Composite Beef Breeds

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Introduction

The terms composite, synthetic and hybrid are used to signify new breeds or new lines of cattle. Many times these terms are used interchangeably. In any case, a planned mating scheme is designed to combine the desirable traits of two or more breeds into one "package" (or composite). A more formal definition of a composite is a breed made up of at least two component breeds, designed to retain heterosis in future generations without crossbreeding and maintained as a purebred.

Composite Breeds

Some composite breeds of beef cattle have their own breed associations with a governing body as well as herdbook registration. Examples include the Bos indicus-influenced cattle, such as Beefmaster, Brangus, Red Brangus, Braford, Santa Gertrudis, etc. Many of these cattle have established themselves in a particular production environment.

Other composites may be considered to be more newly formed lines. Many are based on British and Continental breed combinations. Examples of some of the newly formed lines are Leachman Stabilizer, Leachman Rangemaker and the Noble Line. The genetic merit of composites relies on the performance-oriented breeders who have a commitment to carefully planning composite line development.

Figure 1. A Leachman Rangemaker bull 3/4 British: 1/4 Continental. A blend of Red Angus and Black Angus, South Devon, and Tarentaise (and/or Salers)

Figure 2. A Leachman Stabilizer cow 1/2 British: 1/2 Continental composite 1/4 Red Angus: 1/4 Hereford: 1/4 Gelbvieh: 1/4 Simmental

Figure 3. A Noble Line bull 1/3 Gelbvieh: 1/3 Angus: 1/3 Brahman

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Types of Composites

The term synthetic is used to describe new lines of cattle from an open breeding program where new breeds may be added at any time and no fixed percentages of the breeds are required. The use of hybrid bulls may not be a crossbreeding system in the strictest sense. Yet, these bulls may be of benefit to commercial cow-calf producers who are interested in (1) realizing the benefits of crossbreeding and (2) avoiding some of the limitations associated with conventional crossbreeding systems.

The development of a true composite line of cattle is not easy. Composite breeders must make a tremendous effort to maintain large herd size with adequate representation of genetics for each breed used in the composite. Inbreeding must be avoided to retain high levels of heterozygosity and heterosis in composite breeds.

Seedstock producers should study the variety of breeds currently available before beginning the challenge of constructing a new composite. Composites are difficult to develop. Therefore, before developing

Table 1. Heterozygosity of different mating types and estimated increase in performance as a result of heterosis.

Mating Type	Heterozygosity % relative to F1	Estimated increase in weight weaned per cow exposed (%)[a]
Pure breeds	0	0
Two-breed rotation	66.7	15.5
Three-breed rotation	85.7	20.0
Four-breed rotation	93.3	21.7
Two-breed composite:		
F3 - 1/2A, 1/2B	50.0	11.6
F3 - 5/8A, 3/8B	46.9	10.9
F3 - 3/4A, 1/4B	37.5	8.7
Three-breed composite		
F3 - 1/2A, 1/4B, 1/4C	62.5	14.6
F3 - 3/8A, 3/8B, 1/4C	65.6	15.3
Four-breed composite:		
F3 - 1/4A, 1/4B, 1/4C, 1/4D	75.0	17.5
F3 - 3/8A, 3/8B, 1/8C, 1/8D	68.8	16.0
F3 - 1/2A, 1/4B, 1/8C, 1/8D	65.6	15.3
Five-breed composite:		
F3 - 1/4A, 1/4B, 1/4C, 1/8D, 1/8E	78.1	18.2
F3 - 1/2A, 1/8B, 1/8C, 1/8D, 1/8E	68.8	16.0
Six-breed composite:		
F3 - 1/4A, 1/4B, 1/8C, 1/8D, 1/8E, 1/8F	81.3	18.9
Seven-breed composite:		
F3 - 3/16A, 3/16B, 1/8C, 1/8D, 1/8E, 1/8F, 1/8G	85.2	19.8
Eight-breed composite:		
F3 - 1/8A, 1/8B, 1/8C, 1/8D, 1/8E, 1/8F, 1/8G, 1/8H	87.5	20.4

[a]Based on heterosis effects of 8.5% for individual traits and 14.8% for maternal traits and assumes that retention of heterosis is proportional to retention of heterozygosity. Gregory, K. E., et al. (1990)

one, breeders should investigate existing breeds to see if there are already cattle available to use in a specific environment and that are market-desirable.

Heterosis Retention in Composites

The genetic basis for heterosis is the opposite of the origin of inbreeding depression. Inbreeding tends to cause more gene pairs in an individual to be homozygous. In contrast, crossbreeding tends to cause more gene pairs to be heterozygous. Breeds that are genetically diverse tend to cause more heterozygosity and more heterosis when crossed. Heterozygosity will result in better performance if there is nonadditive gene action (dominance and epistasis). Dominance is present if the heterozygous individual is not exactly intermediate between the two homozygotes. Epistasis is the interaction between different loci.

When composite breeds are formed, some loss of heterosis occurs as the crossbred parents are produced and mated. Once the composite is completely established and random (closed herd) mating occurs among cattle with similar breed makeup, the resulting heterosis should be constant. One of the problems with the development of a composite breed is that the effective population size is so small that inbreeding becomes a concern. The challenge of maintaining heterosis and minimizing inbreeding can only be met using large populations of cattle.

Table 1 presents the level of heterozygosity relative to the F1 that is retained after equilibrium is reached for rotational systems and composites. Retention of initial heterozygosity within the crosses is proportional to (n-1)/n where n = the number of breeds involved in the composite. This formula assumes equal contributions by each breed used to create the composite. For example, a four-breed composite (1/4 of each breed) potentially has 75 pecent heterozygosity relative to the F1 (n=4 and (4-1)/4 = .75).

Retention of heterosis, or hybrid vigor, in composites is influenced by inbreeding. If no inbreeding is practiced, the heterosis is retained in composites for several generations, as shown in research results from the Meat Animal Research Center data (Table 1).

Table 2 below demonstrates the theory behind heterosis retention in composite lines of cattle. Heterosis retention basically revolves around the probability that two genes from any one breed involved in a composite will pair. In an F1 mating, example Hereford x Angus, no alike breed genes are paired. All genes are paired with another gene that is different, thus 100 percent heterozygosity exists.

Use and Evaluation of Composites

The use of composite breeds in a commercial cow-calf operation has both advantages and disadvantages. The commercial cow-calf operator can use composites just like a straightbred population (single breeding pasture). Use of composite cattle may be an advantage to smaller producers who have single sire herds because it may simplify for them the use of breed combinations for their production environment. Also, large herds may use composites or incorporate them into an existing crossbreeding program. The genetical advantage of using composites relates to the ability to combine specialized sire breed lines and heterosis retention.

Table 2. Calculation of percentage retained hybrid vigor in a composite population (1/3 Gelbvieh, 1/3 Angus and 1/3 Brahman).

Probability that genes from the same breed will pair at any location on any chromosome is calculated as follows.

Probability that 2 genes from the Gelbvieh breed will pair is (1/3)2 = 1/9
Probability that 2 genes from the Angus breed will pair is (1/3)2 = 1/9
Probability that 2 genes from the Brahman breed will pair is (1/3)2 = 1/9

Probability that genes from any breed will pair = sum of the above = 3/9 or 1/3

Because all probabilities must sum to one, the probability that genes at any location on any chromosome came from different breeds (the opposite outcome) is calculated as follows.

1-1/3 = 2/3 or 66.7%

Therefore, the composite should maintain 2/3 or 66.7% of F1 hybrid vigor.

The main disadvantage of using composite breeds is the lack of extensive performance data to compare individuals. It is very difficult to find composite breeds of cattle with EPDs available. The EPDs for composites are difficult to compute and a limited number of breeders have these available to bull buyers. Another difficulty in using composites is locating large numbers of quality, performance-tested cattle that are easily accessible to the commercial cow-calf producer.

The advantage to using the composite is simplicity, followed by combining sire breed lines and heterosis retention. These advantages can be easily offset by lack of adequate performance data and the consequence of any inbreeding that may have taken place during composite line formation.

Conclusion

Composites can be viewed as a "simplified" system of crossbreeding for the small producer. However, the advantage of composites may be quickly offset by lack of performance data, limited availability of composite bulls and poor development of the composite line at its beginning. Choosing a composite bull just because of his breed composition is not enough. Selection of herd sires should incorporate the use of performance information.

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