1993

Contributions of Ovum Cytoplasm and Uterine Environment and Postnatal Environment to Maternal Effects in Beef Cattle

Keith E. Gregory
U.S. Meat Animal Research Center

Ralph R. Maurer
U.S. Meat Animal Research Center

Contributions of Ovum Cytoplasm and Uterine Environment and Postnatal Environment to Maternal Effects in Beef Cattle

Keith E. Gregory and Ralph R. Maurer[1]

Introduction

Any contribution or influence on offspring phenotype attributable to its dam, exceeding the inherited sample half of the dam's nuclear genes, is a maternal effect. Maternal effects can be classified into prenatal (e.g., cytoplasmic and uterine components) and postnatal [e.g., lactation, method of rearing (early weaning), plus other postnatal maternal components]. This experiment was designed with two objectives. The first objective was to determine the relative contributions of ovum cytoplasm and uterine influences on prenatal maternal effects by use of embryo transfer (ET). The second objective was to estimate breed differences in prenatal and postnatal maternal effects combined by evaluating differences between reciprocal crosses and the effects of early weaning and to separate the effects of prenatal maternal influences from postnatal maternal influences.

Procedure

Breeds used in this experiment included Red Poll-Angus and Braunvieh-Hereford reciprocal crosses and embryo transfer (ET) into both breeds of each reciprocal cross. In the second part of the experiment, reciprocal cross matings of each pair of breeds was made by natural service. Part of the calves in the second part of the experiment were weaned at 3 to 5 days and reared on a milk replacer and part nursed their dams to an age of 150 to 180 days. Male calves were castrated shortly after birth. All calves produced by embryotransfer (ET) were weaned at 3 to 5 days and reared on a milk replacer and were fed a mixed diet of ground alfalfa hay, rolled oats, cracked corn, soybean meal and molasses (2.8 mCal ME/kg DM and 19.8% CP) to an age of 35 days. Thereafter, they were fed a mixed diet of ground alfalfa hay, corn silage, cracked corn, soybean meal and supplement (2.84 mCal ME/kg DM and 17% CP) to a weight of approximately 250 lb.

Early weaned calves were fed a growing diet of ground alfalfa hay, corn silage, soybean meal and supplement (2.63 mCal ME/kg DM and 14.4% CP) from an average weight of 250 lb to an average weight of 450 lb. Thereafter, females were fed a diet of corn silage, alfalfa haylage and supplement (2.24 mCal ME/kg DM and 12.3% CP) until they were put on improved pasture at an age of 1 yr. All females were retained for breeding.

Castrate males were fed a diet of corn silage, cracked corn, soybean meal and supplement (2.69 mCal ME/kg DM and 12.9% CP) until slaughter at 1052 lb for Red Poll-Angus reciprocal crosses and 1153 lb for Braunvieh-Hereford reciprocal crosses. Individual feed consumption was recorded on each castrate male from approximately 210 days of age until slaughter. Carcass data on castrate males were obtained after a chill period of 24 hr. Standard procedures were used to obtain objective measures and to make subjective evaluations of the traits for which carcass data were collected and analyzed. Soft tissue from the 9-11 rib cut was removed from the bone and ground. Water, dry matter, fat and protein were determined using standard analytical procedures.

Weights were recorded at birth, weaning and every 28 or 56 days during the feeding period of castrate males. For females, weights were recorded at birth, weaning and every 28 or 56 days after weaning until 368 days of age and at 500 days. Thereafter, data on weights, heights and condition scores were recorded on females three times each yr (precalving, prebreeding and when palpated for pregnancy) to an age of 4.5 yr .

Females were retained to produce three calf crops to estimate prenatal maternal effects (ovum cytoplasm and uterine influence) and postnatal maternal effects (reared by breeds of dam differing in maternal ability or weaned at 3 to 5 days) on reproductive and maternal traits and on weight, height and condition score to an age of 4.5 yr.

Results

Neither breed of recipient (uterine influence) nor breed of donor (cytoplasmic influence) had important effects on either growth traits of heifers and steers or on carcass traits of steers. Further, neither breed of recipient nor breed of donor had an effect on percentage conception rate, percentage calf survival, percentage calves produced per cow exposed, or on birth and weaning weights of their progeny. Neither breed of donor nor breed of recipient had an effect on periodic weights, heights and condition scores of females to an age of 4.5 yr. Thus, breed differences in prenatal maternal effects (i.e., ovum cytoplasm and uterine influence) are of little importance for the sample of breeds included in this study.

Large differences in favor of calves that nursed their dams relative to early weaned calves were observed for most growth traits of heifers and steers and in carcass traits of steers. Effects of early weaning were greater in progeny of Braunvieh and Red Poll dams than in progeny of Angus and Hereford dams. Differences between reciprocal crosses favored progeny of Braunvieh and Red Poll dams for growth related traits.

Differences between reciprocal crosses were generally small ($P > .05$) for reproductive, maternal and size related traits of reproducing females, indicating that breed differences in maternal environment provided by breeds that differ greatly in maternal ability do not have long term effects on cow productivity. Even though early weaning resulted in reduced weights and heights, and lower condition scores of cows to an age of 4.5 yr, there was not an effect on cow productivity in regard to percentage conception rate, percentage calf survival, percentage calves produced per cow exposed, and on birth and weaning weights of their progeny.

For greater detail see:

1. Ralph R. Maurer and K. E. Gregory. 1990. Contributions of ovum cytoplasm, uterine environment and postnatal environment to maternal effects in beef cattle. J. Anim. Sci. 68:2319.

2. Keith E. Gregory and R. R. Maurer. 1991. Prenatal and postnatal maternal contributions to reproductive, maternal and size-related traits of beef cattle. J. Anim. Sci. 69:961.

[1]Gregory is a research geneticist, Genetics and Breeding Research Unit, MARC, and Maurer was a research physiologist, Reproduction Research Unit, MARC (deceased December 1989).