Choices in Breeding Programs to Fit Your Environment

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In Texas, climatic conditions, specifically temperature, precipitation, and humidity vary widely. Some parts of the state hardly ever experience a freeze. The coast can be inundated by tropical storms and infrequently by hurricanes, while western Texas evaporates many times more moisture than it ever receives as rainfall. Soil types, levels of soil fertility and types of grasses vary as much or more. East Texas requires inputs of lime and fertilizer to maintain high production of grasses. The lack of rainfall in West Texas keeps forage production low but the quality of the forage high. Subsequently, stocking rates are much higher in eastern Texas than in western Texas and higher along the Gulf Coast than in the Panhandle, sometime more so than is desirable as cattle raisers often tend to maximize rather than optimize production, which may lower returns. Operational characteristics also change from east to west with land values decreasing, ranch sizes increasing, stocking rates and carrying capacity declining, and decreasing operating costs. The challenge is to raise cattle in a specific environment, the one the ranch is in, to produce calves to be fed and marketed potentially in completely different environments.

There have been many excellent presentations given and papers published here at the TAMU Beef Cattle Short Course on the subject of breeds and breeding systems to fit "the" market. Hammack (2003) discussed the production and market conditions, breeding systems, breeds and breed types, and even individual selection in discussing adaptive genetic management strategies. Turner, also in 2003, discussed the importance of specific breed combinations in breeding systems under given climatic conditions to meet market requirements. Finally, Ritchie (2003) explained how to "connect the cowherd to the carcass". In all of these presentations, the authors began with the cowherd and proceeded to build the market-acceptable feeder calf and carcass. All conceded that some straightbred females can do this in favorable environments but a crossbred female is superior in unfavorable ones, and is generally more efficient even in favorable conditions.

In recognizing the role of environment in beef cattle production we can equate its effects with our attempts to improve the herd's genetics and our management skills, in other words, the total "system". All affect input, output and profit. The systems approach incorporates the overall efficiency of beef production. While level of production is an important factor affecting profitability, costs of production are equally important, and optimum balance of the two results in highest profit.

The systems part of this concept means that beef production is influenced by

many components, all of which play a part in determining net return. These include physical environment, cattle biological type, mating systems, management practices, input costs, prices, and market requirements. To understand how to integrate the systems concept, one must first understand how the components of the system interact (Table 1).

Table 1. Matching genetic potential for different traits in varying production environments[1]

Production Environment	Traits						
Feed availability	Environ-mental Stress[2]	Milk Prod.	Mature Size	Ability to Store Energy[3]	Adapt to Stress[4]	Calvin g Ease	Lean Yield
High	Low	M to H	M to H	L to M	M	M to H	H
	High	M	L to H	L to H	H	H	M to H
Medium	Low	M to H	M	M to H	M	M to H	M to H
	High	L to M	M	M	H	H	H
Low	Low	L to M	L to M	H	M	M to H	M
	High	L	L	H	H	H	L to M
Breed Role in Terminal Systems							
Maternal		M to H	L to M	M to H	M to H	H	L to M
Paternal		L to M	H	L	M to H	M	H

[1] L = Low, M = Medium, and H = High.
[2] Heat, cold, internal and external parasites, diseases, mud, drought, altitude, etc.
[3] Ability to store fat and regulate energy requirements with changing availability of feed supplies due to season or drought.
[4] Physiological tolerance of stressors.
(BIF, 2002)

Table 1 characterizes production environments by feed availability and environmental stress. Feed availability refers to quantity, quality and regular availability of grazeable or harvested forage and supplemental feed. Sources of environmental stress include heat, cold, internal and external parasites, diseases, mud, drought, altitude, etc.

Six traits are listed in the table: milk production, mature size, ability to store

energy, adaptability to stress, calving ease and lean yield. It is assumed that the animals produced are sound, fertile and marketable.

The upper part of the table lists the productive ranges for general purpose cattle, those in commercial straightbred or crossbred systems in which female replacements are produced in the herd. The lower part of the table ("Maternal" and "Paternal") refers to specific types of terminal crossbreeding systems, where heifers produced in the herd are not returned as replacements. "Maternal" systems refers to the mother cows used in the system and "Paternal" refers to the sires that are used to produce only feeder calves.

The relationships between the production environments and recommended levels for the various traits are shown in the table. The better the environment, both in terms of feed availability and lack of stress, the wider the range for optimum milk production. Optimum mature size changes with feed availability and for low and high environmental stress.

The ability to store energy is important when feed availability is low or inconsistent. Without this ability, cows are less able to maintain enough condition to rebreed effectively. Cows that are "easy keepers" in low feed environments may become overly fat and inefficient in high feed, low stress environments. High lean yield and ability to store energy are genetic antagonisms. The optimal level of lean yield will vary with market objectives when feed availability is high. When feed is limited however, cows will still need to fatten easily, even though this may not be beneficial to their progeny.

The ability to withstand stress is also important, particularly in the high stress environments. Tolerance to high heat and humidity is important throughout the southern US and most of Texas. However, this tolerance to stress may also be important in shipping and handling cattle and in calving ease, especially with higher birth weight sires.

Recommendations for the sires and dams in maternal and terminal crossbreeding programs vary somewhat from the rest of the table. "Maternal" cattle should have a higher level of adaptability to natural environments (the ability to store more fat and have a lower lean yield). Milk production may not differ from the cows in the general table but the mature size of these cows should most likely be smaller to take advantage of lower cow nutritional costs, relying on large terminal sires to provide genetics for fast growth of calves. Calving ease will be very important to these cows as they are bred to large sires.

The traits to be considered in the terminal sires themselves are growth rate and carcass merit. Calving ease and adaptability are not to be ignored however.

Hammack (1998) in evaluating the functional levels of major cattle breeds of

Texas, reported results of a panel's rating of 22 most numerous breeds on eight different traits: body size, milking potential, age at puberty, hot climate adaptability, fleshing ability, muscle expression, cutability (lean to fat ratio) and marbling. He suggested grouping the breeds by origin and functional level into seven breed groups: British, Continental Beef, Continental Dual Purpose, Dairy, Bos indicus, American and Speciality.

Only five groups are of concern here, the British (Angus, Hereford, Red Angus and Shorthorn), Continental Beef (Charolais, Chianina, and Limousin), Continental Dual Purpose (Braunvieh, Gelbvieh, Maine Anjou. Salers and Simmental), the Bos indicus (American Gray and Red Brahman) and the American (Beefmaster, Braford, Brangus, Red Brangus, Santa Gertrudis and Simbrah). These breeds were then rated these breeds for their genetic expression of the eight traits.

In general, British were categorized as higher marbling (except moderate in Hereford), easy fleshing, and moderate in size, milk and muscling. Continental Beef were rated as relatively low milk (in relation to body size), but muscular, lean, and lower marbling (except moderate in Charolais), and large in size (except moderate in Limousin). Continental Dual Purpose breeds were rated as similar to Continental Beef but higher in milk.

Both the Bos indicus and the American breed groups are rated very high for heat and humidity tolerance, internal and external parasite tolerance, disease resistance, ability to utilize low quality forages, maternal calving ease, longer productive life, with the American breeds containing a moderate degree of heterosis. However, in these two groups, several specific areas are lacking: marbling is mostly lower, as is cold tolerance, sexual maturity occurs later, susceptibility to feeding disorders with high concentrate feeding is more likely and market price as feeders is usually lower. However just the opposite is true for price as replacement females.

Within the American breed group there are differences due to whatever breeds were originally combined with the Bos indicus in their creation. For example, Simbrah have more muscling due to the use of Simmental genetics and Brangus and Red Brangus have more marbling due to the influence of Angus genetics (Hammack, 2003).

Table 2. Functional levels of production of major beef breedtypes in Texas[1].

Breed group	Body size[2]	Milk potential	Age at puberty[3]	Hot climate adapted	Fleshing ability	Muscle expression	Cutability[4]	Marbling
British	M	M	H - VH	M	H	M	L	H
Continental beef	VH	L	L	M	M	VH	VH	L

Continental dual purpose	H	H	M	M	M	H	H	M
Bos indicus	H	M	VL	EH	H	M	M	L
American	M - H	M	L - M	VH	H	M	L	L - M

[1] VL = Very Low, L = Low, M = Moderate, H = High, VH = Very High, and EH = Extremely High
[2] Evaluated as body weight at the same age and condition.
[3] VL = Very Late, L = Late, M = Moderate, H = Early, and VH = Very Early.
[4] Under similar nutrition.
(Hammack, 1998)

To decide on which breeds or breed groups would be best under a given set of environmental conditions, the breed functional levels in Table 2 need to be matched with the functional requirements under the varying environments in Table 1. For example, the British breed group would fit the high feed availability production environment, even under high environmental stress. The same group would also fit under low feed availability as long as environmental stress was low. American breeds would also fit all these levels of feed availability and environmental stress except where feed availability was low and stress was high for mature body size.

In consideration of Table 1, it should be understood that hybrid vigor (heterosis) will be expressed at higher levels in stressful environments, and when crossing diverse genotypes. Both these tables represent guidelines for consideration in the requirements of specific genotypes in given environments. Many different breeding programs may fit a given environment but in most instances the choices are narrowed due to marketing considerations.

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