Cross breeding ideal for small beef herd

CLAY CENTER, Nebr. — Small beef cattle herds, for which complex mating systems are impractical, generally do not share crossbreeding advantages. But they will if a new breeding system is successful.

The new system is under study here at the Roman L. Hruska U.S. Meat Animal Research Center, in cooperation with the University of Nebraska, Lincoln.

Under a conventional three-breed rotational system of crossbreeding, four cows can produce as much weight of calf at weaning as five straight-bred cows of the same breeds.

This advantage can be maintained by continued, systematic crossbreeding. And crossbred cows have another advantage — longer productive lives.

Rotation crossing is difficult and frequently inefficient when there are fewer than 80 or 90 cows in the breeding herd, Science and Education Administration geneticist Keith E. Gregory points out. And 80 percent of the beef herds in the United States contain 50 or fewer cows Many of these small-herd owners are part-time farmers

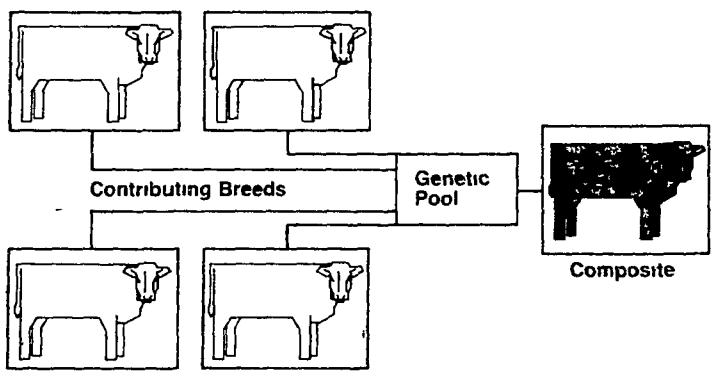
Gregory and associates are forming genetic "pools" by crossing breeds that provide a balance of traits closest to the performance characteristics most desired for specific production situations. Then composite "breeds" are formed by selective intermating within the resulting populations, while maintaining a low rate of inbreeding.

The geneticist visualizes general-purpose composites adapted to various climatic and feed-resource situations, as well as composites excelling in maternal or paternal charactistics.

A small-herd owner would select a general-purpose composite adapted to his production resources. He would manage it like straight-breds, using bulls from the same composite.

Cattle producers with more resources might mate representatives of maternal and paternal composites to produce market animals.

The production advantage of crossbreds results from high levels of heterosis, or hybrid vigor, when genetically different animals are mated. Plant breeders similarly take advantage of heterosis in crop production.



Heterosis effects can increase calf weaning weight per cow by at least 20 percent, Gregory and SEA geneticist Larry V. Cundiff found.

That increase is from three-breed rotational crossing, as compared with straightbreds. The increase, expressed as weight calf weaned per cow exposed to breeding, includes cows exposed to breeding, includes cows not successfully bred and those that conceived but did not produce a calf.

The level of heterosis that can be maintained in composites will be determined in the current Germ Plasm Utilization Program.

Under rotational crossing, heterosis results primarily from the dominant effects of genes. Loss of first-generation heterosis under this breeding system is approximately proportional to loss of heterozygosity.

"Heterozygosity" is a genetic term that can best be defined by example. Genes are the units of inheritance and are present in pairs. One member of each pair comes from the sire and the other from the dam. When genes of a pair differ (Aa) they are heterozygous — when they are alike (aa) they are homozygous.

"Heterozygosity is maximized when the sire and dam are from different breeds. Level of heterosis or hybrid vigor is highly associated with the degree of "heterozygosity."

In 1922, Sewell Wright, eminent USDA scientist known as the "father of modern animal breeding," showed that retention of heterozygosity beyond the first generation in crossbreds depends

upon the number of inbred lines in the initial cross.

Gregory has used Wright's formula to estimate the heterozygosity retention, and he and colleagues are determining the extent to which loss of heterozygosity in composites.

When four breeds contribute equally to a composite, Gregory says about 75 percent of initial heterozygosity should be retained in the third generation. Retention should be about 78 percent in a five-breed composite in which three breeds each contribute one-fourth to the genetic base and two breeds contribute one-eighth each.

Heterosis retention in composites should be similar if losses of heterozygosity and heterosis are proportionate.

Gregory estimates a possible increase in calf weaning weight per cow of 17 to 18 percent over straightbreds in the four- and five-breed composites. This increase is intermediate between that in two- and three-breed rotation crossbreeding systems.

Gregory sees potential advantages of composites over crossbreeding systems beyond those directly related to heterosis. These include:

— increased genetic variation in a population based on four or five breeds should result in greater opportunity for improvement by selection;

— breeds crossed to form composites need not be comparable in birth weight, size, and milk production. This restriction is necessary in rotation crossing, where genetic composition based on breed differences fluctuates widely from generation to generation;

— similar breeds need not be

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