THE SAMUEL ROBERTS NOBLE FOUNDATION

AG News and Views

Originally published September 2013

LIVESTOCK

Does selecting related cattle increase calf uniformity?

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Excellent rainfall in most parts of southern Oklahoma and northern Texas during the 2013 growing season has prompted some producers to consider increasing their cow numbers. Selecting replacement females is no small decision. Their breed type, fertility, conformation, mature size, milking ability and color will all play a role in the future profitability of an operation.

One frequent topic in discussions of bull and female selection is choosing closely related animals, such as half-siblings, to increase uniformity of the offspring. Increasing uniformity of the calf crop is important to cow-calf producers because more uniform lots may receive higher sale prices at market. Lack of uniformity has also been cited as a primary quality concern for industry segments from packers to restaurateurs, according to the 2005 National Beef Quality Audit. It is logical that as offspring become more related, genetic variability decreases and, hence, the phenotypic variability of animals will decrease. However, it is very important to further explore the details in order to judge the magnitude of change that can be expected.

Since this is a quantitative genetics question, math can be used to estimate the phenotypic changes a producer could expect, given certain breeding situations. The two values that must be known to make these estimates are the coefficient of genetic relatedness (GR) and the heritability of a given trait. Genetic relatedness is the probability that two individuals share an allele due to recent common ancestry. As GR increases, the variation in a trait will decrease in proportion to the trait's heritability. In this article, the decrease in variation will be expressed as a percentage relative to a group of unrelated animals, where the unrelated animals equal 100 percent. Therefore, as the percentage gets smaller, the variation of the trait decreases, i.e., the animals are more uniform. This percentage is calculated as:

$$\sqrt{[1 - (GR \times heritability)]} \times 100$$

Table 1 shows that an unrelated bull battery bred to an unrelated cow herd has a genetic relatedness of 0 percent; therefore, the calf crop

Table 1. Genetic relatedness (GR) and expected phenotypic variation of calf crops from matings of increasingly related sires and dams at selected heritabilities (h^2)

			Expected phenotypic variation		
Bull Battery	**Cow Herd**	**GR**	**h^2 = 20%**	**h^2 = 30%**	**h^2 = 40%**
Unrelated	Unrelated	0%	100.0%	100.0%	100.0%
1/2 siblings	Unrelated	6%	99.4%	99.1%	98.7%
Full siblings	Unrelated	13%	98.7%	98.1%	97.5%
One sire	Unrelated	25%	97.5%	96.2%	94.9%
Unrelated	1/2 siblings	6%	99.4%	99.1%	98.7%
1/2 siblings	1/2 siblings	13%	98.7%	98.1%	97.5%
Full siblings	1/2 siblings	19%	98.1%	97.1%	96.2%
One sire	1/2 siblings	31%	96.8%	95.2%	93.5%
Unrelated	Full siblings	13%	98.7%	98.1%	97.5%
1/2 siblings	Full siblings	19%	98.1%	97.1%	96.2%
Full siblings	Full siblings	25%	97.5%	96.2%	94.9%
One sire	Full siblings	38%	96.2%	94.2%	92.2%

expresses all of the expected variation. As the genetic relatedness of the calf crop increases, the expected phenotypic variation decreases. A fairly common practice used is that of selecting all half-sibling bulls. Table 1 shows that if breeding half-sibling bulls to unrelated cows and evaluating a trait with high heritability (40 percent), variation in the calf crop for that trait is only expected to decrease by 1.3 percent (100 percent - 98.7 percent = 1.3 percent). This value is likely much less than what most people would expect it to be. If taken one step further by selecting half-sibling females and breeding them to half-sibling bulls, variation is still only expected to decrease by 2.5 percent. Interestingly, if one went as far as producing a calf crop that is all full siblings, variation would still only be reduced by 10.6 percent compared to an unrelated calf crop.

These numbers indicate that substantial advances in calf crop uniformity will likely not be attained very quickly by using closely related breeding stock. Cattle producers who wish to increase uniformity of the calf crop through genetic selection should likely focus on selecting animals with optimal values for desired traits (i.e., similar expected progeny differences) regardless of their genetic relationships. Producers are encouraged to select commercial females that are accompanied by little or no genetic information based on phenotypic traits (e.g., frame size, conformation, docility) that match their goals and production environment. ■