Beef Crossbreeding Series

Systems of Crossbreeding

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Beef cattle producers have many production and management options available to them today. With the use of these tools, producers should be able to optimize their production potential and approach maximum returns. One of these tools is crossbreeding, the mating of individuals from two different breeds.

One of the most important results of crossbreeding is hybrid vigor. Hybrid vigor, or heterosis, is the increased vigor or vitality or "doing ability" of a hybrid offspring. Hybrids are more capable of withstanding the stresses in life and adapting to a wider range of environments. In general, those traits that respond to crossbreeding in this manner are those traits which are lowly heritable. Thus, improvement through selection would be extremely difficult and may not occur at all. These are primarily traits influencing reproduction and resistance to stress.

Another benefit from crossbreeding is complementarity, or the combining of desirable traits from two different breeds into one unit. Strengths in one breed will often make up for weaknesses in another breed. For example, one breed may be vastly superior to another breed in lean meat production but possess undesirable characteristics as a cow breed (i.e., poor fertility, large size). So bulls from the heavy muscled breed could be bred to cows of a lighter muscled but higher quality breed to produce more desirable market calves. The muscling of Breed A compliments the inadequate muscling of Breed B; however, the meat quality (marbling) of Breed B complements Breed A to produce an offspring more desirable and more profitable than straightbreds of either of the parent breeds. Traits that respond in this manner are generally those traits of moderate to high heritablity and thus could be improved through selection. Carcass and growth traits are examples.

Still another benefit of crossbreeding is that its effects are accumulative. If you look at any one trait, it may seem minor. But, when you consider the entire production cycle, small increases in conception, calf livability and growth rate accumulate to provide a rather substantial margin or improvement over straightbred cattle. In terms of total productivity, such as pounds of calf weaned per cow in the breeding herd, extensive research has indicated that total productivity can be increased 20 to 25 percent in some well planned crossbreeding systems.

An important aspect of crossbreeding is maternal response. The F_1 female exceeds the straightbred in many traits, especially those related to reproductive fitness. In fact, about half of the potential improvement from crossbreeding is realized by the use of crossbred dams.

Crossbreeding is not a cure-all for poor management, or poor nutrition and herd health; nor will it work to the same degree in all situations. Response to crossbreeding is highly dependent upon the quality of the individuals used within breeds. It takes good individuals within breeds to make a good cross. A haphazard approach will not maintain the desirable responses or benefits expected from crossbreeding.

For more detailed discussion on why crossbreeding works see OSU Fact Sheet 3150.

Crossbreeding Systems

To gain the maximum benefits from crossbreeding, a long term plan is necessary. A producer must look at more than one year or even one generation. For example, suppose a producer has cows of Breed A and mates them to a bull of Breed B. He is now producing crossbred calves and can no longer retain the same genetic make-up in his cow herd by saving his own replacements. Therefore, he must either purchase replacement heifers, breed a proportion of the original cows to a bull of Breed A or save crossbred heifers for replacements. Any one of these alternatives could be satisfactory. The point is that a producer must know what to expect and how to deal with it.

Criss-Cross

Perhaps the simplest long range crossbreeding system is the criss-cross, or two breed rotation. This type of system is illustrated in Figure 1. In this program, two breeds are mated and female replacements are saved from the crossbred offspring to breed back to one of the parent breeds (backcross). In each succeeding generation, the replacement females are bred to bulls of the opposite breed than their sire. Two herds are necessary, one to be bred to each breed of bull. Replacement bulls will be the only animals originating from outside the herd. The main drawback of this sytem is that it maintains only about 66

percent of the potential heterotic response. However, it does not require large numbers, it does utilize hybrid dams and is an easily managed system. In fact, if artificial insemination is possible, the cows could still be managed in one herd. In addition, this system generates its own replacement females.

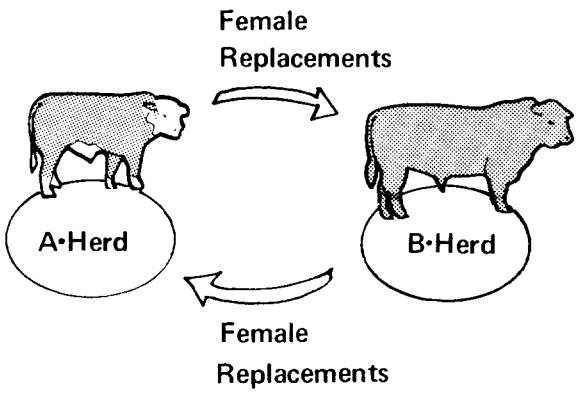

Figure 1. Crisscross or two-breed rotation.

The selection of breeds for this system, as well as any other, is very important. Consider how two breeds will complement each other. One should have strong points which make up for weaknesses in the other. Breeds that have poor maternal performance should be avoided in this crossbreeding system because heifers will be retained for the breeding herd.

Rotational Cross

The rotational crossbreeding system, or three-breed cross (Figure 2) is not too different from the two-breed criss-cross just described except that it requires three breeds and does not include a backcross. In this rotational system, you must maintain three herds or breeding groups. Herd A would all be bred to bulls of one breed. Females from this herd would be used as replacements for Herd B. A bull of a second breed would be mated to the cows in Herd B. Females from this mating would be the replacements for the C herd. The C herd would then be bred to bulls of a third breed; heifers from this mating would be the replacements for Herd A. The same three breeds of bulls would continue to be used in the same sequence.

As the system becomes fully implemented, the cow herd would tend to stabilize in breed percentage of approximately 4/7, 2/7, and 1/7 of blood of each of the breeds in the sequence of the most recently used breed of sire. Again, the selection of breeds is most important. Some factors which should be considered are maternal ability, mature size, longevity, marketability, and others.

The main advantage to the three-breed rotation is that it maintains a higher degree of hybrid vigor than the two-breed system. Theoretically, 87 percent of the potential heterotic response is maintained. Another advantage is that femal replacements are produced in the herd itself. A disadvantage is the necessity for three breeding herds and somewhat larger numbers. Again, A.I. could eliminate the problem of three herds.

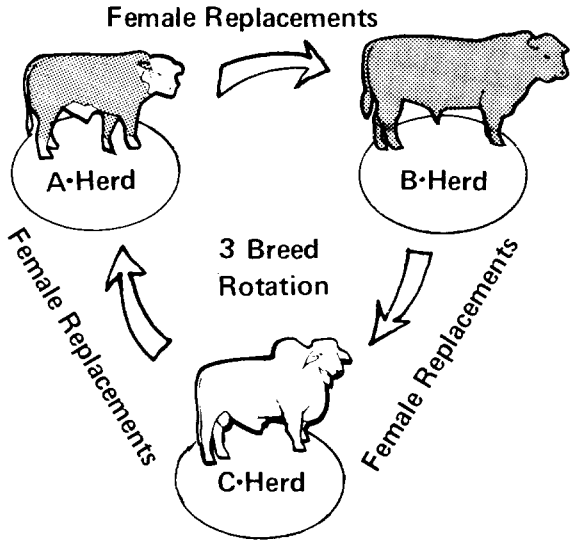

Figure 2. Rotational crossbreeding system.

Rotational crossbreeding need not be limited to three breeds. Four breeds, five breeds, even six, in a planned rotation would further slightly increase potential heterotic response by decreasing the back-crossing effect.

Terminal Cross

Another system in use is commonly referred to as the terminal cross. It is not a self-perpetuating system like the criss-cross or rotational system but requires the input of straightbred females into the system at some point. Figure 3 illustrates the overall approach to the terminal cross system. Although only Herd C represents the terminal cross, Herds A and B are necessary. The last step (Herd C) is the only step at which maximum heterotic response is realized. All of the calves in this step are market animals; thus the name terminal cross.

This system allows for flexibility in establishing selection goals. In the first step Herd A could cross two breeds which place major emphasis on maternal traits such as reproductive fitness, milking ability and longevity. Herd B serves primarily as a bull source for Herd C and would emphasize growth rate and efficiency. This type of selection program will contribute to the maximization of production for Herd C.

This system has the advantage of generating 100 percent of the possible heterosis and also provides an opportunity to take maximum advantage of breed complementarity.

one producer, but the size of the operation would have to be extremely large. In addition, two straightbreed producers are required to furnish replacements for Herd A.

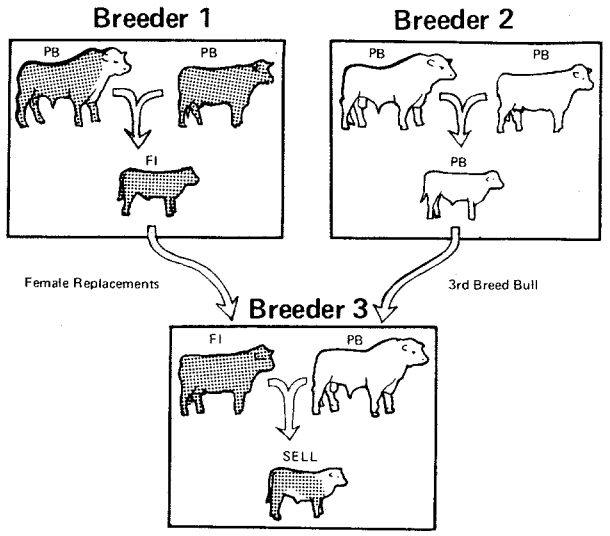

Figure 3. Terminal cross illustration.

A more likely situation might be for each herd to actually be owned by separate breeders. In this case, Herd C would purchase replacement heifers and bulls from Herds A and B, respectively.

If three, four or five producers were involved, a cooperative effort which combined management and other resources would probably provide the greatest return.

Combined Criss-Cross and Terminal Cross

Many modifications of the three systems mentioned previously are possible. For example, Figure 4 illustrates a program in which a criss-cross and terminal cross are combined. In this program, Herds A and B would be used in a criss-cross as illustrated in Figure 1. Replacement heifers would be produced from these two herds and selection would be based primarily on desirable cow traits like high reproductive performance, heavy milking ability and longevity. As the cows mature (4 or 5 years of age) they will be moved to the main production herd where they will be mated to a terminal cross sire. In this manner, a producer could take advantage of the terminal cross to maximize hybrid vigor without having to purchase female replacements from an outside source.

If we assume that we obtain 66 percent of the maximum heterotic response in the criss-cross, 100 percent in the terminal cross and have half of the total cows in Herd C, we would expect this total system to realize approximately 83 percent of the potential hybrid vigor. This does not appear to be as useful as the three-breed rotational system in terms of total response. However, consider that in this system, the third breed utilized in the terminal cross could be more specialized for growth and carcass characteristics without regard to maternal traits, which are important in the three-breed rotation. In other words, complementarity can be used to a much greater degree and, when combined with hybrid vigor, should provide a greater total response.

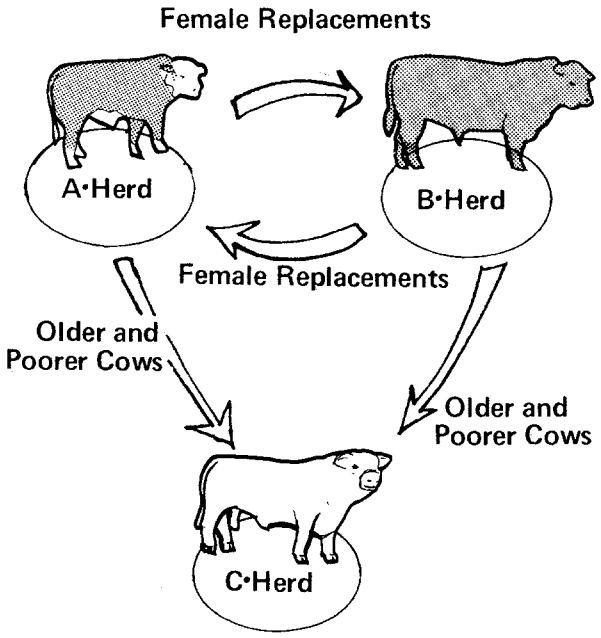

Figure 4. Combination crisscross-terminal system.

This system also provides some flexibility in altering herd size since Herd C can be reduced or enlarged to meet management conditions without changing the basic crossing system.

Conclusion

Crossbreeding is not a magic wand to be waved in hopes of eliminating the effects of poor management and nutrition. Nor will crossbreeding work to the same degree in all situations. The effectiveness of crossbreeding depends on the skills employed in utilizing the resources at hand. This is one reason why a well planned organized system must be followed. There are many alternatives and a producer should know the basic concepts and expected responses in order to integrate the management skills and available resources with the production system.

For information on what response to expect from crossing Hereford, Angus, and Shorthorn cattle see OSU Fact Sheet 3152. For information on crossbreeding British breeds with Brahman cattle see OSU Fact Sheet 3153.

Table 1. Percent of maximum heterosis expected from various systems.

Crossbreeding system	% of maximum
2 Breed Criss-cross	66
3 Breed Rotational	87
4 Breed Rotational	92
Terminal Cross	100