

Crossbreeding Systems for Small Beef Herds

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For most livestock species, crossbreeding is an important aspect of production. Intelligent crossbreeding generates **hybrid vigor** and **breed complementarity**, which are very important to production efficiency. Cattle breeders can obtain hybrid vigor and complementarity simply by crossing appropriate breeds. However, sustaining acceptable levels of hybrid vigor and breed complementarity in a manageable way over the long term requires a well-planned crossbreeding system. Given this, finding a way to evaluate different crossbreeding systems is important. The following is a list of seven useful criteria for evaluating different crossbreeding systems:

1. Merit of component breeds
2. Hybrid vigor
3. Breed complementarity
4. Consistency of performance
5. Replacement considerations
6. Simplicity
7. Accuracy of genetic prediction

Merit of Component Breeds

For any crossbreeding system to be effective, the breeds in the system must be well chosen. Each breed included in a crossbreeding system must bring favorable attributes to the cross. Determining the appropriate breeds to use in a crossbreeding system can be challenging. Another challenge is the availability of animals of those breeds.

Hybrid Vigor

Generating hybrid vigor is one of the most important, if not the most important, reasons for crossbreeding. Any worthwhile crossbreeding system should provide adequate levels of hybrid vigor. The highest level of hybrid vigor is obtained from F1s, the first cross of unrelated populations. To sustain F1 vigor in a herd, a producer must avoid **backcrossing** – not always an easy or a practical thing to do. Most crossbreeding systems do not achieve 100 percent hybrid vigor, but they do maintain acceptable levels of hybrid vigor by limiting backcrossing in a way that is manageable and economical. Table 1 (inside) lists expected level of hybrid vigor or heterosis for several crossbreeding systems.

Definitions

hybrid vigor – an increase in the performance of crossbred animals over that of purebreds, also known as heterosis.

breed complementarity – an improvement in the overall performance of crossbred offspring resulting from the crossing of breeds of different but complementary biological types.

backcrossing – the mating of an individual (purebred or hybrid) to any other individual with which it has one or more ancestral breeds or lines in common.

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Table 1. Expected Heterosis Levels and Breed Complementarity Attributes of Several Crossbreeding Systems			
Crossbreeding System	Expected Heterosis		Breed Complementarity
	Offspring	Dam	
Two-breed terminal cross	100	0	maximum
Three-breed terminal cross (using F1 females)	100	100	maximum
Two-breed rotation	72	56	some
Three-breed rotation	91	70	minimal

Breed Complementarity

Breed complementarity refers to the production of a more desirable offspring by crossing breeds that are genetically different from each other but have complementary attributes. In beef cattle breeding, it is often stated as “big bull × small cow” complementarity. The big bull contributes growth and leanness to the offspring, and the small cow requires less feed to maintain herself. The result is a desirable market animal economically produced.

Consistency of Performance

A crossbreeding system should ideally produce a consistent product. It is much easier to market a uniform set of animals than a diverse one. It is also much easier to manage a female population that is essentially one type than one made up of many types, each with its own requirements. Crossbreeding systems vary in their ability to provide this kind of consistency.

Replacement Considerations

In terms of hybrid vigor, the ultimate female is an F1. Commercial producers would like to have entire herds of F1 females. How can you produce a continuous supply of F1s? One way is to maintain purebred parent populations to cross to produce F1s. A second way is to purchase all the replacements needed from a third party. Neither of these methods is optimum for most producers. A number of crossbreeding systems manage to overcome the replacement female dilemma by allowing breeders to produce replacement heifers from their own **hybrid** populations. However, this convenience comes at a price, a price typically paid in loss of hybrid vigor, breed complementarity and simplicity.

Simplicity

Crossbreeding systems should be relatively simple. Expensive systems or complex systems that require an unrealistically high level of management

are unlikely to remain in place for very long. More complex breeding systems often conflict with important management practices unrelated to breeding. For example, beef cattle crossbreeding systems that require many breeding pastures make grazing management difficult. It is important that crossbreeding systems fit with other aspects of cattle production. This means that crossbreeding systems should be kept simple.

Accuracy of Genetic Prediction

The higher the accuracy of genetic prediction, the lower selection risk and more predictable the offspring. Because relatively little performance information on commercial animals is recorded and even less is reported for analysis, accuracy of prediction in a commercial operation refers to accuracy of prediction for seed stock inputs to the crossbreeding system – typically sires. In many cases, accurate **EPDs** are available for purebred sires, and crossbreeding systems using purebred sires benefit as a result.

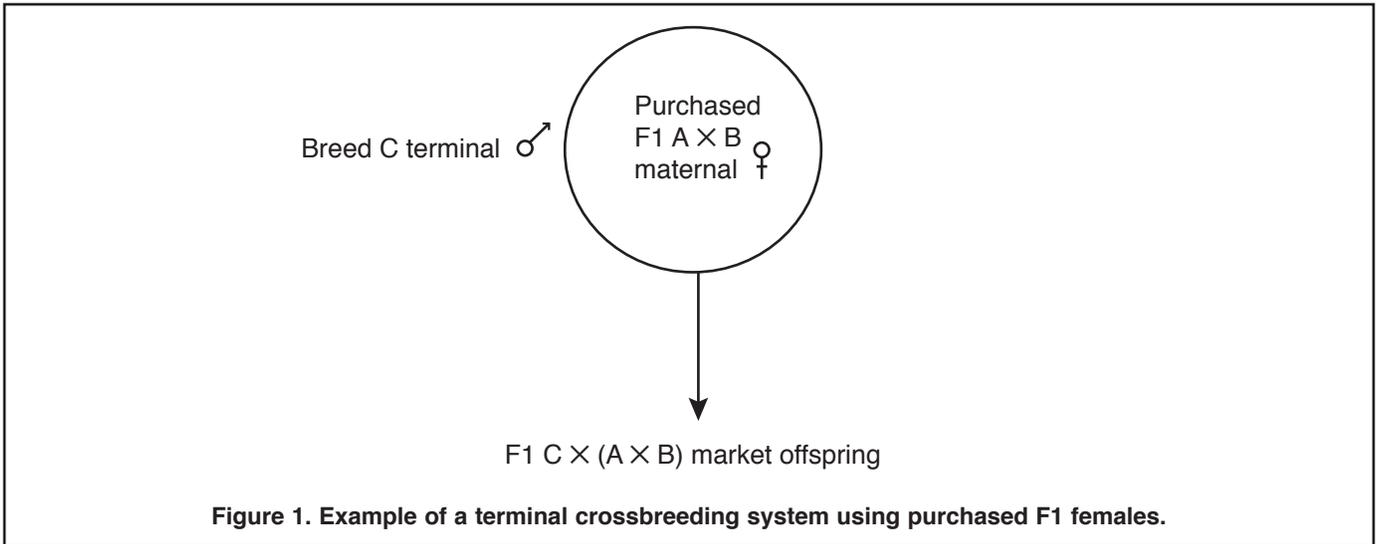
Definitions

hybrid – an animal that is a cross of breeds within a species.
EPD – expected progeny difference.

Example Crossbreeding Systems

Terminal Cross

The simplest form of crossbreeding is a terminal cross. In this system, all offspring are marketed, making it necessary to purchase replacement heifers. If F1 replacement heifers (females that have 100 percent hybrid vigor for maternal traits) are purchased and are bred to bulls of a different breed, both cows and calves take advantage of maximum heterosis. This system also allows the most flexibility



in choosing breeds to use. Replacement heifers can be purchased that are comprised of “maternal” breeds and bred to terminal or high-growth breed bulls. This type system is optimal for many cow-calf producers. This system is illustrated in Figure 1.

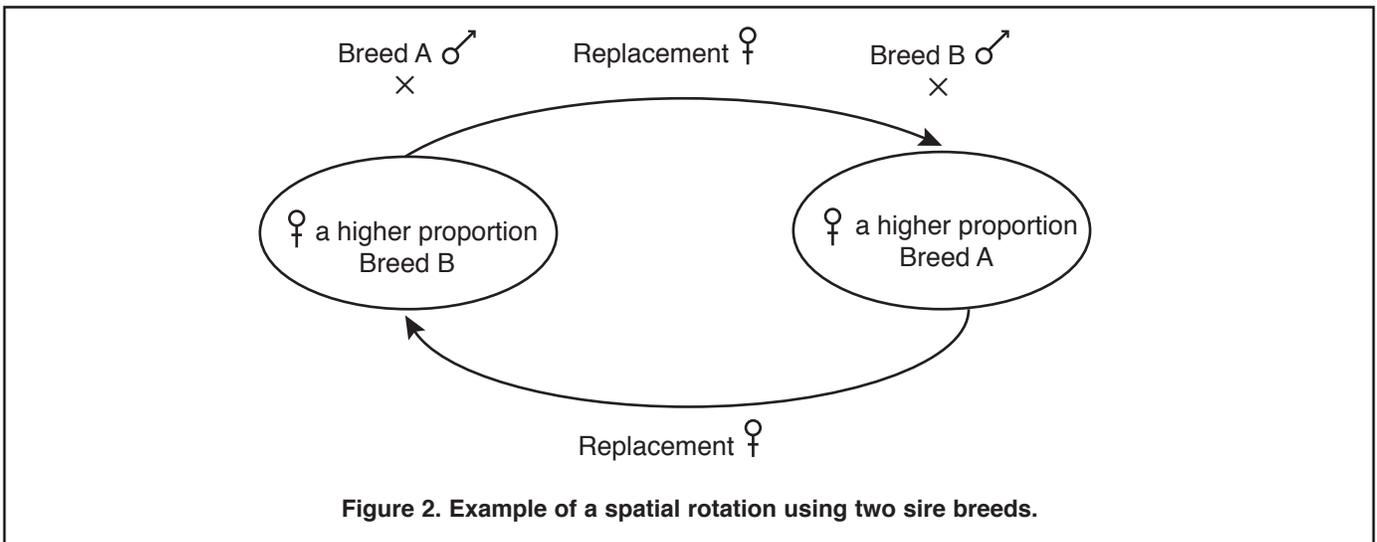
An even simpler form of this system just uses two breeds. Bulls of breed A are bred to females of breed B to produce F1 A × B offspring. These offspring will exhibit maximum heterosis, but since the females that produced these calves were not crossbreeds, the offspring were not able to take advantage of any maternal heterosis.

Rotational Cross

Spatial Rotations – The classic form of a rotational crossbreeding system is a spatial rotation. In spatial rotations, all breeds are used at the same time but are separated specially. This system requires multiple mating pastures, one for each sire

breed. In a two-breed rotation (see Figure 2 for an example), two breeding pastures will be needed. A three-breed rotation would need three breeding pastures. This system is designed to produce replacements. Replacements leave the group into which they were born to join the other breeding group as a replacement. As seen in Figure 2, replacements out of sire breed A move to the group that is to be bred to sire breed B and replacements out of sire group B move to the group to be bred to sire breed A. The more breeds that are included in the rotation, the greater amount of heterosis. Each breed added also increases the level of management needed to keep the system operational.

Rotation in Time – Another commonly used form of rotational crossbreeding is rotating sire breeds across time. In this system, only one breed of sires is used at one time. Typically, sire breeds are rotated every one or two breeding cycles. This system is simpler to manage than a spatial rotation,



but the level of observed heterosis is somewhat less due to increased backcrossing. This system is illustrated in Figure 3. The major problem with utilizing this system is that over time the groups of breeding females become very inconsistent in their breed makeup and performance. This introduces inconsistency in their offspring. This variation in calf performance can be a hindrance during marketing of the offspring.

Summary

In comparing crossbreeding systems, you will notice that each system excels in some criteria, often at the expense of other criteria. Inevitably, there are trade-offs to be considered. Some systems sustain very high levels of hybrid vigor but are a management nightmare. Some take advantage of breed complementarity but cannot produce their own replacement females.

A planned mating system is the nucleus of a successful crossbreeding program. The mating system should maintain heterosis at an optimal level and permit uninterrupted production of a uniform product from generation to generation. Matching the crossbreeding system to the facilities and environment is of utmost importance. Likewise, the choice of breeds is important. The use of a crossbreeding system that produces offspring efficiently will play a large part in the profitability of cow-calf producers.

For more information or to receive assistance in setting up a crossbreeding system for your herd, contact your local county extension office.

