METHODS TO GENETICALLY IMPROVE BEEF CATTLE

Charles A. McPeake

Oklahoma State University

Today's beef cattle population is facing an era of drastic changes. In the last few years we have witnessed changes such as fifty percent of the nation's beef being sold as ground beef, transportation demanding boxed beef rather than hanging carcasses, consumers demanding leaner beef, and relaxed quality grade standards. With these changes came stiff competition from pork and poultry along with disrupted beef cycles that were common place to the industry. Which way next is the question.

Regardless of the direction of the beef industry, production efficiency will be essential. Tools for improving the genetic potential of beef cattle are available and working, and other advances are just over the horizon before being practical in production. Improvement per year for any trait equals heritability (or the segment of genetic material that may be passed from parent to offspring) times the selection differential (difference of animals selected as parents and average of all animals in herd) divided by the generation interval (average age of parents when offspring are produced). The preceding improvement formula is basic to modern animal breeding. Several tools are necessary in order to implement this equation: performance records, selection, mating plans and artificial insemination. Embryo transplant is now being practiced but seems to be a long way from practical application. Cloning is still over the horizon, but may be a major factor in future changes that could take place in improving genetic material.

Differences in performance between individual animals are due to either genetic or environmental causes. The performance of each animal in each trait is the result of its heredity and the total environment in which it is produced. Random or chance environmental variables also contribute to the accuracy in estimating the genetic superiority of animals and must be identified in order to measure genetic potential. Thus, systematic measurements and the use of records in selection will increase the rate of genetic improvement if the records are collected and used properly. Genetically superior animals can, therefore, be more accurately identified when the animals are reared under identical management systems and their performance records are adjusted for known differences.

Performance records are necessary in order to provide a basis for comparing cattle handled alike within a herd. Large environmental differences due to location, management, health, and nutrition are likely to exist between herds or different management groups within herds. Genetic differences between herds may well exist, but only through a carefully controlled evaluation can genetic differences be separated from environmental and used to improve quality and quantity in beef production.

Three factors must be considered for any trait on which selection

can be practiced. These points are: heritability of the trait, accuracy of measurement of the trait, and economic benefits from improving the trait.

Growth traits such as weaning weight, average daily gain and yearling weight are moderate to high in heritability. Thus, response to selection can be predicted with increased accuracy. A higher heritability trait insures more genetic material being passed from parent to offspring. Over time this genetic material is cumulative and continues as long as a producer selects genetically superior individuals. Reproductive traits unfortunately have low heritabilities and show little response to selection.

Accuracy in measuring any trait depends on conditions in which data was gathered. Secondly, if systematic readily available measurements can not be taken, other traits need consideration.

Traits with economic importance should receive primary emphasis if a producer is going to get paid for improvement made through a selection program. The measure of improvement has to be dollar return.

To benefit producers a selection scheme must be constructed and implemented over a long period of time. Remember, the more traits on which selection is practiced, the improvement in any single trait will be smaller. Conversely, attention to a single trait may produce rapid improvement in that trait at the expense of the other important traits. Fortunately, many traits (example, the growth traits) are genetically correlated, and selection for one tends to improve the others.

Techniques are available to assist in locating genetically superior individuals; these include: sire evaluation reports from structured programs and field data, the use of estimated breeding values, and central test stations.

MATING PLANS

Crossing breeds (crossbreeding) will become increasingly popular with commercial producers. They will tend to rely on heterosis and breed complementarity to make beef production more profitable. With crossbreeding the selection for more rapid growth or higher maternal traits can be accomplished in a much shorter time than waiting on improvement from straightbred selection. Good purebred seedstock will remain important because crossbreds are only as good as the parent breeds.

ARTIFICIAL INSEMINATION

For seedstock producers, aritificial insemination will continue to play a major part in spreading the elite bulls across a breed. Today a purebred producer must be utilizing A.I. either to test bulls produced within his herd or using it to introduce outside bulls into a program.

A.I. may be the most practical way for a commercial producer to attain genetic improvement in the shortest time. Bull studs have reasonably priced germ plasm from elite bulls. The exploitation of A.I. in a commercial program will depend primarily on available labor, facilities and desire to mold a beef production program that fits the needs of the individual producer.

EMBRYO TRANSFER

To date, embryo transfer has been used primarily by seedstock producers. It has been throughly misused and tragically abused. Embryo transfer has been used as a promotional tool with little realization of true genetic improvement. Most people are intrigued by thoughts of a litter of full-sibs while in actuality each animal's genetic makeup is simply a random one half of each parent. Animals have been transfered that could not be justified (not enough proof on parents). These are some problems that will be corrected by the economics of the procedure.

When the dust settles, realistic cattlemen will use embryo transfer to an advantage in improving genetic material. Seedstock producers will be the primary users. Economics of the program have eliminated the commercial producer from attempting to employ the procedure in his quest for improvement. There may be commercial opportunities as future development and fine tuning take place.

CLONING

Cloning is still over the hill but success in this technique will provide great possibilities for the seedstock producer. One caution is the type of cloning being discussed. If cloning is to be accomplished from a fertilized egg, the possibility for genetic improvement is little greater than improvement from embryo transfer. From one egg it is a hit or miss proposition as to whether or not the egg selected to be cloned is truly superior in genetic material. Tremendous possibility for genetic improvement exist when cloning can be accomplished from a single cell of a proven superior animal. When this can be done not only the seedstock producers will profit, but chances become closer to commercial application.

SUMMARY

Regardless of the changes that take place within the beef industry, modern animal breeding practices are available to assist in the improvement of beef cattle traits with economic importance. To implement these practices, records must be accurately gathered, analyzed and used in a selection program. Further progress may be attained through many different tools that are available to aid in making rapid genetic progress.