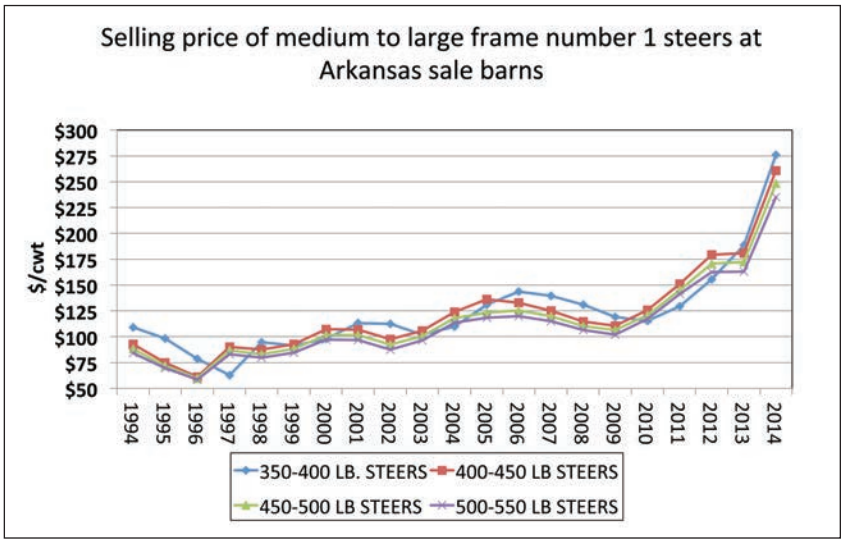


FIGURE 12-2. Arkansas average steer prices.

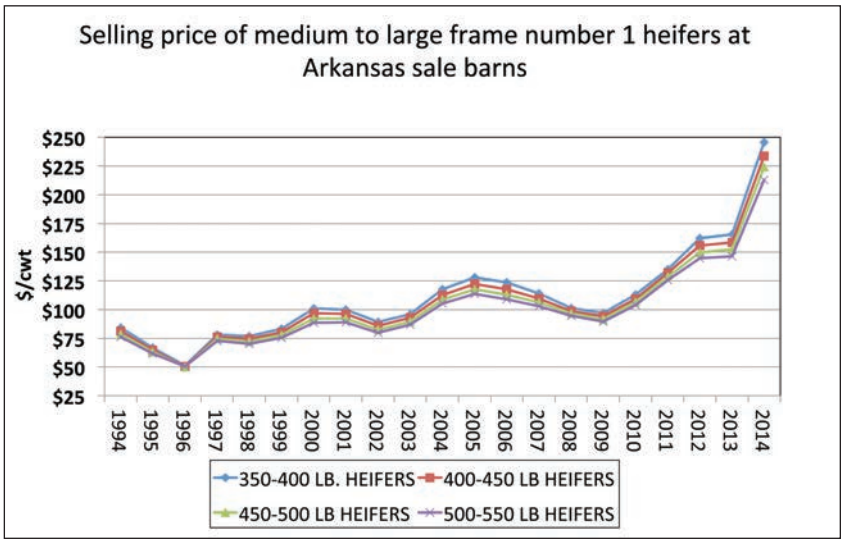


FIGURE 12-3. Arkansas average heifer prices.

Current Market Information

Producers should stay abreast of the current market prices and conditions to make profitable marketing decisions. Much reliable market information on current prices and supply is available.

The Arkansas Federal-State Livestock Market News Service covers 14 auction markets in the state and issues reports to newspapers and radio stations. A statewide summary of auctions is prepared each day for use by radio stations. In addition, daily market reports are available from terminal markets nationwide.

Direct sales of slaughter and feeder cattle are reported. Sales of carcass beef and primal wholesale cuts are reported daily for all major producing and consuming areas nationwide. Other reports on offal value, daily slaughter estimates and total weekly meat production are available.

Market Value

The value of slaughter cattle is dependent upon the quantity and quality of beef produced from the animal. Quality determines the uses that can be made of the beef. Cutability and dressing percentage affect quantity. Stocker and feeder cattle value depends on the potential value of the animal when finished for slaughter and the cost of finishing the animal to a slaughter point.

Several factors that affect the value of cattle in the market are:

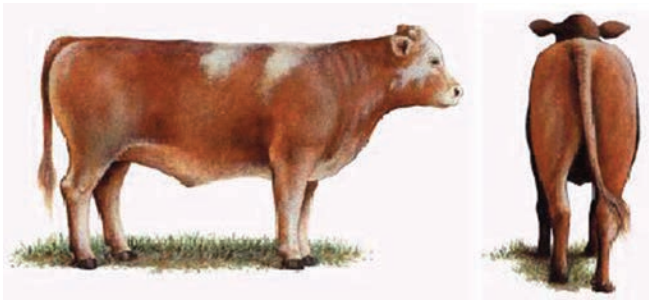
Muscle Thickness

Muscle thickness is related to muscle to bone ratio at a given degree of fatness to carcass yield grade. USDA developed a standard muscle scoring system (USDA, 2000). The scoring system is 1, 2, 3 and 4 (Figure 12-4). Muscle score 1 cattle are thrifty and

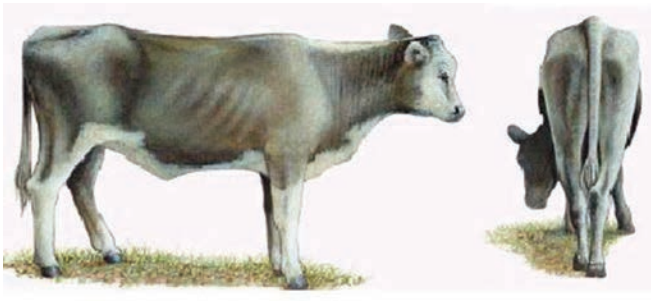
FIGURE 12-4. Examples of the USDA Muscle Scoring System.

Muscle score 1 cattle are thrifty and moderately thick throughout. They are moderately thick and full in the forearm and gaskin, showing a rounded appearance through the back and loin with moderate width between the legs, both front and rear.

Muscle score 3 cattle express a forearm and gaskin that are thin, and the back and loin have a sunken appearance. The legs are set close together, both front and rear.



Muscle score 2 cattle show a high proportion of beef breeding, are thrifty and tend to be slightly thick and full in the forearm and gaskin, showing rounded appearance through the back and loin with slight width between the legs, both front and rear.



Muscle score 4 cattle are thrifty but have less thickness than the minimum requirements specified for the No. 3 grade.

moderately thick throughout. They are moderately thick and full in the forearm and gaskin, showing a rounded appearance through the back and loin with moderate width between the legs, both front and rear. Muscle score 2 cattle show a high proportion of beef breeding, are thrifty and tend to be slightly thick throughout. They tend to be slightly thick and full in the forearm and gaskin, showing a rounded appearance through the back and loin with slight width between the legs, both front and rear. Muscle score 3 cattle express a forearm and gaskin that are thin, and the back and loin have a sunken appearance. The legs are set close together, both front and rear. Muscle score 4 cattle are thrifty but have less thickness than the minimum requirements specified for the No. 3 grade.

The discounts due to lack of muscling are large regardless of feeder calf weight. The discount comparing a No. 2 to No. 1 is approximately $10 per cwt, or $50 for a 500-pound feeder calf. The selling discount for a No. 3 compared to a No. 1 usually ranges $20 to $25 per cwt, and the discount continues to increase when comparing a No. 4 to No. 1 ($35 to $40 per cwt). Culling light-muscled cows and replacing them with moderate-muscled cows is the first step to producing heavier-muscled feeder cattle. Selecting sires with a full forearm and gaskins, showing rounded appearance through the back and loin with moderate width between the legs, is very important.

Frame Score

Frame scores are determined based on the revised U.S. Standards for Grades of Feeder Cattle (USDA, 2000). According to the standards, frame size is related to the weight at which, under normal feeding and management practices, an animal will produce a carcass that will grade USDA Choice. USDA large-framed steers and heifers are expected to weigh over 1,250 and 1,150 pounds, respectively, to grade USDA Choice. USDA medium-framed steers and heifers are expected to weigh 1,100 to 1,250 and 1,000 to 1,150 pounds, respectively, to grade USDA Choice, and USDA small-framed steers and heifers are expected to weigh less than 1,100 and 1,000 pounds, respectively. Large-framed animals require a longer time in the feedlot to reach a given grade and will weigh more than a small-framed animal would weigh at the same grade.

Therefore, USDA Feeder Cattle Grade Medium is equal to hip height frame scores 4 and 5, Small is equal to or less than 3 and Large is equal to or greater than 6. The ideal calf should be between a frame score of 5 to 6. That means at 205 days of age males should be 44.1 to 46.1 inches tall and heifers should be 43.3 to 45.3 inches tall at the hip (see Appendix). It is much easier to produce frame score 5 to 6 calves from frame score 5 to 6 cows. Therefore, it may be important to frame score the cow herd and bulls and eliminate extremely large- and small-framed cattle.

USDA small-framed feeder cattle experience severe discounts, $22 or more per cwt, compared to large-framed feeder cattle. Feeder cattle that are small-framed will generally have more backfat at slaughter than large-framed cattle. The excessive backfat negatively affects yield grade and red meat yield. The difference between large- and medium-framed feeder cattle selling price is usually less than $5 cwt. Oftentimes for feeder cattle weight between 500 to 600 pounds, large- and medium-framed cattle sell for the same price.

Breed Composition

It has often been stated that there is as much variation within a breed as there is across breeds. When designing breeding programs, it becomes very important to truly identify those superior animals within a breed. The results of crossbreeding can have a greater impact when superior purebred animals are used. The major advantage to using superior animals in crossbreeding programs is heterosis, or "hybrid vigor," and breed complementation.

When a calf enters the sale ring, buyers evaluate each feeder calf and determine its breed or breed type based on frame score, muscle thickness, color, breed characteristics and body structure. Therefore, breed or breed combination is based on common industry perception rather than actually knowing the breed composition.

Feeder cattle perceived to be Hereford x Charolais, Angus x Hereford, Angus, Charolais x Limousin, Angus x Limousin, Angus x Charolais and Hereford x Brahman x Angus are usually sold for higher-than-average prices in Arkansas livestock auctions than feeder calves of other breeds. In addition, feeder calves of one-quarter Brahman crosses, Simmental, Hereford, Brahman and Longhorn historically sold for lower prices than from other breeds or breed combinations.

Breeds or breed types do affect the selling price of feeder cattle. This is due to the perception by the order buyer as to how different breeds or breed types perform (gain, sick rate, quality grade, etc.). For many years, a perception existed that if cattle were black they had some degree of Angus breeding. Today that may or may not be true. Many beef breeds have animals that are black, such as Limousin, Simmental and Gelbvieh, to name a few. The perceptions regarding certain breeds and subsequent performance may be

right or wrong, but they exist. With a high percentage of feeder cattle sold in livestock auctions weighing less than 550 pounds, the majority of these cattle are purchased for placement in a backgrounding grazing program. Backgrounding programs are forage based (native pasture, wheat, etc.), and buyers are looking for the breeds or breed combinations that perform best under those conditions. Cow-calf producers should be aware that the breeds or breed types that perform best under backgrounding programs might not be the breeds or breed types that make good replacements. Cow-calf producers must be attentive of this and design an appropriate breeding program.

Color

The color of the calf does affect the selling price. Yellow, yellow-white faced, black-white faced and black colored calves have historically sold for a higher price than red, gray, white, red-white faced, gray-white faced and spotted or striped feeder cattle. A uniform set of cows bred to the bull of the same breed can help produce the color of calf that will be advantageous in the marketplace.

Management Factors Affecting Market Price

Castration

Research at the University of Arkansas demonstrated calves castrated shortly after birth and bulls gained at the same rate from birth to weaning. Weaning weights and average daily gains were the same. Therefore, there is no weight gain advantage for keeping male calves as bulls. The main reason for castrating bulls is to control behavior and disposition. If a cow-calf producer sells weaned bull calves, somebody will castrate them.

Historically, steer calves sell for a higher selling price than bull calves regardless of the selling weight group. The price difference between steers and bulls varies but averages approximately $5 to $6 per cwt. Therefore, the selling price difference between a 500-pound steer and a 500-pound bull is approximately $25 to $30. The selling price of heifers averages $10 per cwt less than the selling price for steers.

Fill

When compared to the average fill selling price, selling prices for gaunt and shrunk feeder cattle are usually higher ($2 to $4 per cwt). The selling prices for feeder cattle classified as full and tanked are discounted considerably ($6 to $14 per cwt). Feed and water can be purchased for less, relative to the selling price of cattle, but those animals exhibiting excessive fill are discounted. Order buyers discount feeder calves that show excessive potential for shrinkage. This affects the cow-calf producer in two ways. The producer not only absorbs the extra feed cost that results in the extra fill, but also the calf is discounted when it is sold.

Body Condition

The only body condition classification that usually sells for a higher price than the average body condition is thin feeder cattle (approximately $1 to $3 per cwt). All of the other body condition classifications (very thin, fleshy and fat) usually sell for less than the average body condition ($2 to $15 per cwt). Calves that are overconditioned have usually been on a high plane of pre-weaning nutrition (creep feeding, etc.). Subsequent to weaning, the level of nutrition may decrease and the overconditioned feeder cattle may actually lose weight for a period. Order buyers will not pay for that weight and time loss, thus the large discounts seen with fleshy and fat feeder calves.

Horned Cattle

Most of the feeder cattle raised in Arkansas are polled (86 percent). Historically, polled, or dehorned, feeder cattle sell for $4 per cwt more than horned feeder cattle. Because horns can damage loins, cow-calf producers should change management practices to reduce the presence of horns.

Sick or Lame Cattle

Over 98 percent of the feeder cattle sold in Arkansas are healthy. Healthy feeder cattle sell for a much higher price than any of the unhealthy categories do. Discounts on unhealthy cattle were greatest with lame and sick feeder cattle usually ranging between $26 to $30 per cwt. Selling prices of feeder cattle that had dead hair, were stale or had bad eye(s) generally range between $12 and $14. Preconditioned calves sold for a $4 per cwt premium over the average.

Size and Uniformity

Arkansas primarily produces feeder cattle that weigh less than 550 pounds. Most of the feeder cattle are sold individually (75 percent). The selling price for feeder cattle sold in groups of two to five head is usually higher than the selling price of feeder cattle sold as singles. There is a trend in the cattle industry to sell larger, uniform lots of feeder cattle versus selling feeder cattle one head at a time.

Marketing Purebred Cattle

Purebred breeders are producers of seedstock. Primarily, they develop bulls and heifers for use by commercial cattlemen. A few "top-line" bulls and females capable of contributing to breed improvement are sold to other purebred herds. Certain breeders, especially in breeds noted for their mothering ability, have a good outlet for females to commercial herds.

Producing crossbred "F1" females from two complementary pure breeds for commercial replacement heifers has become popular in recent years. This, too, may be considered a form of purebred production.

Many large breeders have an annual "production" auction sale for bulls and females produced in their herds. The "consignment" auction sale will include cattle consigned by several breeders. The consignment sale benefits primarily small breeders who wish to sell at auction but do not have sufficient numbers for an individual production sale. An individual breeder may consign only one or several animals to a consignment sale.

Both large and small breeders can sell successfully by private treaty. Many breeders regularly furnish the breeding stock needs of their neighbors, and such sales are often single animals. Some large breeders may sell to large commercial herds in lots that include ten or more animals.

Purebred cattle are a special-type product requiring certain specialized marketing techniques not altogether common in marketing commercial cattle.

Marketing costs per animal for purebred auction sale are often ten times the per-animal cost of selling commercial cattle at a regular weekly auction. Many purebred breeders advertise regularly in trade magazines and newspapers, especially those breeders who sell predominantly at private treaty. For production and consignment sales, there is the cost of sale catalogues, television, radio and newspaper advertisements, photography, artwork, postage and pre-sale and post-sale entertainment.

Breeders who do have an annual production sale usually construct their own sale facilities and show barns. Most consignment sales and some production sales lease facilities.

Consignment sales are usually sponsored by a producer association that handles all the sale arrangements for a fee paid by the breeder.

The market value of purebred cattle relates to the market for commercial cattle in that the same characteristics which contribute to production efficiency and consumer acceptance are important. However, breeding values are multiplied many times when total offsprings from a bull or female are considered.

Breeder reputation, visual characteristics and performance records largely determine the market value of a purebred animal.

Visual characteristics and performance records influence market value of an animal to the extent that the desirable characteristics are expected to be transmitted to its offsprings.

Market Regulations

The Packers and Stockyards Act, a law passed by Congress in 1921, places the responsibility of regulating the livestock and meat industry on the Secretary of Agriculture. The law was passed to restrict unfair and deceptive practices of people involved in livestock marketing.

The Packers and Stockyards Administration regulates stockyards, auction markets, packers, market agencies and dealers engaged in interstate livestock marketing business. The regulations include requirements dealing with fair trade practices, bonds, records and weighing conditions. All agencies have to maintain sufficient records to disclose the full nature of each transaction. Farmers who buy or sell in their farming or feeding operations are not considered livestock dealers and do not come under the P&S regulations.

Market operators and dealers must carry a bond based on volume of businesses to assure farmers they will receive the net proceeds for their livestock sold through the agency. All scales must be tested at least twice a year. No stockyards, commission firm, auction, livestock dealer or packer is to engage in unfair practices that could injure producers. Each producer selling through a marketing agency must receive full and accurate accounting concerning the sale of livestock. The account of sale shows the buyer, number of head, weight, price, all expenses and the net amount realized from the sale.

Chapter 13

Farm Management Factors

Finance

A potential borrower may be asked to provide the following financial documents:

1. Net worth statement – provides a listing of assets and liabilities.

2. Cash flow statement – provides a listing of all cash coming in and going out.

3. Profit and loss statement – itemized estimates of incomes and expenses.

The borrower may be asked to estimate cash flow and profit and loss for the future year(s) in which the loan will be in effect. If the borrower is unknown to the lender, the lender may visit the farm and observe such factors as quality and amount of pastures, fencing, working facilities and water supplies. Also, a lender may ask about experience in raising cattle, education, family status, health, income, insurance, etc.

Major agricultural lenders include local banks, Farm Credit Service and the USDA Farm Service Agency. Other sources of funds are individuals, insurance companies and credit unions.

Two types of cattle loans are (1) annual operating loans and (2) intermediate loans. An annual operating loan is common for financing a feeder cattle venture, feed and other inputs for a cow-calf enterprise, or improvement in facilities and pastures. Intermediate loans commonly are made for purchase of cows, replacement heifers, bulls, equipment and major facilities. These intermediate loans are commonly set up with a timely repayment schedule.

Income Taxes

An understanding of income tax principles can avoid overpayment of taxes. Two critical times exist for cattle producers – the beginning year and the ending year. Major tax management decisions must be made during the initial years of development of a farm enterprise. These primarily involve expensing the investments over future years. Those individuals quitting the cattle business may face a large, unplanned income tax liability if careful attention is not given to a dispersal plan.

The complexities of income tax accounting coupled with almost always annual changes in tax laws create the need for the services of a tax advisor. Simply hiring a professional to file an annual tax return is not tax planning and management. Once a transaction is made, the accountant can only properly report the amounts on the client's tax forms. Ideally, a farm business manager would hire a professional who can advise on a regular basis and also prepare and file the income tax returns.

Arkansas has an income tax system, and the codes and regulations generally follow the federal rules. Even though the income tax rate for Arkansas is lower than IRS rates, the payment can be substantial.

The *Farmer's Tax Guide* is available from the IRS and provides much information for those interested in learning about managing income taxes. It is not recommended as a substitute for a tax advisor, but it is highly recommended as a source of basic information for farmers.

Budgeting

An enterprise budget is an organized listing of direct income and expenses associated with the enterprise. A budget can be prepared for the actual costs and returns for a past year, or it can be prepared for a future year. Obviously, a budget for next year will be an organization of estimates or guesses because most future events cannot be precisely predicted.

A well-organized, detailed enterprise budget requires much input and preparation time. The budgets shown in Tables 13-1 and 13-2 provide excellent examples of detailed budgets for a commercial cow-calf herd. These budgets can be prepared for most any herd size and actual farming situation.

Feeder Cattle Budgeting

Budgeting a feeder cattle production enterprise is less complex than budgeting a cow-calf enterprise. Feeder cattle production involves weaning and retaining calves from the cow-calf herd or buying calves. Lightweight feeder calves are generally grown from weaning weights of 300 to 600 pounds to 600- to 900-pound feeder cattle that are ready to be fattened and finished in the feedlot. Weight ranges vary with breed, producer's preferences and overall management practices.

Table 13-3 illustrates the budgeting of 320 steers on permanent pasture with hay and grain supplements with costs shown on a per-head basis. Calves, purchased or retained, weighed 400 pounds and were valued at $300 per cwt. They were sold at a weight of 730 pounds at a price of $195 per cwt. Other inputs include grazing lease, vet medicine, mineral, supplementation, hay, fuel, etc. One may want to include ear tags, implants, feed additives and other supplies as appropriate. Also shown is a 2 percent reduction in receipts for death loss.

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Table 13-1

Arkansas Cow/Calf Budget per Cow and Total Cow Herd, 2016

Calving rate, percent	85.00%	0.050	Bull per cow		
Death loss for cow herd, percent	2.50%	0.125	Full retained heifer replacement rate		
Death loss for calves, percent	0.00%	0.125	Retained heifer replacement rate		
Cows per bull	20.00	0.300	Heifers sold	Head	12.0
Head, cow herd	40	0.425	Steers sold	Head	17.0
Cull cows sold from cow herd, percent	10.00%	4.0	Head, cull cows sold		
Percent of full retained heifer replacement rate	100.00%	5.0	Head, retained replacement heifers		
Purchased heifers, not bred for current year	0	0.0	Head, cow herd change		

Revenue	Unit	Quantity	Price	$ per Cow	Total $
Cull Cows	lb.	1,100	0.70	77.00	3,080
Heifer Calves	lb.	520	1.60	249.60	9,984
Steer Calves	lb.	550	1.80	420.75	16,830
Total Revenue				**747.35**	**29,894**
Operating Expenses					
Pasture Production	acre	2.25	35.00	78.75	3,150
Hay Production	acre	0.00	122.99	0.00	0
Purchased Hay per Cow	ton	2.25	60.00	135.00	5,400
Supplemental Feed for Cows	lb.	495.00	0.095	47.03	1,881
Supplemental Feed, Replacement Heifers	lb.	675.00	0.095	8.02	321
Supplemental Feed, Bulls	lb.	0.00	0.000	0.00	0
Supplemental Feed, Calves Sold	lb.	0.00	0.000	0.00	0
Salt, Minerals for Cows	lb.	90.00	0.360	32.40	1,296
Veterinary & Medicine for Cows	head	1.00	22.00	22.00	880
Veterinary & Medicine, Replacement Heifers	head	0.13	9.00	1.13	45
Veterinary & Medicine, Bulls	head	0.05	59.00	2.95	118
Veterinary & Medicine, Calves Sold	head	0.73	10.73	7.78	311
Other Expenses	head	1.00	0.00	0.00	0
Labor, Hired	hours	0.00	12.00	0.00	0
Production Expenses				**335.05**	**13,402**
Interest, annual rate: paid for 6 months	$	335.05	4.75%	7.96	318
Hauling and Auction for Calves & Cull Cows	head	0.83	44.24	36.49	1,460
Land Rent	acre	0.00	0.00	0.00	0
Total Operating Expense				**379.50**	**15,180**
Returns to Operating Expenses				**367.85**	**14,714**
Fixed Costs					
Livestock Facilities & Equipment	head	1.00	666.82	117.73	4,709
Pasture & Hay Machinery, Equipment	head	1.00	513.61	105.89	4,236
Purchased Breeding Stock	head	1.00	175.00	29.44	1,178
Purchased Heifers, not bred for current year	head	0.00	1,500.00	0.00	0
Total Fixed Costs				**253.06**	**10,122**
Total Specified Expenses				**632.56**	**25,302**
Net Returns				**114.79**	**4,592**

Developed by Archie Flanders, Extension economist, University of Arkansas System Division of Agriculture

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University of Arkansas System

Table 13-2

Arkansas Cow/Calf Budget per Cow and Total Cow Herd, 2016

Calving rate, percent	85.00%	0.050	Bull per cow		
Death loss for cow herd, percent	2.50%	0.125	Full retained heifer replacement rate		
Death loss for calves, percent	0.00%	0.125	Retained heifer replacement rate		
Cows per bull	20.00	0.300	Heifers sold	Head	12.0
Head, cow herd	40	0.425	Steers sold	Head	17.0
Cull cows sold from cow herd, percent	10.00%	4.0	Head, cull cows sold		
Percent of full retained heifer replacement rate	100.00%	5.0	Head, retained replacement heifers		
Purchased heifers, not bred for current year	0	0.0	Head, cow herd change		

Revenue	Unit	Quantity	Price	$ per Cow	Total $
Cull Cows	lb.	1,100	0.70	77.00	3,080
Heifer Calves	lb.	520	1.60	249.60	9,984
Steer Calves	lb.	550	1.80	420.75	16,830
Total Revenue				**747.35**	**29,894**
Operating Expenses					
Pasture Production	acre	2.25	35.00	78.75	3,150
Hay Production	acre	0.75	122.99	92.24	3,690
Purchased Hay per Cow	ton	0.00	60.00	0.00	0
Supplemental Feed for Cows	lb.	495.00	0.095	47.03	1,881
Supplemental Feed, Replacement Heifers	lb.	675.00	0.095	8.02	321
Supplemental Feed, Bulls	lb.	0.00	0.000	0.00	0
Supplemental Feed, Calves Sold	lb.	0.00	0.000	0.00	0
Salt, Minerals for Cows	lb.	90.00	0.360	32.40	1,296
Veterinary & Medicine for Cows	head	1.00	22.00	22.00	880
Veterinary & Medicine, Replacement Heifers	head	0.13	9.00	1.13	45
Veterinary & Medicine, Bulls	head	0.05	59.00	2.95	118
Veterinary & Medicine, Calves Sold	head	0.73	10.73	7.78	311
Other Expenses	head	1.00	0.00	0.00	0
Labor, Hired	hours	0.00	12.00	0.00	0
Production Expenses				**292.29**	**11,692**
Interest, annual rate: paid for 6 months	$	292.29	4.75%	6.94	278
Hauling and Auction for Calves & Cull Cows	head	0.83	44.24	36.49	1,460
Land Rent	acre	0.00	0.00	0.00	0
Total Operating Expense				**335.73**	**13,429**
Returns to Operating Expenses				**411.62**	**16,465**
Fixed Costs					
Livestock Facilities & Equipment	head	1.00	724.78	127.25	5,090
Pasture & Hay Machinery, Equipment	head	1.00	1,044.80	202.89	8,115
Purchased Breeding Stock	head	1.00	175.00	29.44	1,178
Purchased Heifers, not bred for current year	head	0.00	1,500.00	0.00	0
Total Fixed Costs				**359.58**	**14,383**
Total Specified Expenses				**695.31**	**27,812**
Net Returns				**52.04**	**2,082**

Developed by Archie Flanders, Extension economist, University of Arkansas System Division of Agriculture

Projections for Planning Purposes Only

Table 13-3. 2015 Estimated Costs and Returns Per Animal
Stockers on Native Pasture – 320 Head

Number of Head	320					
REVENUE	**Head**	**Pay Weight**	**Units**	**$/Unit**	**Total**	**Enterprise Total**
Stocker	0.98	7.30	CWT	$195.00	$1,395.03	$446,409.60
Total Revenue					$1,395.03	$446,409.60
VARIABLE COSTS		**Quantity**	**Units**	**$/Unit**	**Total**	**Enterprise Total**
Production Costs						
Stocker Purchase		4.00	CWT	$300.00	$1,200.00	$384,000.00
Grazing						
Acre Lease		4.00	Acre	$8.00	$32.00	$10,240.00
Health						
Vet. Medicine - Stocker		1	Head	$7.00	$7.00	$2,240.00
Feed						
Bermuda Hay Bale		4	Bale	$6.00	$24.00	$7,680.00
Mineral - Stocker		0.263	CWT	$15.00	$3.95	$1,262.40
Supplement - Stocker		0.75	CWT	$10.75	$8.06	$2,580.00
Miscellaneous						
Miscellaneous		1	Head	$4.00	$4.00	$1,280.00
Fuel		1	Head	$3.71	$3.71	$1,187.13
Lube (As a % of fuel)		10.0%	Percent	$3.71	$0.37	$118.71
Repairs		1	Head	$0.96	$0.96	$307.20
Marketing		0.98	Head	$14.60	$14.31	$4,578.56
Labor		1	Head	$15.83	$15.83	$5,066.28
Interest on Credit Line				4.75%	$20.64	$6,603.77
Total Variable Costs					$1,334.83	$427,144.05
Planned Returns Above Variable Costs:					$60.20	$19,265.55
Breakeven Price to Cover Variable Costs				$182.85 CWT		
FIXED COSTS		**Quantity**	**Units**	**$/Unit**	**Total**	**Enterprise Total**
Depreciation		1	Head	$15.50	$15.50	$4,960.91
Equipment Investment		$429.69	Dollars	6.00%	$25.78	$8,250.00
Total Fixed Costs					$41.28	$13,210.91
Total Costs					$1,376.11	$440,354.96
Planned Returns to Management, Risk, and Profit:					$18.92	$6,054.64
Breakeven Price to Cover Total Costs				$188.51 CWT		

Developed by Jason Johnson, associate professor and Extension economist, Texas A&M AgriLife Extension.
Information presented is prepared solely as a general guide and not intended to recognize or predict the costs and returns from any one operation. Brand names are mentioned only as examples and imply no endorsement.

Appendix

BULL HIP HEIGHTS (INCHES) AND FRAME SCORES*

Age in Months	Frame Score								
	1	2	3	4	5	6	7	8	9
5	33.5	35.5	37.5	39.5	41.6	43.6	45.6	47.7	49.7
6	34.8	36.8	38.8	40.8	42.9	44.9	46.9	48.9	51.0
7	36.0	38.0	40.0	42.1	44.1	46.1	48.1	50.1	52.2
8	37.2	39.2	41.2	43.2	45.2	47.2	49.3	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	54.7	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

Frame Score = $-11.548 + (0.4878 \times Ht) - (0.0289 \times Age) + (0.00001947 \times Age^2) + (0.0000334 \times Ht \times Age)$, where Age = days of age.

HEIFER HIP HEIGHTS (INCHES) AND FRAME SCORES*

Age in Months	Frame Score								
	1	2	3	4	5	6	7	8	9
5	33.1	35.1	37.2	39.3	41.3	43.4	45.5	47.5	49.6
6	34.1	36.2	38.2	40.3	42.3	44.4	46.5	48.5	50.6
7	35.1	37.1	39.2	41.2	43.3	45.3	47.4	49.4	51.5
8	36.0	38.0	40.1	42.1	44.1	46.2	48.2	50.2	52.3
9	36.8	38.9	40.9	42.9	44.9	47.0	49.0	51.0	53.0
10	37.6	39.6	41.6	43.7	45.7	47.7	49.7	51.7	53.8
11	38.3	40.3	42.3	44.3	46.4	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	41.0	43.0	44.9	46.9	48.9	50.8	52.8	54.8	56.7
17	41.4	43.3	45.3	47.2	49.2	51.1	53.1	55.1	57.0
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

Frame Score = $-11.7086 + (0.4723 \times Ht) - (0.0239 \times Age) + (0.0000146 \times Age^2) + (0.0000759 \times Ht \times Age)$, where Age = days of age.

* Taken from *Beef Improvement Federation (BIF) Guidelines for Uniform Beef Improvement Programs*, Eighth Edition, 2002. Hip height measurement should be taken at a point directly over the hip bones (hooks) with the animal standing on a level surface.

GESTATION TABLE – BASED ON 283 DAYS PREGNANCY											
Date of Service	**Calf Due**	**Date of Service**	**Calf Due**	**Date of Service**	**Calf Due**	**Date of Service**	**Calf Due**	**Date of Service**	**Calf Due**	**Date of Service**	**Calf Due**
Jan	Oct	Mar	Dec	May	Feb	Jul	Apr	Sep	Jun	Nov	Aug
1	10	1	8	1	7	1	9	1	10	1	10
2	11	2	9	2	8	2	10	2	11	2	11
3	12	3	10	3	9	3	11	3	12	3	12
4	13	4	11	4	10	4	12	4	13	4	13
5	14	5	12	5	11	5	13	5	14	5	14
6	15	6	13	6	12	6	14	6	15	6	15
7	16	7	14	7	13	7	15	7	16	7	16
8	17	8	15	8	14	8	16	8	17	8	17
9	18	9	16	9	15	9	17	9	18	9	18
10	19	10	17	10	16	10	18	10	19	10	19
11	20	11	18	11	17	11	19	11	20	11	20
12	21	12	19	12	18	12	20	12	21	12	21
13	22	13	20	13	19	13	21	13	22	13	22
14	23	14	21	14	20	14	22	14	23	14	23
15	24	15	22	15	21	15	23	15	24	15	24
16	25	16	23	16	22	16	24	16	25	16	25
17	26	17	24	17	23	17	25	17	26	17	26
18	27	18	25	18	24	18	26	18	27	18	27
19	28	19	26	19	25	19	27	19	28	19	28
20	29	20	27	20	26	20	28	20	29	20	29
21	30	21	28	21	27	21	29	21	30	21	30
22	31	22	29	22	28	22	30		Jul	22	31
	Nov	23	30		Mar		May	22	1		Sep
23	1	24	31	23	1	23	1	23	2	23	1
24	2		Jan	24	2	24	2	24	3	24	2
25	3	25	1	25	3	25	3	25	4	25	3
26	4	26	2	26	4	26	4	26	5	26	4
27	5	27	3	27	5	27	5	27	6	27	5
28	6	28	4	28	6	28	6	28	7	28	6
29	7	29	5	29	7	29	7	29	8	29	7
30	8	30	6	30	8	30	8	30	9	30	8
31	9	31	7	31	9	31	9	---	---	---	---
Feb	Nov	Apr	Jan	Jun	Mar	Aug	May	Oct	Jul	Dec	Sep
1	10	1	8	1	10	1	10	1	10	1	9
2	11	2	9	2	11	2	11	2	11	2	10
3	12	3	10	3	12	3	12	3	12	3	11
4	13	4	11	4	13	4	13	4	13	4	12
5	14	5	12	5	14	5	14	5	14	5	13
6	15	6	13	6	15	6	15	6	15	6	14
7	16	7	14	7	16	7	16	7	16	7	15
8	17	8	15	8	17	8	17	8	17	8	16
9	18	9	16	9	18	9	18	9	18	9	17
10	19	10	17	10	19	10	19	10	19	10	18
11	20	11	18	11	20	11	20	11	20	11	19
12	21	12	19	12	21	12	21	12	21	12	20
13	22	13	20	13	22	13	22	13	22	13	21
14	23	14	21	14	23	14	23	14	23	14	22
15	24	15	22	15	24	15	24	15	24	15	23
16	25	16	23	16	25	16	25	16	25	16	24
17	26	17	24	17	26	17	26	17	26	17	25
18	27	18	25	18	27	18	27	18	27	18	26
19	28	19	26	19	28	19	28	19	28	19	27
20	29	20	27	20	29	20	29	20	29	20	28
21	30	21	28	21	30	21	30	21	30	21	29
	Dec	22	29	22	31	22	31	22	31	22	30
22	1	23	30		Apr		Jun		Aug		Oct
23	2	24	31	23	1	23	1	23	1	23	1
24	3		Feb	24	2	24	2	24	2	24	2
25	4	25	1	25	3	25	3	25	3	25	3
26	5	26	2	26	4	26	4	26	4	26	4
27	6	27	3	27	5	27	5	27	5	27	5
28	7	28	4	28	6	28	6	28	6	28	6
---	---	29	5	29	7	29	7	29	7	29	7
---	---	30	6	30	8	30	8	30	8	30	8
---	---	---	---	---	---	31	9	31	9	31	9

Cow Herd Management

Month	Fall Calves	Spring Calves
January	Cows and calves with bulls grazing on stockpiled tall fescue. Fertilize small grains and ryegrass. Monitor body condition. Apply herbicides for winter annual weeds in dormant bermudagrass. Graze cool-season annuals. Plant red and white clovers.	Heifer calving season. Permanently identify calves at birth. Record birth dates. Castrate at birth. Implant steer calves. Vaccinate replacement heifers. Sire selection for breeding season. Fertilize small grains and ryegrass. Monitor body condition. Apply herbicides for winter annual weeds in dormant bermudagrass. Graze cool-season annuals. Plant red and white clovers.
February	Continue grazing stockpiled tall fescue. Castrate and implant bull calves. Dehorn. Cow breeding season. Watch for grass tetany. Vaccinate calves for Blackleg 7-way and IBR-BVD-PI_3. Vaccinate cow herd for Lepto, IBR-BVD-PI_3 and vibriosis. Fertilize small grains and ryegrass. Fertilize cool-season grasses and clover. Spray for buttercup and other winter weeds. Plant annual lespedeza, red and white clover. Graze cool-season annual grasses.	Cows grazing deferred tall fescue and fescue and legume; hay in bad weather. Cow calving starts. Permanently identify calves at birth. Record birth dates. Castrate at birth. Implant steer calves. Fertility test bulls (BSE). Watch for grass tetany. Fertilize small grains and ryegrass. Fertilize cool-season grasses and clover. Spray for buttercup and other winter weeds. Plant annual lespedeza, red and white clover. Graze cool-season annual grasses.
March	Graze tall fescue and legume. Get egg count on fresh manure for deworming. Remove bulls from cows. Watch for grass tetany. Fertilize cool-season grasses and clover. Spray for buttercup and other winter weeds. Graze cool-season annual grasses.	Cow calving season continues. Heifers breeding season begins. Get egg count on fresh manure for deworming. Graze tall fescue and legume. Permanently identify calves at birth. Record birth dates. Castrate at birth. Fertility test bulls. Implant steer calves. Watch for grass tetany. Fertilize cool-season grasses and clover. Spray for buttercup and other winter weeds. Graze cool-season annual grasses.
April	Graze tall fescue and legume. Deworm cows if egg check indicates. Vaccinate heifers for Brucellosis. Pregnancy test heifers. Vaccinate calves prior to weaning. Watch for grass tetany. Spray for summer annual broadleaf weeds. Begin grazing warm-season grasses. Hay cool-season perennial grasses.	Graze tall fescue and legume. Cow breeding season. Heifer breeding season. Watch for grass tetany. Spray for summer annual broadleaf weeds. Begin grazing warm-season grasses. Hay cool-season perennial grasses.
May	Vaccinate heifers for Brucellosis. Evaluate heifer target weights. Precondition and wean calves. Fly control. Re-implant calves if needed. Treat for external parasites if present. Fertilize bermudagrass and other warm-season grasses. Spray for summer annual broadleaf weeds. Apply brush control herbicides. Spray for summer perennial broadleaf weeds. Hay season. Plant bermudagrass.	Cow breeding season. Heifer breeding season comes to an end. Fly control . Fertilize bermudagrass and other warm-season grasses. Spray for summer annual broadleaf weeds. Apply brush control herbicides. Spray for summer perennial broadleaf weeds. Hay season. Plant bermudagrass.
June *(continued)*	Vaccinate heifers for Brucellosis. Weigh and evaluate calves. Pregnancy test all cows. Sell open cows. Treat for external parasites. Fertilize bermudagrass and other warm-season grasses.	Vaccinate calves for Blackleg 7-way and IBR-BVD-PI_3. Treat for external parasites. Remove bulls from cows. Fertilize bermudagrass and other warm-season grasses. Spray for summer annual broadleaf weeds. Apply brush control herbicides.

Month	Fall Calves	Spring Calves
June *(cont.)*	Spray for summer annual broadleaf weeds. Apply brush control herbicides. Spray for summer perennial broadleaf weeds. Hay season.	Spray for summer perennial broadleaf weeds. Hay season.
July	Graze bermuda and legume. Treat for external parasites. Fertilize bermudagrass and other warm-season grasses. Apply brush control herbicides. Spray for summer perennial broadleaf weeds. Hay season.	Monitor body condition. Treat for external parasites. Fertilize bermudagrass and other warm-season grasses. Apply brush control herbicides. Spray for summer perennial broadleaf weeds. Hay season.
August	Evaluate heifers for target weights. Graze bermudagrass and legume. Treat for external parasites. Fertilize for stockpiled bermudagrass for fall grazing. Apply brush control herbicides. Spray for summer perennial broadleaf weeds. Hay season.	Pregnancy test heifers. Vaccinate heifers for Brucellosis. Vaccinate calves prior to weaning. Graze bermudagrass and legume. Treat for external parasites. Fertilize for stockpiled bermudagrass for fall grazing. Apply brush control herbicides. Spray for summer perennial broadleaf weeds. Hay season.
September	Heifer calving season. Sire selection and management. Forage test. Pour-on for grubs and lice. Treat for external parasites. Check manure for egg count and deworm cows if egg check indicates. Fertilize to stockpile fescue for winter pasture. Apply brush control herbicides. Spray for summer perennial broadleaf weeds. Finish haying season. Plant small grains and ryegrass.	Pregnancy test cows. Evaluate heifer target weights. Vaccinate heifers for Brucellosis. Wean calves. Graze bermudagrass and legume. Weigh and evaluate calves. Pregnancy check all cows. Sell open cows. Pour-on for grubs and lice. Treat for external parasites. Deworm cows if egg check indicates. Fertilize to stockpile fescue for winter pasture. Apply brush control herbicides. Spray for summer perennial broadleaf weeds. Finish haying season. Plant small grains and ryegrass.
October	Graze tall fescue and legume. Cow calving starts. Permanently identify calves at birth. Record birth dates. Castrate at birth. Implant steer calves. Heifers continue calving. Prepare sires for breeding season (BSE). Begin grazing stockpiled bermudagrass. Sod-seed winter annuals and legume in bermudagrass.	Graze bermuda and legume and move to fescue and legume. Market cull cows. Vaccinate heifers for Brucellosis. Evaluate heifer target weights. Wean calves. Begin grazing stockpiled bermudagrass. Sod-seed winter annuals and legume in bermuda.
November	Finish cow calving season. Heifer breeding season begins. Care of newborn calves. Apply herbicides for winter annual weeds in dormant bermudagrass. Spray for buttercup and other winter annual weeds. Graze tall fescue and legume. Fertility test bulls. Graze stockpiled bermudagrass pastures. Graze cool-season annuals grasses. Graze cool-season perennial grasses.	Monitor body condition. Market calves most years. Market cull cows. Graze stockpiled bermudagrass pastures. Graze tall fescue and legume. Apply herbicides for winter annual weeds in dormant bermudagrass. Spray for buttercup and other winter annual weeds. Graze cool-season annuals grasses. Graze cool-season perennial grasses.
December	Cow breeding season. Heifer breeding season comes to an end. Graze tall fescue and legume. Graze cool-season annuals grasses. Graze cool-season perennial grasses. Apply herbicides for winter annual weeds in dormant bermudagrass. Spray for buttercup and other winter annual weeds.	Heifer breeding season begins. Evaluate heifer target weights. Prepare for calving season. Deworm cows. Graze tall fescue and legume. Market calves in years that fall weather is good. Market cull cows. Treat for internal parasites if needed. Begin grazing stockpiled fescue pastures. Graze cool-season annuals grasses. Graze cool-season perennial grasses. Apply herbicides for winter annual weeds in dormant bermudagrass. Spray for buttercup and other winter annual weeds.

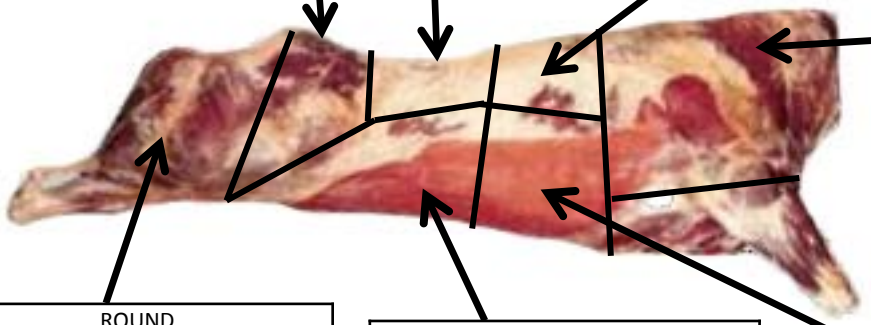
Carcass Breakdown of a Feedlot Steer

DROP CREDIT	
By-product	Weight, lbs
Hide	65.0
Edible tallow	16.5
Bleachable tallow	64.8
Tongue	3.3
Cheek meat	4.4
Head meat	1.79
Oxtail	3.3
Heart	5.2
Lips	1.8
Liver	13.2
Scalded tripe	8.9
Honeycomb tripe	2.1
Inedible lungs	6.5
Spleen	1.9
Meat & bone meal	50.8
Blood meal	8.2
TOTAL:	254.7

SIRLOIN	
Primal/subprimal cut	Weight, lbs.
Top sirloin butt	26.8
Bottom sirloin flap	7.4
Bottom sirloin tri-tip	6.6
Bottom sirloin ball-tip	5.0
TOTAL:	45.8

LOIN	
Primal/subprimal cut	Weight, lbs.
Boneless strip loin	25.1
Tenderloin	12.6
TOTAL:	37.7

RIB	
Primal/subprimal cut	Weight, lbs.
Ribeye roll	30.6
Blade meat	7.1
Back ribs	8.8
TOTAL:	46.5



CHUCK	
Primal/subprimal cut	Weight, lbs.
Chuck roll	48.6
Chuck tender	7.3
Flat iron steak	4.0
Shoulder clod	39.4
Petite tender	1.7
Pectoral meat	5.2
Bnls chuck short ribs	3.8
TOTAL:	109.9

ROUND	
Primal/subprimal cut	Weight, lbs.
Inside round	48.2
Outside round	31.3
Eye of round	11.7
Peeled knuckle	22.3
TOTAL:	113.5

FLANK	
Primal/subprimal cut	Weight, lbs.
Flank steak	4.3
Inside skirt	4.1
Outside skirt	3.3
TOTAL:	11.7

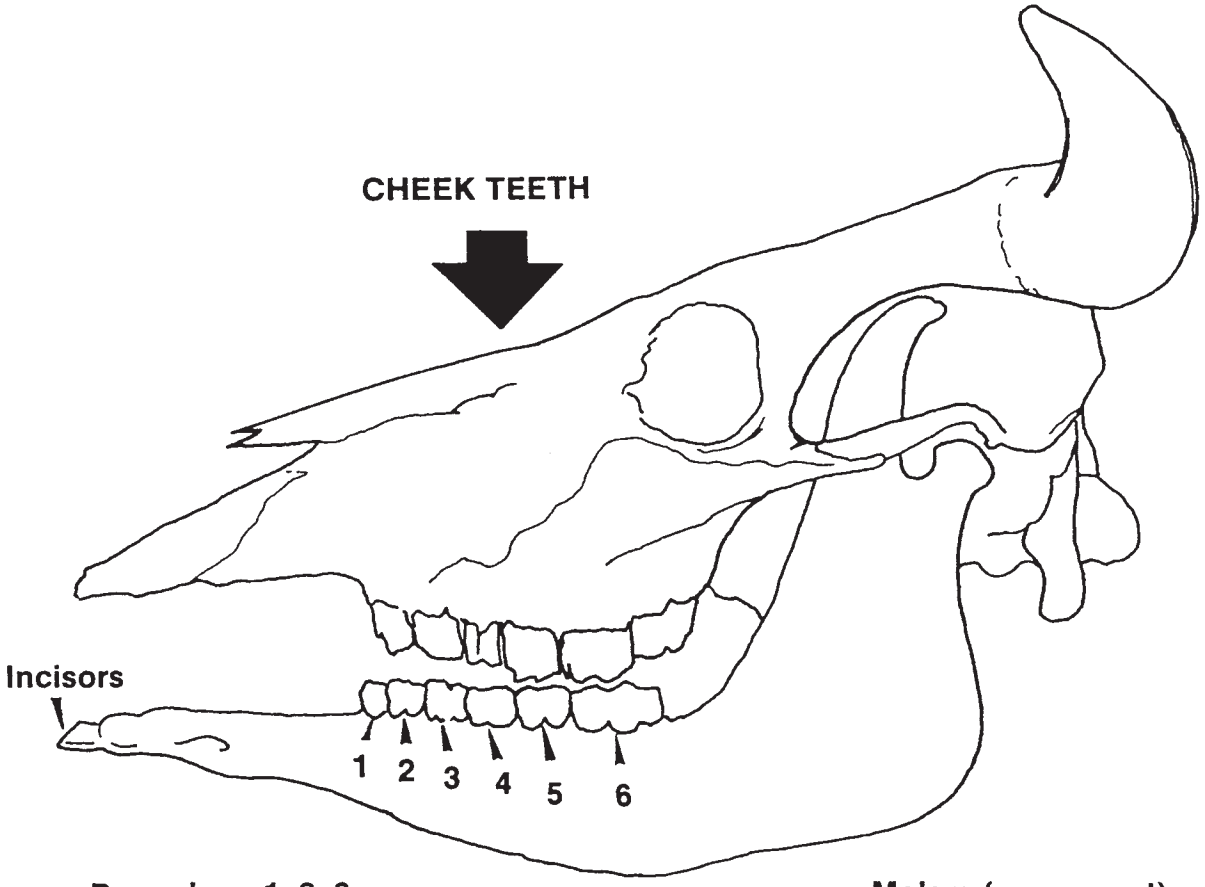
PLATE	
Primal/subprimal cut	Weight, lbs.
Short plate	29.5
Short ribs	11.4
TOTAL:	40.9

SUMMARY (1,350-lb Choice, YG 3 steer that dresses 64%)	
	Weight, lbs.
Saleable by-product	254.7
Harvest loss	231.3
Saleable product	787.1
Cutting losses	76.9
TOTAL:	1,350.0

MISCELLANEOUS	
Primal/subprimal cut	Weight, lbs.
Boneless brisket	24.7
80:20 coarse ground	71.9
Fat	134.8
Bone	149.6
TOTAL:	381.0

Compiled by Dr. Jason Apple, University of Arkansas, Department of Animal Science

Estimating the Age of Cattle Using Teeth



Premolars: 1, 2, 3

Temporary: birth- 1 month

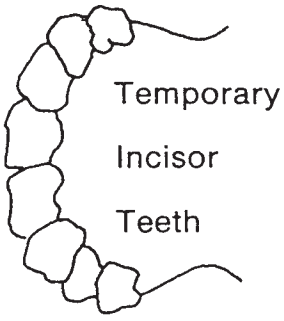
Permanent: 2-3½ years

Molars (permanent)

4 *5-6 months*

5 *1-1½ years*

6 *2-2½ years*



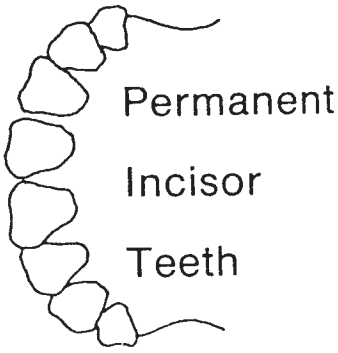
Are present at birth or appear at 2-4 weeks.

Corners, 3½-4 years

Laterals, 36 months

Medials, 24-30 mos.

Centrals, 18-24 mos.



Handy Guide to Determining the Age of Adult Cattle by the Teeth[1]

Drawing of Teeth	Age of Animal	Description of Teeth
	at birth to 1 month	Two or more of the temporary incisor teeth present. Within first month, entire eight temporary incisors appear.
	2 years	As a long-yearling, the central pair of temporary incisor teeth or pinchers is replaced by the permanent pinchers. At 2 years, the central permanent incisors attain full development.
	2 1/2 years	Permanent first intermediates, one on each side of the pinchers, are cut. Usually these are fully developed at 3 years.
	3 1/2 years	The second intermediate or laterals are cut. They are on a level with the first intermediates and begin to wear at 4 years.
	4 1/2 years	The corner teeth are replaced. At 5 years the animal usually has the full complement of incisors with the corners fully developed.
	5 to 6 years	The permanent pinchers are leveled, both pairs of intermediates are partially leveled, and the corner incisors show wear.
	7 to 10 years	At 7 or 8 years the pinchers show noticeable wear; at 8 or 9 years the middle pairs show noticeable wear; and at 10 years the corner teeth show noticeable wear.
	12 years	After the animal passes the 6th year, the arch gradually loses its rounded contour and becomes nearly straight by the 12th year. In the meantime, the teeth gradually become triangular in shape, distinctly separated, and show progressive wearing to stubs. These conditions become more marked with increasing age.

[1]The illustrations for this table were prepared by R. F. Johnson.

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