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BREEDING BEEF GERM PLASM COMPOSITES TO FIT SPECIAL ENVIRONMENTS

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SUMMARY

A long term breeding program has been designed to take advantage of the heterosis available in a six breed composite while developing a cow which can reproduce on crop residue. A controlled natural selection method has been developed for those reproductive traits which did not lend themselves to objective measurement. Reproductive efficiency and feed conversion will always be desirable traits in beef cattle. Intensive selection pressures were applied to the above traits during the initial generations of crossing to form the composite. Culling rates of 70% were used in the initial and backcross generations. The effectiveness of selection has been estimated by comparing the average reproductive rate of all the F1 cows to that observed in the composite. Correlated responses to selection for reproduction have been observed between the reproductive traits and the production traits.

INTRODUCTION

Beef cattle cannot compete with other meat producing species in the conversion of grain to protein for human consumption. Thus, as human population increases, the cattle population must either be reduced, or cattle must be genetically adapted to utilize available low quality roughage such as crop residue. Current breeds have been selected during a period of surplus land and grain. When these breeds have been limited to low-quality forages, their reproductive performance has been poor. Even breeds with the reputation as range animals have been unable to sustain themselves and reproduce at a satisfactory rate when limited to low-quality roughage diets. Since Ferral cattle developed on forage diets, we may assume that cattle have the genetic capacity to reproduce satisfactorily on roughage. A breeding program was designed in 1957 to develop a composite breed of beef cattle. These cows were to be scavengers who could efficiently convert crop residues into milk and calves. This breeding project was undertaken to evaluate the effectiveness of heterosis when combined with intense F1 selection as a method to develop cattle for specialized environments.

DISCUSSION

Breeding programs based on established genetic principles have been published, which if utilized should give the progress expected. Few commercial breeding programs have been followed for sufficient time to observe the predicted results. Goals of the beef cattle industry have interrupted most breeding programs. The ideal type of beef cow and the goals of U.S. breeders of registered beef cattle have shifted dramatically during the 20th century. Beef cattle breeding programs must be designed under the limitations of generation interval, number of progeny per pregnancy and heritability of the important traits. For these reasons beef cattle breeding programs have not been as effective as have those of corn, poultry and

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others that used selection based on economic factors. Breeders have spent a good part of their efforts in changing their herd from the existing type of cattle to the most recently established ideal type. Examples would be the change from the ideal being a short, wide and deep bodied animal to the ideal being a long, tall and well muscled animal, or the cyclic changes in coat colors preferred by breeders within breeds. The development of any new breed through a designed genetic breeding program is a long range project and, as such, cannot succeed in a few generations. The criterion for assuring the longevity of a breeding program is to design a program based on improvement of biologically variable traits that have economic value to the consumer, processor, or producer. A partial listing of these traits might be tenderness, yield, temperament, efficiency of gain, growth rate, ability to convert low-cost roughage and reproductive rate. The desired type of product may change with time (i.e., percent fat) so breeders are left with reproductive efficiency, growth rate, temperament and efficiency of growth as their only dependable goals.

The cumulative effects of heterosis on the weight of calves weaned per cow has been shown to be in excess of 20% for crosses between *Bos Taurus* breeds of cattle (Cundiff *et al.*, 1974). More than 60% of this observed heterosis is the result of the cumulative effects on maternal traits. An important consideration in the decision to form a composite breed would be the opportunity to utilize heterosis at uniform levels in all generations while maintaining additive gene effects at an optimum level. More than 80% of U.S. beef cattle are in herds of less than 50 cows. Herds of this size are unable to utilize effective crossbreeding systems and thus have been excluded from realizing the optimum levels of heterosis. These smaller herds will be able to realize the benefits of heterosis as composite breeds are developed which fit their special environment.

DESIGNING AND SYNTHESIZING A BEEF COMPOSITE

Selection of Germ Plasm

The breeds used in building this composite were selected based upon the results of crossbreeding research that had been published. The germ plasm pool available to the cattle breeder is relatively large but those adapted to the temperate zone have been maintained in rather uniform environmental conditions and originated from the same base populations. An attempt was made to bring breeds into the composite which had been shown to combine well with each other in prior research reports. Characteristics such as rumen capacity, temperament, muscling, birth weight and growth rate were used to evaluate potential breeds for use in forming the composite. Breeds selected were: 1) Red Poll, for their eye pigment and their milk production; 2) Hereford, for their ability to forage over extensive range areas and for their high fertility; 3) Angus, for their early maturity, their growth, their carcass quality and carcass grade and their maternal traits; 4) Brown Swiss, for their temperament, their milk production and their specific combining ability with British breeds; 5) Friesian, for their excellent udders, their growth, and

their capacity to consume forage; 6) Simmental, for their growth and their muscling characteristics.

Within each breed it was considered extremely important that the animals be a highly select group. Individuals within a breed were selected for excellence in those traits for which that breed was selected for inclusion in the composite. Individuals were rejected if they were outside the limits set for important traits. (i.c.) Simmental bulls were not used if they had birth weights over 85 lbs or average progeny birth weights over 80 lbs.

Development Procedures

Germ plasm sources were introduced in the following sequence:

- 1) Swiss bulls were mated to Red Poll-Hereford cows. The resulting calves formed a herd of Red Poll-Hereford-Swiss crossbreds that was backcrossed in succeeding generations to obtain a herd having germ plasm composed of 5/32 Red poll, 15/32 Hereford, 12/32 Brown Swiss.
- 2) A small herd of Angus cows was used to develop a group of Angus-Friesian cattle with germ plasm composed of 5/8 Angus, 3/8 Friesian.
- 3) Angus-Friesian bulls were mated to the Red Poll-Hereford-Swiss herd, resulting in a herd with germ plasm composed of 5/64 Red Poll, 15/64 Hereford, 5/16 Angus, 3/16 Swiss, and 3/16 Friesian.
- 4) Simmental bulls were mated to an elite herd of the composite cows. The male calves were mated back to the base herd. This produced a germ plasm composite of 15/256 Red Poll, 45/256 Hereford, 15/64 Angus, 9/64 Friesian, 9/64 Swiss, and 16/64 Simmental.

Selection Practices

The breeder must apply continuous and strict selection to all animals in all steps of the introduction process if he intends to make maximum use of the new genetic variation. The strict selection levels and breeding procedures used were: 1) Restricted breeding season, Heifers were exposed to bulls for 30 days and culled if not pregnant, Cows were exposed for 45 days and culled if not pregnant; 2) Heifers requiring assistance at calving were culled; 3) Calves that were the lowest 10% for preweaning gain, and their dams, were culled; 4) Weaning age calves were fed 60% concentrate diets for 60 days to evaluate their ability to gain; 5) At least 30 steers from each calf crop were fed in commercial feedlots and followed through the packing plant. Failure to grade resulted in culling of the dam. 6) All animals that became excited when handled were culled, along with their ancestors or descendants. 7) Only the most recent crop of bull yearlings was used for breeding, which shortened generation interval.

Selection for Reproductive Efficiency

There are traits which can only be measured subjectively, other where one must rely on correlated traits that can be measured, and yet other traits where the traits can only be measured in the carcass or are expressed in only one sex. For those traits selection can never be as effective as if the character could be measured objectively in each animal. The selection method chosen for improving

reproduction in the development of this composite was one of controlled natural selection. Exposing females to males for a very limited time and then culling those females which were open, both increased variation among cows and increased the selection pressure applied during the initial generations of crossing when the genetic variation was greatest. Also the forage energy level and the forage quality was low while the forage quantity was unlimited. This provided selection pressure for greater rumen capacity and for improved ability to digest cellulose.

The same selection procedures for reproductive rate have been used during 10 generations of selection for improved calving efficiency by heifers and cows grazing crop residues. Calving rate in first calf heifers changed dramatically during the first four generations of selection. The observed improvement in calving rate was less rapid for females in their second parity.

Production Results From The Composite

The results of following a consistent path in the composite breeding program for over 20 years have been: 1) The composite herd produces over a 95% calf crop and weans over 90% while supporting themselves on crop residue; 2) The weaning weight of this herd has averaged 560 lb for steers and 515 lb for heifers; 3) Bulls in gain tests have averaged over 580 lbs for the 140 day test periods, with two exceeding 700 lbs gains; 4) Steers fed in commercial feedlots over the past 10 years have averaged 3.65 lbs per day gain for 162 days; 5) The steers fed in commercial lots have had an average as fed conversion of 6.82 lbs of feed per pound of gain; 6) Slaughter steers have had an average yield of 63.26%, a loin area of 13.86 sq in, a fat thickness of .32 in, yield grade of 1.96 and a quality grade of 91% average choice.

The Beef Machine has been designed for the grain farmer of the United States excluding the extreme southern areas. The 1985 Beef Machine cow: weighs 1,100 lbs; has a calf weighing 78 lbs at birth; weans a steer calf weighing 560 lbs at 180 days; raises steers that gain an average of 4.11 lbs per day in High Plains commercial feedlots with an average as fed conversion of 6.74 lbs of feed per lb of gain; has steers whose carcasses grade 80% choice at 14 months and 1,100 lbs, with an average loin eye of 2.1 sq in per 100 lbs of carcass and a yield grade average of 1.8. One fourth of these steers were fed less than 110 days while another fourth were fed more than 190 days. These results indicate that the cattle feeder will have a minimum of 80 days in which to market this composite steer with no discount for undesirable yield grade.

Utilization Of The Composite

The goal of developing a cow capable of conceiving and raising a calf on a diet of crop residue has been achieved. This composite should be adapted to cultivated areas of the Midwest, including the central and southern High Plains. Most landowners have a mixture of cropland, native grassland, and wasteland acreage. This composite would fit into these operating units and provide additional income with small capital investment. With proper timing, the calving

season can be scheduled to occur in a slack season, thus better utilizing the available labor. Selection for reproductive efficiency has had a correlated response in feed efficiency and growth rate. Those cows that could consume and convert the large volume of roughage necessary to reproduce have produced calves with increased capacity to convert feed into growth.

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