

Guidelines For Developing And Testing Beef Bulls On-Farm

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Proper bull selection is the most rapid way to genetically change a herd of cattle. Selection of bulls based on expected progeny differences (EPDS) can double genetic progress compared to selection of bulls based on within-herd ratios or individual performance. However, to select young bulls based on EPDS, individual measurements must be taken and recorded with the appropriate beef breed association. Also, proper nutrition and herd health management during development can help bulls reach their genetic potentials and ensure long and productive lives.

Many producers have used central bull tests to develop herd sire prospects. Most central test stations have limited each producer to testing one bull per year because of space limitations and to allow as many producers to participate as possible. However, testing only one bull per producer per year eliminates estimation of yearling weight EPDS, including individual performance for bulls in central tests, because bulls are in a contemporary group size of one. Thus, to produce bulls with yearling weight EPDs including individual performance, producers should develop and test bulls on-farm.

With each live calf produced on-farm, the value of that calf as a parent comes into question. If the calf is superior to its parents, the calf becomes a candidate as a replacement animal. Not all bull calves should be considered herd sire prospects. At weaning, bull calves should be evaluated for soundness, adequate muscling and growth, and testicular development. Any bulls with unsoundness, especially feet and legs, should be removed as herd sire prospects. Bull calves with inadequate muscling and growth should also be eliminated. Bulls with testicular abnormalities, such as having only one testicle, testicles not descended into the scrotum, or abnormally small testicles, should also be eliminated as herd sire prospects. Inferior soundness, muscling, growth, or testicular development will decrease the productive life of a bull in a herd. These traits can also be passed on to offspring.

Nutritional Management For Bull Development

A good feeding program is essential for growth and development of future herd sires. Failure to supply proper nutrition during the growth and development stage of a bull can result in permanent damage to the bull's digestive tract. This may render the bull useless as a herd sire or shorten his productive life from many years down to several months. A sound feeding program in developing bulls will aid a producer in establishing and maintaining a reputation as a reliable breeder.

Providing Properly Formulated Rations

There are numerous feedstuffs suitable for ration formulation in Alabama. Producers should feed rations that provide nutrients in ample quantities for the bull's stage of development. Nutrients consist of protein, energy, minerals, vitamins, and water. Nutrient requirements for bulls are listed in Table 1 and Table 2. Contact your county Extension agent for help in formulating diets with feed ingredients available in your area.

Protein. Natural protein should be provided for developing bulls. Natural protein is protein found in feedstuffs such as hay, corn, and oilseed meals. Nonprotein nitrogen sources, such as urea, are not natural proteins and are of questionable value for developing animals. Non-protein nitrogen is best utilized in finishing cattle rations. Developing bulls should be maintained on a 12 percent protein diet.

Energy. Energy is measured as total digestible nutrients (TDN) or net energy for maintenance or gain (NE-M or NE-G). Energy is important for growth, maintenance, and reproduction. Energy is supplied by forages, hay, grain, feed by-products, and oilseeds but will vary depending upon the stage of maturity and type of feed. Table 3 ranks feedstuffs in descending order, according to the amount of energy they contain. The values listed are average energy values. Energy levels in feedstuffs will vary with individual samples. Developing bulls should be fed diets which contain between 62 and 69 percent TDN.

Table 3. Energy Contained In Feedstuffs

Feedstuff	Energy (% TDN ^(a))
Corn	90
Grain sorghum	85
Oats	78
Silage	65
Hay	50
Peanut hulls	23

(a)TDN = Total Digestible Nutrients

Minerals. Major or macrominerals are minerals needed in relatively large amounts in the diet. Trace or microminerals are minerals needed in relatively small amounts. Macro or micro do not denote importance but rather the amounts of a mineral required by livestock. Table 4 lists the minimum mineral requirements for growing beef cattle.

Minerals can be supplied in the diet or provided free choice in a mineral feeder. If calcium and phosphorus are included in the diet, calcium should be about 0.45 percent of the diet, and phosphorus should be about 0.35 percent of the diet. These levels of calcium and phosphorus will provide adequate levels of both minerals at the correct ratio (1.3 to 1.5:1). Calcium-phosphorus ratios may be as high as 2 to 1 in diets with some forages. This is acceptable, and no additional phosphorus needs to be added to the ration. Phosphorus is the most expensive mineral fed to cattle because of cost and amount fed.

In a complete feed, calcium, phosphorus, and magnesium should be added based on the amount in the feed ingredients. A good source of calcium is steamed bone meal or feed grade limestone (calcium carbonate). A good source of phosphorus is Dynophos (dicalcium phosphate).

A good free-choice mineral mix for cattle is 50 pounds of dicalcium phosphate thoroughly blended with 50 pounds of trace mineral salt. This mixture contains about 40 percent salt and 9 percent phosphorus. Cattle will consume about 2 ounces of this mixture per day. Commercial mixtures contain about 20

percent salt and 4 to 6 percent phosphorus. Cattle will consume about 4 ounces per day of this mixture. Cattle consume about the same amount of phosphorus per day in both mixtures. The amount of minerals consumed is determined by the salt level in the mineral mix.

Ten pounds of trace mineral salt per ton of mixed feed will provide an adequate amount of trace minerals.

Vitamins. Developing cattle need vitamins. Beef cattle are not normally supplemented with B vitamins since they are synthesized in the digestive tract. The fat-soluble vitamins (A, D, E, and K) are usually adequate in all green forages. The only vitamin which may be limited in dry forages is vitamin A. Dry forages and feeds which include brofler litter are low in vitamin A. Even though vitamin A is stored in the liver for long periods of time, liver stores should not be relied upon for vitamin A supplementation during periods when cattle are on dry forages. The vitamin A requirement for growing and breeding bulls is 2000 IUs per pound of feed. Since vitamin A is relatively inexpensive, cattle on dry forages can be supplemented with 2000 IUs of vitamin A per pound of diet or 4 million IUs per ton of feed.

Water. Water should never be a limiting nutrient for bulls. Clean, fresh water should be provided at all times.

Starting Calves on Mixed Feeds

The most stressful time in a bull's life is at weaning and during the following 3 to 4 weeks. Weaning stress can aggravate existing nutritional deficiencies. Many weaned calves do not know how to eat mixed feeds and must be taught to eat a mixed ration gradually. Starting calves gradually on mixed feeds will help them maintain weight at weaning and diminish the likelihood of their getting sick.

Hay is the first feed of choice when calves are weaned. High quality legume or grass hay should be fed to the calves. Good hay should be about 9 percent protein, 50 percent TDN, relatively low in acid detergent fiber, and mold free. Hay alone does not provide the energy and protein necessary to maintain adequate growth in bulls. Bulls must be supplemented with grain (energy) and a natural protein source such as cottonseed, cottonseed meal, or soybean meal.

Because weaned cattle eat sporadically, bloat, acidosis, and sudden death can occur when cattle are fed a mixed ration if proper precautions are not taken. Never provide weaned cattle a high energy mixed feed free choice. Start with a small amount of feed and gradually increase the amount fed.

The following are steps for getting bulls on feed:

- Creep feed calves the last 2 months prior to weaning. Calves which have been creep fed are easier to get on feed after weaning because they already know how to eat from a feed bunk.
- Get bulls on limited feed as quickly and safely as possible. Wean calves into an area where they can be observed closely for at least 4 weeks. Check at least twice a day to see if they are consuming their feed. Failure to come up for feed is often an early sign of sickness.
- Have circular weaning pens if possible. After weaning, calves will walk the fence. Place feed bunks and water troughs perpendicular to the fence to entice cattle to eat because they are forced to walk around the water troughs and feed bunks.
- Place hay in the feed bunks rather than free choice in hay rings. This will encourage calves to eat out of feed bunks. Do not place round bales of hay in the center of the weaning pen.
- Provide Bovatec or Rumensin in the feed following manufacturer's recommended amount per

head per day. Bovatec or Rumensin will help to control feedlot bloat.

- Vitamins are inexpensive. Formulate mixed feed to supply vitamin A (at 2000 IUs), D (at 125 milligrams), and E (at 20 milligrams) per pound of feed.
 - Formulate feed to contain at least 20 percent fiber, 12 percent protein, and 62 to 69 percent TDN. Fiber can be provided by hay or cottonseed hulls. Peanut hull pellets are not a good source of fiber for young cattle. The protein source should be all natural protein such as cottonseed meal or soybean meal and should contain no non-protein nitrogen, such as urea.
 - Calcium, phosphorus, salt, and trace minerals can be provided free choice or mixed into the ration. If minerals are to be fed in the mixed ration, the ration should contain a minimum of 0.45 percent calcium, 0.35 percent phosphorus, 0.35 percent trace mineral salt, and 1.0 percent potassium.
 - To start calves eating feed, sprinkle a mixed feed over hay in feed bunks. This will entice calves to consume some grain to get hay. Start feeding a mixed feed 2 to 3 days after weaning at the rate of 2 pounds per animal.
 - Increase mixed feed 0.75 pound per day. Calves should consume about 1.5 pounds of feed per 100 pounds of body weight in 10 to 12 days.
 - Keep only fresh feed available. Do not feed more than calves will clean up. Reduce the amount of hay as the mixed feed is increased.
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Pre-Weaning Health Program for Bull Development

Bulls which are to remain on the farm for a postweaning performance test should undergo a pre-weaning health program (See Table 5). Weaned calves remaining on-farm are at risk for several types of disease, the most common being respiratory disease, or "shipping fever pneumonia." A pre-weaning health program will insure that these potentially valuable animals are prepared for the stress of weaning and that their subsequent performance during the test is not affected by health problems.

The health program for a bull calf includes vaccinations and dewormings. Never implant a bull calf to be used for breeding. Implants can cause serious infertility problems and will not significantly increase the bull calf's gain performance while on test.

In all cases, consult with your herd veterinarian to construct a program which best fits your herd. Everyherd is different. Some herds and some locations may require additional health management procedures. Your veterinarian can also recommend particular products to use.

Performance Guidelines

All performance recommendations found within this section are based on Beef Improvement Federation (BIF) guidelines.

Contemporary Groups

Performance measurements and procedures are dependent upon the correct formation of contemporary groups. A contemporary group is defined as a group of animals that is from the same herd, sex, and birth season and that is similarly managed. Contemporary groups account for management and environmental

differences among groups of animals. This allows for determination of genetic differences among individuals once contemporary groups are properly formed. The producer is the only one who knows the proper designation of contemporary groups.

Contemporary groups are largest at birth and generally become smaller at weaning and yearling ages due to death loss and sale of cattle. Most beef breed associations use 3-month intervals to define initial birth contemporary groups within herds and sexes. These are December to February, March to May, June to August, and September to November. These definitions encourage distinct calving seasons.

For cattle to remain in one contemporary group at weaning, cattle must be 160 to 250 days of age and must be measured on the same day. Similarly at yearling, cattle must be 330 to 430 days of age and must be measured on the same day so that contemporary groups will not be split. No other cattle can be added to weaning or yearling contemporary groups because prior management and environmental differences cannot be properly accounted for and, thus, genetic differences will be incorrectly estimated. However, initial birth contemporary groups can be split at weaning and/or yearling when inferior bull calves are removed from the herd or are castrated. Steer calves are not considered to be the same sex as bull calves.

Weaning Measurements

Two primary measurements that should be taken at weaning are weaning weight and height. An additional measurement of scrotal circumference can also be beneficial. Cattle need to be measured between 160 and 250 days of age to adjust measurements to 205 days.

Weaning Weight. Once weaning weight measurements are submitted to the appropriate beef breed association, adjusted weaning weights can be calculated. Weaning weight records are adjusted for age of calf and age of dam. The adjusted weaning weight formula most breed associations use is:

$$\text{Adjusted Weaning Weight} = \frac{\text{WW} - \text{BW}}{\text{Age of Calf}} \times 205 + \text{BW} + \text{Age of dam adjustment}$$

where WW is weaning weight and BW is birth weight. Age of dam adjustment factors are breed dependent. However, magnitude of age of dam adjustment factors are dependent on cow age, sex of calf, and whether the calf received creep feed.

Weaning Height. Figure 1 depicts the correct measurement of hip height, which can be converted into a frame score. Hip height or frame score can be used as an indication of mature size. Measurement needs to be at a point directly over the hooks. To adjust weaning heights for age and sex of calf and age of dam, follow these steps:

1. Determine the number of days above or below 205 the bull is in age.
2. Multiply the answer in step 1 by 0.033 inches (which is the height growth an average bull will undergo each day).
3. Find adjusted 205-day hip height by taking the actual hip height and adding or subtracting the adjustment found in step 2.
4. Adjust the answer in step 3 for age of dam using the adjustment factors found in Table 6. Multiply the answer in step 3 by the adjustment factor in the table.

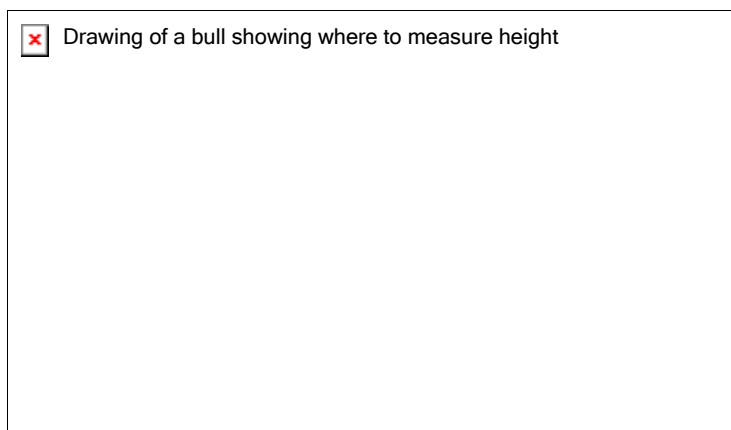


Figure 1. Height measurement

Example:

Bull calf born January 1, 1994. Weaned July 31, 1994.

Dam is 4 years old. Height is 45 inches.

1. 205 days - 211 days = -6 days
2. -6 days x 0.033 inches = -0.198 inches
3. 45 inches + (-0.198 inches) = 44.802 inches
4. Adjusted weaning hip height = 44.802 inches X 1.01 = 45.25002 inches

To convert the adjusted weaning hip height into a frame score, use Table 7. Find the age in months in the first column and follow the row across until you find the approximate height. The number above that column is the frame score.

To find an exact frame score, use the following formula:

$$\text{Frame Score} = -11.548 + (0.4878 \times \text{height}) - (0.0289 \times \text{days of age}) + (0.00001947 \times \text{days of age squared}) + (0.0000334 \times \text{height} \times \text{days of age})$$

This formula can be used only for cattle less than 742 days of age (approximately 24 months). Frame scores will be incorrect after 742 days of age. Using figures from the above example, the exact frame score would be 5.49.

Scrotal Circumference. Scrotal circumference measurements are taken with a scrotal circumference tape at the widest point of the scrotum with both testicles descended. Pull testicles firmly into the lower portion of the scrotum by encircling the top of the scrotum with thumb and fingers and pulling down on the testicles. Put the scrotal tape around the widest portion of the testicles. Make sure fingers are on the side of the scrotum, rather than between testicles. The tape must be adjusted so it fits snugly when taking the measurement. Measurements are taken in centimeters (cm). Bulls with abnormally small scrotal circumferences at weaning (less than 20 cm), should be eliminated as herd bull prospects. Bulls with testicular abnormalities, such as having only one testicle, testicles not descended into the scrotum, or abnormally small testicles, should also be eliminated as herd sire prospects. Bulls with small scrotal circumferences will reach sexual maturity at a later age and pass this trait on to both male and female progeny.

Post-Weaning Test Procedures

In the Southeast, two types of post-weaning tests are used to develop bulls: full feed tests and forage tests. However, the best program for bull development usually combines the two. By combining full feed tests and forage tests, producers can take advantage of forages when available and supplemental feed when forages are in short supply or are of low quality. Usually, bulls which are sold as yearlings need to be grain fed from weaning to sale, and bulls which are sold as 18-month bulls or older can be developed using a combination feeding program of complete feed and forages. All bulls should be fed to gain at least 2.25 pounds per day.

No matter which format is chosen to test bulls on farm, the following procedures should be strictly adhered to:

- All bulls should be 180 to 270 days of age when the test is begun.
- Bulls on test should not exceed a 90-day spread in age.
- Initial and final test weights can either be full or shrunk weights. If full weights are taken, weights should be taken on 2 consecutive days and averaged. If shrunk weights are taken, food and water should be removed 12 hours prior to weighing.
- Nutritional programs need to provide adequate protein and energy requirements to express genetic differences among bulls.
- All bulls sold should be structurally sound and pass a complete Breed Soundness Exam (BSE). The BSE should be performed by a qualified veterinarian or reproductive physiologist.

Full Feed Tests. Full feed tests allow bulls to eat ad libitum amounts of feed that are 62 to 69 percent of TDN for a minimum of 112 days. These types of tests allow for maximum gains. Table 8 is an example of the ration fed at the Auburn University Bull Test facility.

In addition to the above recommendations, the following guidelines should be followed during the full feed test:

- Bulls should have a 21-day warm-up period prior to beginning the test. This will allow bulls to become accustomed to feed and water and to eliminate compensatory gain. Compensatory gain occurs in animals whose nutritional level is not adequate prior to test. These animals are able to gain at a more rapid rate compared to bulls that received a normal or high level of nutrition prior to test.
- Never let bulls run out of feed since this can cause severe digestive problems.
- Monitor bull feed intake closely and increase the amount of mixed feed fed when needed.
- Do not put more feed than the bulls will consume in 1 day into open feed bunks. This wastes feed and will lead to feed spoilage.
- Maintain the maximum recommended level of energy of 69 percent TDN for growing bulls. This level of energy is adequate for evaluating genetic differences among bulls. Greater levels of gain bring higher risk levels of acidosis founder and bloat.
- Supply hay in limited quantities to bulls. Approximately 2 pounds per head per day is adequate. Hay is needed to keep the rumen properly functioning. However, limit hay intake during the 112-day test period to make sure bulls are eating as much mixed feed as possible and maximizing gains.
- At the end of the test period, decrease the amount of grain in the feed over a 3- to 4-week period until the ration contains about 60 percent TDN. As the amount of grain is decreased, increase the amount of forage or hay supplied to the bulls.
- After completion of the 112-day test period, bulls should undergo a 4- to 6-week period of reduced concentrate intake and increased exercise prior to herd exposure. This will increase

reproductive and performance efficiency in the field.

- Bulls should have yearling measurements (weight, height, and scrotal circumference) taken when bulls are between 330 and 430 days of age.

Forage Tests. Forage tests allow bulls to be developed at a moderate rate with a moderate level of nutrition. These tests do not put nutritional stresses on the bull as full feed tests do. The length of a forage test is at least 168 days to compensate for the moderate level of nutrition and to ensure that genetic differences between bulls are expressed. However, forage tests can be shortened in years when weather conditions are extreme or when both forage and supplemental feed are unavailable or are cost prohibitive.

Success of developing bulls on a forage test takes careful planning and good management throughout the period bulls are on test. The same rules for getting bulls on feed apply to bulls going on a forage test. In addition to general guidelines, these guidelines should be followed during a forage test:

- The warm-up period is optional.
- Forage test feasibility is dependent on year-round high quality forage availability.
- The season when bulls are born will affect farm forage testing programs. In Alabama, a good forage program will use winter annuals such as oats, rye, ryegrass, and wheat with clover mixes to extend grazing late into spring. Summer forages should consist of permanent pastures and millet. No high quality forages are available for fall grazing; thus, fall testing should be avoided unless supplemented with a high quality mixed feed.
- Supplemental mixed feed and hay should also be available for periods of forage shortages as well as extended periods of cold weather or drought. Periods of forage shortages should be anticipated so producers can incorporate feed at 1 percent of the calf's body weight prior to the shortage period. Feed can be increased by about 0.5 pound per day until bulls are on full feed. Feed should contain about the same levels of protein and energy as the forage.
- Sudden or rapid changes in the bulls' diet will decrease performance and could upset their digestive tracts.
- Bulls should have yearling measurements (weight, height, and scrotal circumference) taken between 330 and 430 days of age.

Test Measurements. Average daily gain (ADG) and ADG ratios can be calculated for either full feed or forage tests. ADG should be calculated at the end of the test period. Intermediate ADG measurements can be calculated at regular intervals throughout either the full feed or forage test. To find ADG:

$$\text{ADG} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Length of test period}}$$

To calculate an ADG ratio within a contemporary group:

$$\text{ADG Ratio} = \frac{\text{Bull's ADG}}{\text{Average ADG for contemporary group}} \times 100$$

The average ratio within a contemporary group for ADG is always 100. A ratio of 100 indicates the bull was average for that contemporary group. A ratio above 100 indicates performance above average in the contemporary group. A ratio below 100 indicates below average performance. Thus, an ADG ratio of

112 indicates that the bull was 12 percent above average for ADG, compared to other bulls in his contemporary group. Ratios are only valid within a contemporary group and cannot be compared across groups.

Yearling Measurements

Like weaning measurements, yearling measurements include weight, height, and scrotal circumference. Cattle must be 330 to 430 days of age and must be measured on the same day so that contemporary groups will not be split.

After yearling measurements are taken, they should be submitted to the appropriate beef breed association before the announced cutoff date for submission of data to be included in the next analysis. EPDs which incorporate the individual's own record can then be estimated for yearling traits.

Yearling Weight. Yearling measurements for weight should also be adjusted for age of calf and age of dam. Age of dam is still included in these measurements because yearling weight is a function of weaning weight. Adjusted yearling weight is calculated as:

$$\text{Adjusted Yearling Weight} = \frac{\text{YW} - \text{Adjusted WW}}{\text{Age of bull at yearling}} \times 160 + \text{Adjusted WW}$$

where YW is yearling weight and WW is weaning weight.

Yearling Height. Adjusted yearling hip height is calculated similarly to adjusted weaning hip heights. No age of dam adjustments are made to this measurement. Maternal influences are negligible at this point for hip height. To calculate adjusted yearling hip height:

1. Determine the number of days above or below 365 the bull is in age.
2. Multiply the answer in step 1 by 0.033 inches.
3. Adjust the actual hip height by the answer found in step 2.

The adjusted yearling hip height can be converted to a frame score using Table 7. To calculate an exact frame score, use the frame score formula discussed previously in the section on weaning height.

Scrotal Circumference. The suggested minimum scrotal circumference at yearling is 32 cm. If scrotal circumference is below 32 cm at yearling, the bull should not be retained as a herd bull prospect. Bulls with a 32 cm or larger scrotal circumference are sexually mature. Research has shown that yearling bulls with larger scrotal circumferences sire progeny reaching puberty at earlier ages. Early puberty can have many benefits in the cowherd.

Summary

There are many advantages to growing and developing herd bull prospects on-farm rather than consigning them to a central test station. However, proper nutrition and health programs are essential to successfully raising bulls on-farm. Testing and developing bulls puts tremendous stress on their

digestive tracts. Improper nutrition or health practices can reduce a bull's productive and reproductive life significantly.

To accurately detect genetic differences between yearling bulls, contemporary groups need to be tested and developed together. Information should be submitted to the appropriate beef breed association for yearling weight EPD estimates to include individual performance. Selecting young bulls on EPDs is a much better indicator of what the animal will do as a sire than any other available information, such as weights or ratios.

For more information, contact your county Extension office. Look in your telephone directory under your county's name to find the number.

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