

Beef Bull Development

Developing beef bulls can be both challenging and rewarding. Sale of breeding-age bulls is often a significant source of revenue for seedstock producers. A comprehensive bull development program addresses selection and breeding strategies to produce bulls that fit production and marketing conditions. Nutrition, health, and management strategies are key to bull development programs. Design bull development programs to keep costs at acceptable levels but meet production goals. A successful development program produces bulls that are healthy, well grown, and ready to serve as active and effective herd sires.

Bull Development Goals

An effective bull development program starts with planning. Evaluate resources to develop a reasonable plan for developing young bulls. Consider factors such as time, capital, land, labor, facilities, forages, and others. A proper bull development program includes cost management, a sufficient nutritional program, and a well-designed herd health program. Goals for a bull development program may include the following:

- Design breeding programs to produce high-quality bulls.
- Develop selection criteria for placing weaned bulls in a development program.
- Keep costs at reasonable levels.
- Develop forage and feed programs that meet nutritional needs for target weight gains.
- Plan for bulls to be well-grown without excess condition as yearlings.
- Plan for bulls to continue developing properly until mature.
- Have bulls physically fit so they will be active breeders.

- Design a herd health program with a veterinarian to minimize health problems.

Goals for a bull development program may differ among operations, depending on production and marketing conditions and personal preferences. In addition, goals may change over time. Regularly evaluate the program to identify goals or management practices that need to be modified or improved.

Selecting Bulls for Development

Selection of bulls for a development program begins before calves are born with careful selection of sires that complement the cow herd and are expected to produce a desired type of bull calf. Not all bulls are suitable herd sires. Likewise, not all young bulls are worth developing into breeding bulls. Bulls in a development program should be physically sound, free from genetic defects, display acceptable temperament, and have suitable reproductive and genetic potential. The genetic potential of a bull will impact his value as a herd sire and the price he can command.

Observe nursing bull calves for problems that necessitate culling. Culling bulls early allows producers to perform cost-effective management practices, such as early castration and implantation with growth promoters, that would not otherwise be done with bulls developed for breeding purposes. These practices can help add value to animals not selected for bull development.

Weaning is a good time to cull low-performing, unthrifty, structurally unsound, or genetically inferior bull calves and select those bull calves that will continue into a postweaning development



program. Use performance data and expected progeny differences (EPD's) in bull selection decisions. Detailed information on these selection tools is available in Mississippi State University Extension Service Publication 2491, "Expected Progeny Differences and Selection Indices for Beef Cattle Selection."

Bull Nutritional Requirements

To be effective herd sires, beef bulls must develop properly after weaning. Nutrient intakes below requirements reduce growth weights and delays puberty in bulls. Severe malnutrition can permanently impair sperm production.

Many seedstock producers market bulls as yearlings instead of incurring the costs of holding them to 2 years of age. Using bulls first as yearlings rather than as older sires also reduces the general interval, which speeds the progress of genetic improvements. Because of the additional costs associated with holding younger bulls until 2 years of age, yearling bulls with desirable genetics may be less expensive to purchase than more mature bulls with similar genetics. However, young, developing bulls require different nutritional management than do mature bulls.

As bulls mature, their nutritional requirements change (Table 1). For example, daily nutrient requirements for a 700-pound bull gaining 2 pounds per day are approximately 16 pounds of dry matter intake

with 11.4 percent crude protein and 65 percent total digestible nutrients (TDN) on a dry matter basis. A 1,500-pound bull gaining at the same rate needs approximately 34.5 pounds of daily dry matter intake with 6.1 percent crude protein and 63 percent TDN on a dry matter basis.

Mature bulls use nutrients primarily to support body maintenance, whereas younger bulls need nutrients to support growth also. Younger bulls require less quantity but higher quality diets. Daily dry matter intake generally increases with increasing body weight, but crude protein requirement as a percentage of dry matter intake decreases. Younger bulls require higher protein percentages for the rapid lean muscle growth that occurs during early development.

Achieving yearling weight goals are often important for bull marketability. The Mississippi Beef Cattle Improvement Association bull sale program and many bull test sales have minimum requirements for bull weaning and yearling weights. Acceptable bull growth must also continue postyearling. Generally, bulls should reach 75 percent of their expected mature weights at 2 years of age. For instance, if a bull's expected mature weight is 2,200 pounds, then he should weigh approximately 1,650 pounds ($2,200 \times .75 = 1,650$) at 2 years of age. For bulls marketed prior to maturity, bull buyers must continue proper bull development.

Table 1. Nutrient requirements of bulls with expected mature weights of 2,000 pounds

Body weight, pounds	Average daily gain, pounds	Daily dry matter intake, pounds	Total digestible nutrients, % dry matter	Crude protein, % dry matter
300	1.0	8.3	58	11.4
	2.0	8.6	65	16.3
	3.0	8.6	72	21.3
500	1.0	12.2	58	9.8
	2.0	12.6	65	12.9
	3.0	12.6	72	16.3
700	1.0	15.6	58	9.1
	2.0	16.3	65	11.4
	3.0	16.3	72	13.9
900	1.0	18.9	58	8.3
	2.0	19.6	65	9.9
	3.0	19.6	72	11.9
1500	2.0	34.5	63	6.1
2000	0.0	37.2	46	5.6

Bull Management Groups

Just as bull nutritional requirements vary by animal age, so do appropriate management strategies. Separate bulls into weanling bull calves, yearling bulls, gain-tested bulls, 2-year-old bulls, and mature bulls, and manage them accordingly. Separate younger and older bulls to reduce the risk of injuries from fighting. Dividing bulls into management groups also allows different nutritional needs of the groups to be better met. Effective use of bull management groups can help achieve optimum bull reproductive performance and longevity.

Because it can often be difficult to supplement bulls separately from the rest of the breeding herd, bulls should begin the breeding season in good body condition without being excessively fat. A body condition score of 6, where 1 is extremely thin and 9 is obese, is a good goal for bulls at the start of breeding. Obtain information from breeders about previous bull nutrition when planning for continued development of young, purchased bulls in preparation for breeding season. In addition to managing body condition and weight, make sure that bulls are classified as satisfactory potential breeders as determined in a breeding soundness examination before each breeding season.

During the breeding season, maintain acceptable bull-to-female ratios considering bull age and breeding pasture size so as not to overwork bulls and compromise reproductive performance. Observe bulls closely for changes in body condition. Adjust bull feeding programs in a timely manner.

Increased physical activity of bulls during the breeding season often results in body condition loss, regardless of bull age. Adequate body condition is important for effective breeding performance. To remain effective herd sires, bulls must regain weight lost during the breeding season, and young bulls must also continue to grow before the next breeding season. In between breeding seasons, manage bulls in small pasture traps with effective fences to keep them separated from herd females and maintain a controlled breeding season. Provide supplemental feed to thin or growing bulls to reach breeding season weight and condition targets. To prepare them to be fit and sound for upcoming breeding seasons, supply bulls with room to exercise and good footing surfaces. Keep them off of hard surfaces, such as concrete, that may promote lameness.

Bull Testing Programs

Bull tests are bull development programs where bull weights and growth rates are monitored at specific intervals during a development period. Bulls are compared for growth performance during the test period. Bull tests also often measure additional traits, such as yearling ultrasound body composition and scrotal cir-

cumference. Bull tests can be on-farm development programs or centralized tests where multiple breeders pool bulls at one development site.

Mississippi has two long-standing centralized bull test programs. The Hinds Community College Bull Test operates an annual 112-day grain-based development test in Raymond, Mississippi. The South Mississippi Gain-on-Forage Bull Test is managed as a 140-day forage-based development test utilizing annual ryegrass pastures near Tylertown, Mississippi. Both centralized Mississippi bull testing programs adhere to Beef Improvement Federation guidelines for bull testing programs and are endorsed by the Mississippi Beef Cattle Improvement Association.

Bull Development Options

There are several effective nutritional approaches for developing young bulls. Bull development programs differ based on target rates of gain, length of development, and feedstuffs (forages and grain-based feeds) used in the diets. To test genetic differences accurately, bull development diets must be capable of supporting adequate rates of weight gain, typically at least 3 pounds of gain per head per day. For all bull development programs, make sure that bulls have access to clean water and a complete mineral supplement at all times.

Developing bulls at a moderate rate of gain can be achieved with excellent quality pasture or hay and supplemental feed. Hay and average-quality pasture generally contain enough nutrients to provide only about 1.5 pounds per day gain for growing bulls. Hay and average-quality pasture are therefore not acceptable as sole feed sources for bull development.

Forage-based bull development programs can use one or more forage species in a single program. Forage availability, seasonal growth patterns, and quality must be managed properly to develop bulls successfully on pasture-based systems. Cool-season annual grass pastures such as annual ryegrass, wheat, and cereal rye can support 2 pounds or more of weight gain per day. Legumes, such as clovers and alfalfa, and cool-season perennial crops, such as novel endophyte-infected tall fescue, provide additional forage options for bull development. Warm-season perennial grass pasture, such as bermudagrass, bahiagrass, and dallisgrass, usually requires supplementation to provide acceptable rates of gain for developing bulls.

Many bull development programs use daily rations of grain-based feedstuffs. Giving developing bulls in these programs access to long-stem forages during development can benefit digestive health and animal performance by providing effective fiber. For example, place hay bales in bull feeding areas with free-choice access to the hay. Otherwise, cottonseed hulls or a similar effective fiber source needs to be

Table 2. Supplemental feeding rate calculations

	Incorrect method	Correct method
Initial bull weight	600 pounds	600 pounds
Days in each feeding period	28 days (adjusting intake each new period)	28 days (adjusting intake each new period)
Target rate of gain	3.5 pounds/day	3.5 pounds/day
Bull weight used to calculate feeding rate	600 pounds (initial weight at start of feeding period)	28 days ÷ 2 = 14 days (halfway point) 3.5 pounds/day × 14 days = 49 pounds 600 pounds + 49 pounds = 649 pounds (average weight over feeding period)
Supplement intake rate	2.5 percent of body weight	2.5 percent of body weight
Feed amount	600 × 0.025 = 15.000 pounds/head/day	649 lbs. × 0.025 = 16.225 pounds/head/day

added to the ration. Some high-fiber feedstuffs have very little or no nutritional value in a bull development program and should not be fed to developing bulls. Examples of such feedstuffs include rice hulls and peanut hulls.

Commercial supplements are available at feed suppliers, or custom supplements can be blended from locally available feedstuffs at a mill or on the ranch. Begin with a nutrient composition analysis of pasture and stored forage when designing a grain-based (concentrate) feed supplement for developing bulls. The proper nutrient composition and feeding rate of the supplement can be determined more accurately using forage analysis results. Forage nutrient content and availability of pasture will change over time, particularly as forages mature. Factor changing forage conditions into supplement planning.

Determine how much feed to offer bulls each day based on feed nutrient composition and bull nutrient requirement tables. Weigh growing bulls periodically to monitor growth performance and determine if the nutritional program is providing a desired rate of gain. Feed and forage intake levels increase as bulls grow. As a bull gains weight, a set amount of supplement represents a diminishing amount of its intake as a percentage of body weight. Adjust the level of supplementation periodically throughout the development period to account for this. Establish supplemental feeding levels on bull weights adjusted for the expected average daily gain over the feeding period instead of just using bull weights at the start of

the period (Table 2). For percentage body weight calculations of feed amounts, use a true average bull weight over the feeding period.

Note the ingredient composition of supplements used in bull development programs. Many highly-fermentable grain-based feeds have bloat or acidosis potential and require daily feeding of limited quantities or adjustment periods where feed intake levels are slowly increased over time. Developing bulls on a high-grain diet for rapid weight gain requires careful feeding management to prevent digestive problems. Bulls accustomed to forage-based diets must be adapted slowly to high-grain diets to avoid inducing acidosis or founder. Dividing the grain portion of the ration into at least two feedings per day, morning and evening, can help reduce the chances of digestive problems. Put digestive upset prevention measures in place before a bull development testing period begins. This includes providing adequate effective fiber in bull diets.

For a feed-based test, use a minimum 3-week warm-up period to adjust bulls onto the test ration. This adjustment period is vital for maintaining the digestive integrity of the animals. Adapt bulls slowly to the test ration by starting them off with about 4 to 5 pounds of the test ration per head per day. Increase the amount of the test ration by approximately 1 pound per head per day every other day until the bulls eventually start leaving feed in the trough. Do not increase the daily feeding level if feed remains in the trough.

For a forage-based bull development test, use a 2- to 3-week diet warm-up period. During this time, shift bulls gradually from their pretest nutritional program to the test nutritional program. This allows time for bulls to adjust to the forage and supplementation program before initial test weights are taken.

Use a 3- to 4-week step-up period for adapting bulls to a high-grain diet. If bulls are already adapted to grain supplementation, such as creep feeding prior to weaning, the 3-week adjustment period may be sufficient. An easy method of stepping bulls up to a high-grain diet is to limit the high-grain ration and provide free-choice access to good-quality, long-stemmed hay. If the bull is not adapted to grain and the final ration being limit fed contains adequate roughage, such as chopped hay or cottonseed hulls, start grain feeding at about 50 percent of a bull's intake. If the bull is not adapted to grain and the final ration being limit fed does not contain adequate effective fiber, then start the grain feeding amount at 4 to 5 pounds per head per day. Increase the feeding rate of the grain ration by up to 15 percent each week until on full feed or the target feeding level starting week 5 or by 0.5 pounds per day every other day until bulls reach the desired feeding level.

Some bull development programs allow bulls free-choice access to grain-based feed supplements after an

adjustment period. Free-choice access may facilitate the use of self-feeders and reduce labor needs, but it is often economically unwise. The use of self-feeders also increases the risk for digestive disorders. These feeders can accumulate stale or moldy feed.

Bull development can require considerable, but necessary cash outlays to meet the nutritional needs of growing bulls. Yet bull development targets can often be achieved with limit feeding grain-based supplements or forage-based programs for significant savings over full-feeding programs. An average daily feeding rate for a postweaning bull development program through yearling age may be 15 to 20 pounds per head per day. If these same bulls were allowed all they could eat, they might consume 25 or more pounds of grain-based feed per day and yet not sell for prices that would justify the additional feed expense. The risk of overconditioning bulls is also greatly reduced by developing bulls on excellent quality forage systems or limit-fed, grain-based supplement systems instead of grain-based, full-feed programs.

Growing bulls fed to achieve a high rate of gain are often given rations that include both grains and roughage. Maintain at least 15 to 20 percent effective fiber in rations to maintain appropriate rumen pH, prevent acidosis, and keep the rumen healthy. Roughage can come from coarsely chopped hay or cot-

Table 3. Beef bull development ration examples

Feed ingredient, pounds	Example bull development rations ^{1,2}			
	Ration 1	Ration 2	Ration 3 ³	Ration 4 ³
Corn	773	744	313	338
Corn gluten feed	150	750	383	
Cottonseed hulls	200	208		
Cottonseed meal	125			
Molasses	50			
Soybean hull pellets	540	270	1188	1485
Soybean meal			100	152
Wheat midds	100			
Dicalcium phosphate				9
Sodium bicarbonate	10			
Feed grade limestone	20	16	11	4
Ammonium chloride	10			
Nutrient composition, % dry matter				
Total digestible nutrients	75	80	73	70
Crude protein	12.8	13.5	15.1	14.3
Crude fiber	18.2	14.1	25	29.5
Calcium	.68	.60	.61	.60
Phosphorus	.37	.45	.33	.32

¹ Ensure that each ration contains enough macrominerals (including salt), trace minerals, and Vitamins A and E. For specific mineral and vitamin nutrition recommendations, refer to Mississippi State University Extension Service Publication 2484, "Mineral and Vitamin Nutrition for Beef Cattle".

² Include an ionophore in the ration to improve bull growth performance and feed efficiency. Follow label directions for ionophore inclusion.

³ These rations do not contain adequate effective fiber. Feed them in conjunction with a free-choice effective fiber source such as long-stem hay.

tonseed hulls. If the roughage is not mixed with the grain portion of the diet but instead fed separately, limit grain intake so bulls will consume at least 0.5 percent of body weight as roughage. Keep hay or grazing available at all times in these situations. Add liquid molasses at 5 percent of the ration to help stimulate intake and reduce dust.

To end the high-grain diet, gradually adjust bulls back to a forage-based diet before market or turning out to pasture. Decrease the grain-based ration intake by 15 to 20 percent each week over several weeks until bulls are on forage alone or forage plus a supplement. Bull buyers sometimes complain that grain-fed bulls often lose body condition and weight rapidly after being placed on average- or low-quality pasture. Buyers typically do not want bulls to lose condition rapidly after being turned out to pasture. Move bulls to a larger lot and increase the distance between feed and water resources to increase exercise and help prepare bulls for the physical demands of pasture breeding.

Nutritional programs must provide adequate levels of protein and energy to allow bulls to express genetic differences in growth. Qualified nutritionists can help formulate proper bull development rations. Table 3 lists example feed rations for developing bulls, but the options are not limited to these examples. Consider feed ingredient availability, price, nutrient content, handling characteristics, and feeding risk factors in determining which feedstuffs and feeding levels to use. Also consider including an ionophore in bull diets to improve feed efficiency and growth rates. For a feed-based test, use rations with 70 to 80 percent TDN on a dry matter basis at a feeding rate of 2.2 to 2.5 percent of body weight. Free-choice grain feeding is an option but not as cost effective as limit feeding. In a grain-based development program, allow free-choice access to hay or pasture if not using a total mixed ration including an effective fiber source.

If a concentrate ration with 70 to 80 percent TDN on a dry matter basis is provided as part of the forage-based test, limit feed it at a rate of 1.0 to 1.5 percent of body weight. When selecting supplements for forage-based tests, remember that high-starch supplements, such as corn, can negatively affect forage fiber digestion. Corn fed at levels higher than 0.25 percent of the body weight has been shown to depress forage intake and digestibility. Soybean hull pellets are a good energy supplement for forage-based diets because they are high in both digestible fiber and TDN. They are not good sources of effective fiber, though.

Use of coproduct feeds such as soybean hulls and corn gluten feed can help reduce bull development feed cost. These feeds also contain more fiber and less starch than corn, maintaining a rumen environment

better for forage digestion. Note expected rates of gain for diets containing coproduct feeds in assessing the value of these feedstuffs. Ultimately, consider feed cost of gain in evaluating the economics of developing bulls. Exercise care when feeding some of these coproducts to keep the fat level of the total ration from becoming too high. Do not feed fat levels higher than 5 percent of the total diet to avoid problems with rumen microbe function and associated scours and lower digestibility of forage.

Maintain a back-up feed supply in case forage availability declines to inadequate levels. Limit grazing time and start feeding the back-up feed before forage available for grazing runs out. When forage supply is inadequate and bulls are constantly hungry, they may spend more time fighting with each other. Risk of injury to bulls increases when they fight or mount one another. This can be a problem during forage tests because of the advancing age of bulls. Minimize fighting amongst bulls by providing a back-up forage supply or offering supplemental feed during periods when forage supply limits intake. Change from grazing to feed gradually over a period of 2 to 3 weeks to maintain digestive health.

Observe bulls closely during the breeding season. Identify bulls that do not display adequate libido or become injured during the breeding season. Also recognize when bulls become too thin. If bulls are not performing as expected and environmental conditions have not been extreme, evaluate feed bunk and water trough management. Keep feed bunks clean and free of stale or moldy feed. Feed intake is highly correlated with water intake, and feed intake may be reduced if water sources are not kept clean. During the breeding season, hand feeding may be necessary to ensure that bulls maintain adequate condition for active breeding.

Summary

Bull development programs involve carefully planned animal selection, nutritional management, and herd health programs. Younger bulls need less quantity but higher quality diets. Adjust feed offerings as bulls grow and mature. Develop bulls to reach 75 percent of expected mature weight at 2 years of age. Properly managing bulls during the development phase will make the transition to the breeding pasture much smoother. Target body condition scores of 6 for bulls to start each breeding season. Breeding season activity can reduce body condition, so manage bulls between breeding seasons to regain lost condition. Maintain an acceptable balance between program quality and cost effectiveness. For more information on development programs for beef bulls, contact an office of the Mississippi State University Extension Service.

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Publication 2564

Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. Dr. Melissa Mixon, Interim Director

(POD 09-09)



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