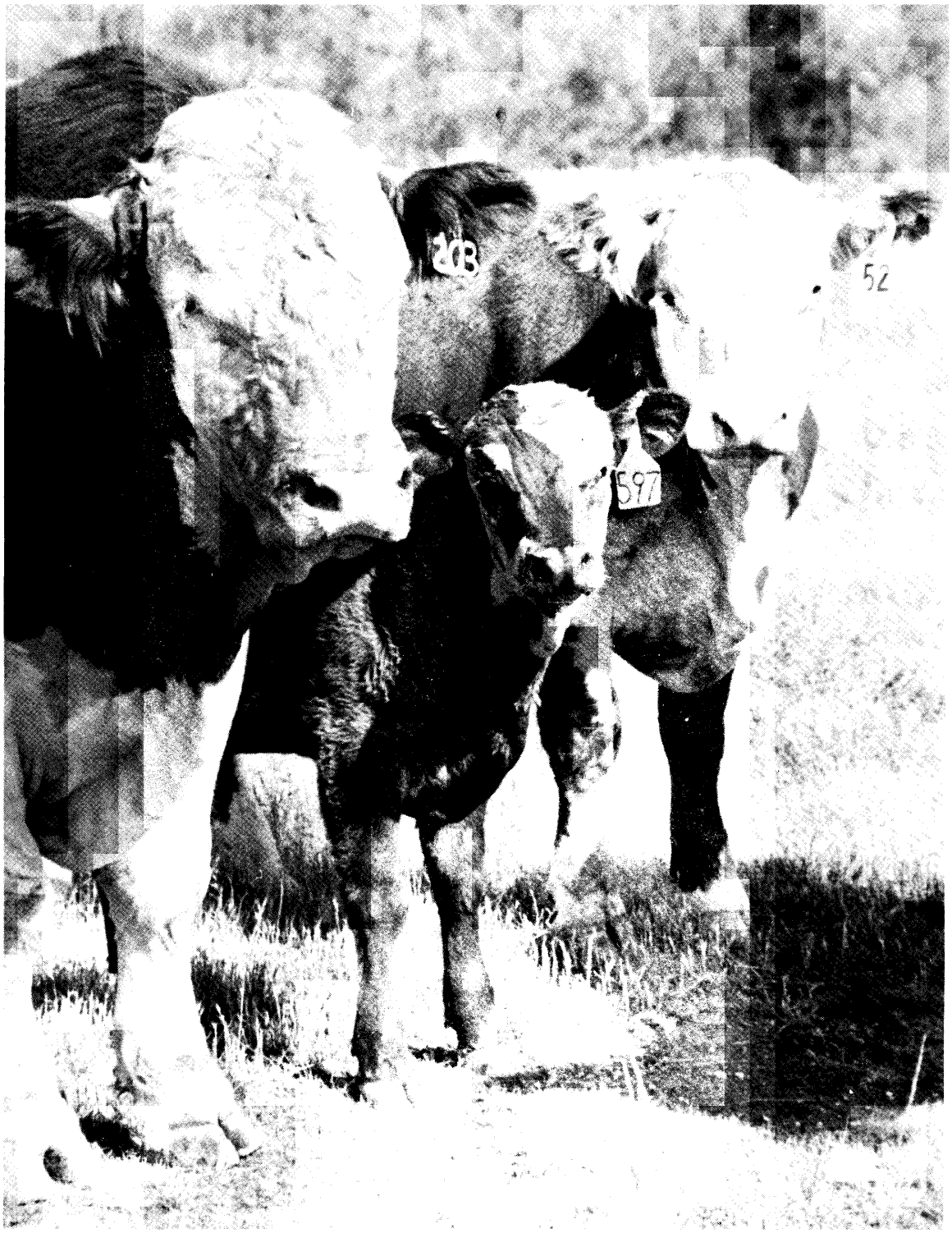


Crossbreeding Beef Cattle

Cooperative Extension Service ■ Kansas State University ■ Manhattan

Crossbreeding Beef Cattle

Although the benefits of crossbreeding have been known for many years, it has been accepted by commercial cattlemen only in the past few years and has become a standard for the commercial industry. To increase profitability, crossbreeding must be used in a systematic plan, since many of the production benefits will result only from an organized approach. Before designing an effective crossbreeding plan, the producer must have some understanding of how crossbreeding increases production.

Crossbred animals have two advantages over straightbreds:

■ Crossbreds exhibit heterosis or hybrid vigor — the phenomenon in which a crossbred is more vigorous and has higher production than straightbreds. This increase in production, coupled with greater calf vigor and survival, results in increased calf crops and weaning weights.

■ Crossbreeding can take advantage of breed complementarity, since a weakness of one breed can be offset by combining it with a breed strong in that trait. The resulting crossbred may not be superior in any single trait but superior in overall performance.

A crossbreeding program that will increase profitability must take maximum advantage of these characteristics of crossbreds. In other words, the producer must keep heterosis (maternal and individual) at the highest level possible and combine breeds that complement each other.

What Determines the Level of Heterosis?

The level of heterosis is determined by the degree of genetic difference between the parent breeds. From a practical standpoint, this means that the greater the difference between two breeds, the greater the hybrid vigor exhibited by the cross.

A cross between an Angus and a Brahman gives more hybrid vigor than a cross between an Angus and a Hereford. This also explains why a 3/4 Angus, 1/4 Hereford will exhibit less hybrid vigor than a 1/2 Angus, 1/2 Hereford — more of the genetic material is different in a combination of 1/2, 1/2 than in 3/4, 1/4.

A crossbred that is 1/2 of breed A and 1/2 of breed B will exhibit 100 percent of the possible heterosis, while a crossbred that is 3/4 breed A and 1/4 breed B should exhibit 50 percent of the possible heterosis between breeds A and B.

Thus, in designing a systematic crossbreeding program, the producer should try to keep the breed combinations as close to 1/2, 1/2 and 1/2, 1/4, 1/4 as possible to maximize heterosis.

Table 1 illustrates the relative percentage of heterosis which will be expressed by various breed combinations.

Table 1. Examples of percentage of the maximum heterosis (hybrid vigor) in various breed crosses.

Breed Combination	Percent of Maximum Heterosis of Progeny
Angus X Angus	0
Hereford X Hereford	0
Angus X Hereford	100
Angus X Simmental	100
1/2 Angus, 1/4 Hereford, 1/4 Simmental	100
3/4 Angus, 1/4 Hereford	50
3/4 Simmental, 1/4 Hereford	50
3/8 Angus, 5/8 Hereford	75

As one backcrosses to one of the parent breeds, the percentage of the maximum heterosis obtained is decreased compared to the first cross of the breeds. Therefore, the most effective crossbreeding systems keep the percentage of any breed no higher than 50 percent.

Selection of Breeds for a Crossbreeding Program

Breeds used in a successful crossbreeding program must be suited to the resources and market and must complement each other. For example, it was earlier noted that crosses of Brahman X Angus give greater heterosis than crosses of Angus X Hereford; however, high-percentage Brahman females aren't adapted to the cold winters of the Great Plains. Thus, while heterosis maybe high, production may be reduced by increased death loss and feed requirements.

Factors to Consider in Breed Selection:

■ Adaptation to Climate

While adaptation of the Brahman to cold weather is a classic example, many of the breeds with a heavy hair coat aren't especially adapted to hot, humid weather. The key, then, is to select breeds that are adapted to the normal variation in weather.

■ Adaptation to Feed Resources

The quality, quantity, and relative cost of available feed resources should be a major consideration in breed selection, since the breeds used will influence cow size and milk production potential, which will set feed requirements per cow.

The goal is to match cow size and milk production to the feed resources. As a general rule, if an abundance of inexpensive roughage is available, the operation can probably run cows that tend to be larger and heavier-milking than average. Conversely, where feed supplies are limited, expensive, or of poor quality, select breeds that will keep cow size and milk production low.

Note that milk production potential has a greater impact on feed requirements than size does. Failure to match cow type to the resources provided will result in poor reproduction or uneconomical production.

■ Labor and Management

Another environmental factor to consider is available labor and management. Using larger breeds of bulls on cows of small breeds generally increases the labor involved because of increased calving difficulty. However, in any breeding program, whether straightbred or crossbred, as production potential increases, management needs to improve simultaneously.

■ Production System

A final factor to consider is the production system, since the normal marketing age may dictate the breeds of choice. For example, a producer who sells calves at weaning may want to emphasize preweaning growth rate and milking ability in the breeds selected. On the other hand, a producer who retains ownership should place more emphasis on postweaning traits.

Table 2 contains a summary of the breed evaluation research at the Meat Animal Research Center at Clay Center, Nebraska. While it provides an indication of breed characteristics, note that there is tremendous variation within each breed, with some lines of breeding differing markedly from the general characteristics. (EPDs within a breed should be used in selecting bulls for a crossbreeding program.)

Importance of Breed Differences

■ Growth Rate and Mature Size

Increased growth rate is both a plus and a negative, since it indicates increased pounds to sell as well as increased body size to maintain. Trying for maximum growth rate and frame size may lead to disaster if maintenance requirements, resulting from increased cow size, exceed feed resources provided.

Since the key indicator of excess mature size for the feed provided is a reduction in reproductive rate, producers should closely monitor reproduction in the herd.

■ Lean-to-Fat Ratio

Cattle with a high lean-to-fat ratio (more X's in Table 2) will take longer to feed to a choice grade under conventional feeding programs. The importance of this characteristic will depend on the direction of beef marketing in the next few years. If, for example, emphasis is placed on lean beef, then breeds with a high lean-to-fat ratio will be in demand.

However, if emphasis is placed on marbling, breeds with a lower lean-to-fat ratio will be preferred.

■ Age at Puberty

Breeds with the fewest X's in this column are preferred, since breeding heifers to calve at two years of age is a common practice. Correspondingly, breeds with more than three X's require better nutrition and management if they are to calve as two-year-olds.

■ Milk Production

At first thought, more milk might seem desirable, and, in general, it is. Yet, with many of the breeds available today, there is a possibility of getting too much milk for the available resources. Many producers using high milk-production breeds have found it necessary to increase supplementation greatly in order to maintain adequate reproduction.

Table 2. Summary of Breed Evaluation Research at the Meat Animal Research Center.

Breed group	Growth rate and mature size	Lean to fat ratio	Age at puberty	Milk production
Jersey-X	X	X	X	XXXXX
Hereford-Angus-X	XX	XX	XXX	XX
Red Poll-X	XX	XX	XX	XXX
South Devon-X	XXX	XXX	XX	XXX
Tarentaise-X	XXX	XXX	XX	XXX
Pinzgauer-X	XXX	XXX	XX	XXX
Sahiwal-X	XX	XXX	XXXXX	XXX
Brahman-X	XXXX	XXX	XXXXX	XXX
Brown Swiss-X	XXXX	XXXX	XX	XXXX
Gelbvieh-X	XXXX	XXXX	XX	XXXX
Simmental-X	XXXXX	XXXX	XXX	XXXX
Maine-Anjou-X	XXXXX	XXXX	XXX	XXX
Limousin-X	XXX	XXXXX	XXXX	X
Charolais-X	XXXXX	XXXXX	XXXX	X
Chianina-X	XXXXX	XXXXX	XXXX	X
The following breeds are undergoing evaluation in Cycle IV, and thus the evaluation below should be considered preliminary.				
Longhorn-X	X	XXX	XXXX	X
Saler-X	XXXX	XXXX	XXX	XXXX
Galloway-X	X	XX	XXX	X
Nellore-X	XX	XXX	XXXXX	XXXX
Shorthorn-X	XXX	XX	XXX	XXXX
Piedmontese-X	XX	XXXXXX	XX	XX

Each "X" indicates the relative difference between breed groups.

Obviously, there is a point where the cost of extra nutrition isn't covered by extra production. The point at which there is too much milk potential in the herd will vary for each operation, requiring each producer to monitor reproduction and cost closely as milk production potential is increased.

Practical Crossbreeding Programs

Reaping the benefits of crossbreeding requires a systematic program of using breeds that complement each other and maintenance of a high level of heterosis. Additionally, the crossbreeding program must fit the size of the operation, number of pastures and other practical constraints. The following crossbreeding programs are generally recognized as systems that meet these requirements.

Two-Breed Rotation

One of the simplest of the systematic crossbreeding programs is the two-breed rotation in which cows sired by breed A are mated to bulls of breed B. The heifers resulting from this cross are mated to bulls of breed A for the rest of their lives. Then heifers from this cross are mated to bulls of breed B for the rest of their lives. In other words, a female is always bred to the breed different from her sire as shown in Diagram 1.

Two breeding pastures are required, as well as identification of the breed of sire for all replacement females. This system works best if the bulls selected are similar genetically for birth weight, mature size, and milk production. This minimizes calving problems and reduces the within-herd variation in nutritional requirements. One of the advantages of this system is that it does produce replacements within the herd.

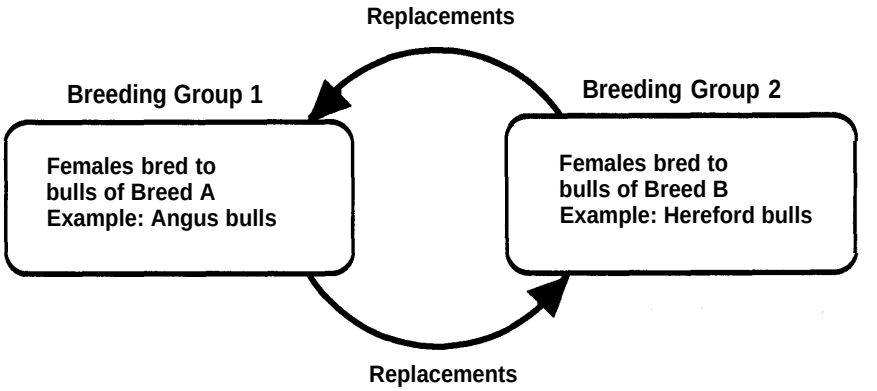
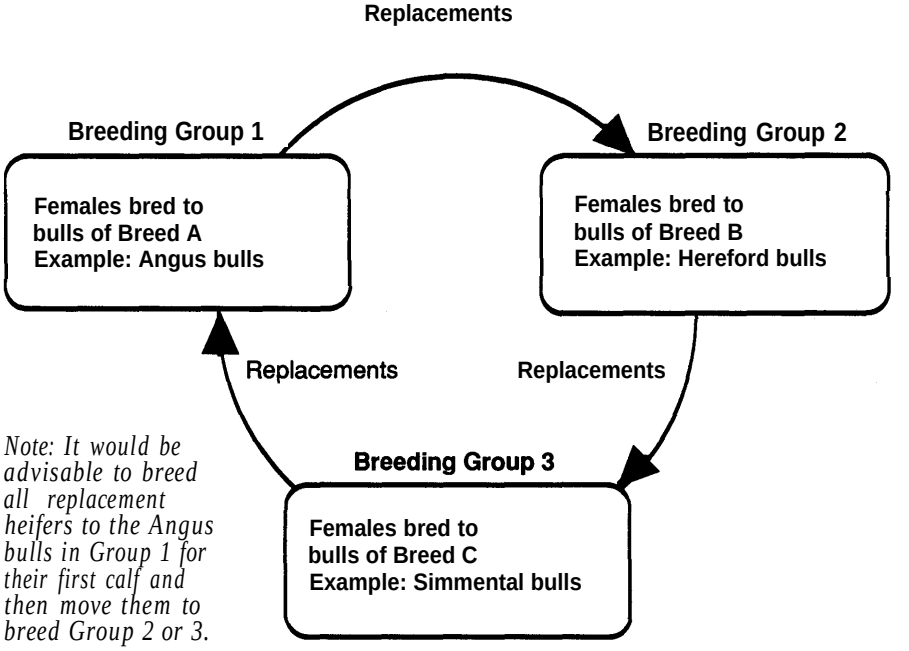


Diagram 1. A two-breed rotation crossbreeding system.

Three-Breed Rotation

The three-breed rotation system is essentially the same as the two-breed with another breed added. As a general rule, in this system a female is always mated to the breed of bull to which she is least related as shown in Diagram 2. This allows more heterosis to be maintained.

As the diagram illustrates, three breeding pastures must be maintained as well as three breeds of bulls. This system again has the advantage of producing replacements within the herd. However, it does require considerable management to maintain identity of the breed groups on a long-term basis, and making a mistake by breeding a female to the wrong breed of bull greatly reduces the amount of heterosis obtained.



Note: It would be advisable to breed all replacement heifers to the Angus bulls in Group 1 for their first calf and then move them to breed Group 2 or 3.

Diagram 2. A three-breed rotation crossbreeding system.

Terminal Sire System

In this system, cows of a specific two-breed cross are mated to bulls of a third breed with all offspring marketed. Obviously, this allows a producer to use cow breeds that are well suited to the environment and breed them to a large third breed to maximize growth rate in the calves. This part of the program is easy to manage and requires only one breeding pasture.

Unfortunately, the weakness of this system is its failure to produce any replacements. Thus, to produce replacements, the producer must maintain separate breeding groups of straightbred cows in order to produce the specific crossbred females desired, which reduces the overall level of heterosis in the system.

Another source of replacements is simply to purchase the desired crossbred females; however, they may not be available at a reasonable cost or of adequate quality. The terminal sire system with the breeding groups required to produce replacement females is shown in Diagram 3.

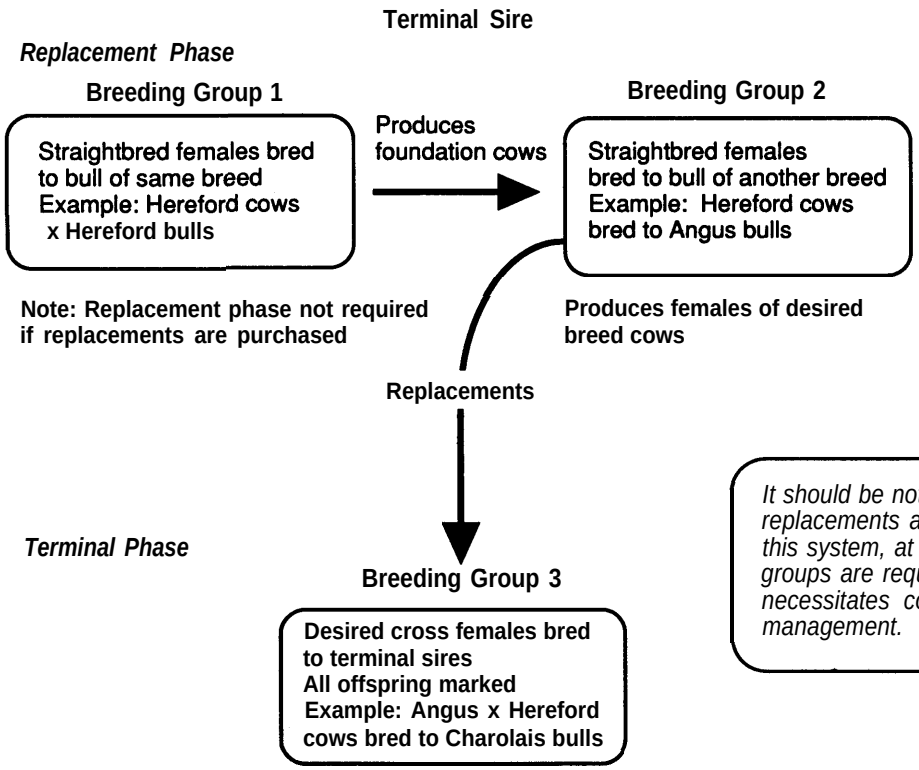


Diagram 3. Terminal Sire Crossbreeding System with the Breeding Groups Required to Produce Replacements.

It should be noted that when replacements are produced within this system, at least three breed groups are required which necessitates considerable management.

Rota-Terminal System

This crossbreeding system is essentially a combination of a rotation system and a terminal system, with the rotational breeding groups producing the replacements for the terminal system as shown in Diagram 4.

Although this system requires a high level of management, it does maintain high levels of heterosis and it does produce its own replacements. The breeds in the rotational portion can again be selected to match the resources and for complementarily. The breed used as a terminal sire should be selected primarily on growth rate and carcass desirability.

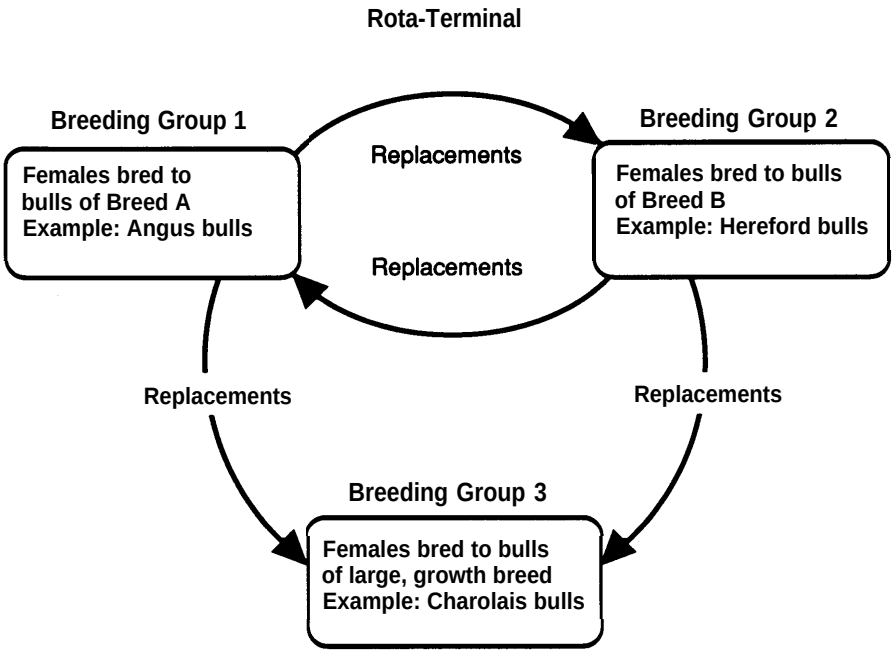


Diagram 4. Rota-Terminal Crossbreeding System.

Multi-Year Bull Breed System

In this system, a breed of bull is used on all of the cows for a period of four to six years, after which another breed of bull is used on all of the cows for four to six years. As few as two breeds of bulls may be used in rotation or several breeds may be used over an extended period. In small herds, it maybe necessary to rotate bulls more often to avoid breeding a bull to his daughter. This system is illustrated in Diagram 5.

This system is simple to implement and maintains a fairly high level of heterosis. One practical problem is what breed of bull to use on heifers if the breed in current use is relatively large. But the fact that it requires a single breeding pasture and produces its own replacements makes it a useful system on many Kansas ranches.

Multi-Breed Bull System

In this system, essentially equal numbers of bulls of two or more breeds are used in the same pasture at the same time with random mating as illustrated in Diagram 6.

This crossbreeding system requires only one breeding pasture, doesn't require identification, and produces its own replacements. Consequently, it is one of the easiest crossbreeding systems to implement and maintain.

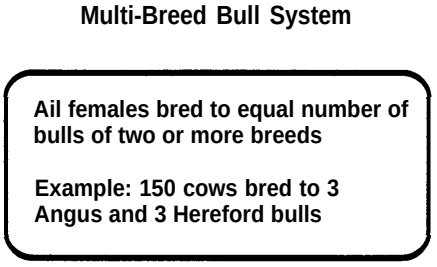


Diagram 6. A Multi-Breed Bull Crossbreeding System.

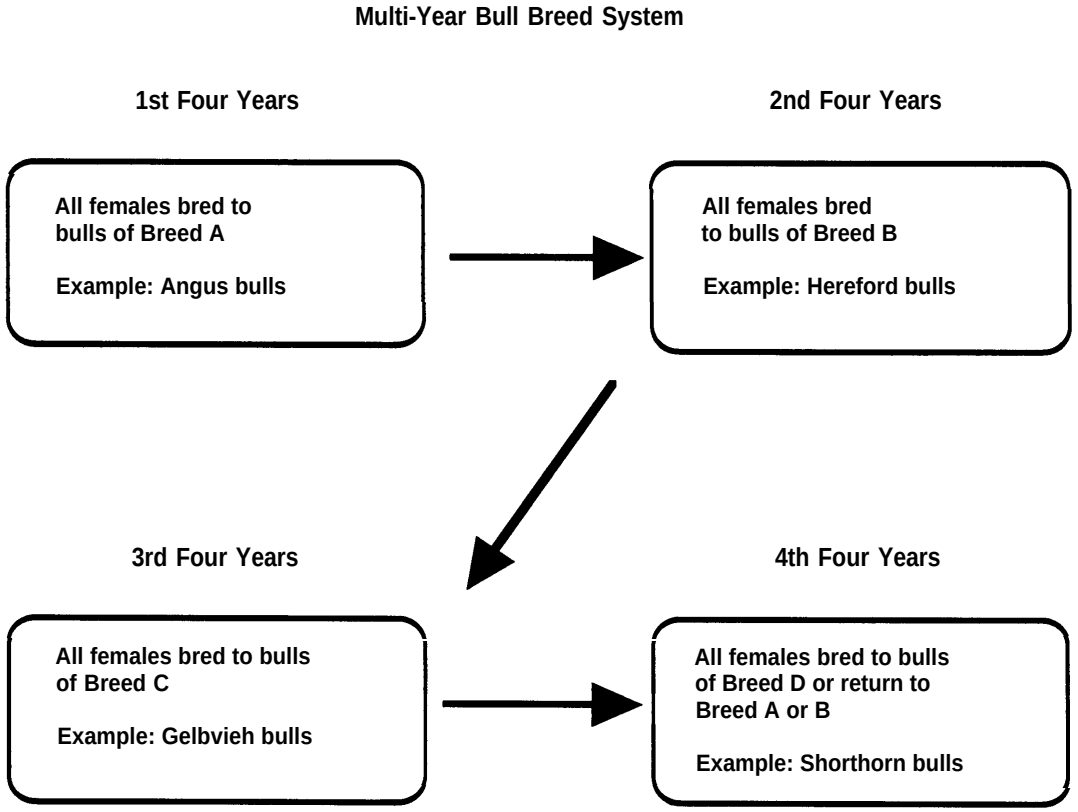


Diagram 5. The Multi-Year Bull Breed System.

Table 3. Comparison of Crossbreeding Programs.

Crossbreeding Program	Advantage (%)[1]	No. of Breeding Pastures	Degree of Management Required
2-Breed Rotation	16	2	Moderate
3-Breed Rotation	20	3	High
Terminal Sire			
Buy crossbred females	28	1	Low
Buy straightbred females	24	1	Low
Rota-Terminal (45% of cows in 2 breed rotation breed groups, 55% in terminal groups)	21	3	High
Bull Breed Rotation			
(2 breeds in a 4-year cycle)	12	1	Low
(3 breeds in a 4-year cycle)	16	1	Low
Multi-Breed Bull System (with crossbred females)			
(2 breeds of bulls)	10	1	Low
(3 breeds of bulls)	15	1	Low

[1] Percentage advantage for pounds of calf weaned per cow exposed when compared to the average of the breeds involved in the crossbreeding program. Assumes 80% calf crop weaned, 20% replacement rate, individual heterosis = 8.5%, maternal heterosis = 14.8% and 5% increase in calf weight due to terminal sire. (University of Nevada Experiment Station Bulletin TB-88-1)

Comparison of Crossbreeding Systems

A comparison of crossbreeding programs appears in Table 3 (at left) including the percent advantage in pounds of calf weaned per cow exposed, the number of breeding pastures required, and the relative amount of management required.

Summary

Many crossbreeding systems are available to commercial cattle producers, all of which will be effective if implemented properly. The most important point is that a crossbreeding plan is developed and implemented; otherwise, the potential increases in production and efficiency that crossbreeding offers won't be obtained. In fact, a poorly managed crossbreeding program may be no better than a well managed straightbred breeding program.

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